

# LAMPIRAN

## Lampiran 1. Daftar Terjemah Bahasa Asing

**Tabel 1** Daftar Terjemah Bahasa Asing

<b>No</b>	<b>BAB</b>	<b>Kutipan</b>	<b>Halaman</b>	<b>Terjemah</b>
1	I	Q.S Ali Imran/3: 190	2	“Sesungguhnya dalam penciptaan langit dan bumi, dan pergantian malam dan siang terdapat tanda-tanda (kebesaran Allah) bagi orang yang berakal”
2	I	Q.S Ali Imran/3: 191	2	“(yaitu) orang-orang yang mengingat Allah sambil berdiri, duduk, atau dalam keadaan berbaring, dan mereka memikirkan tentang penciptaan langit dan bumi (seraya berkata), “Ya Tuhan kami, tidaklah Engkau menciptakan semua ini sia-sia, Maha Suci Engkau, lindungilah kami dari azab neraka”

## Lampiran 2. Dokumentasi Pencarian Data Artikel Jurnal Menggunakan Publish or Perish (PoP)

Harzing's Publish or Perish (Windows GUI Edition) 8.8.4274.8411

Search terms: ethnochemistry from 2021 to 2023, ethnokimia from 2018 to 2023, ethnochemistry from 2018 to 2019, ethnokimia from 2020 to 2020, Integration of indigenous [title] ethnoche..., ethnochemistry from 2018 to 2023

Source	Papers	Cites	Cites/y...	h	g	h,no...	hA	acc...	Search date	Cache date	Las...
Google Sc...	126	212	106.00	7	11	6	6	3	01/23/2023	01/23/2023	0
Google Sc...	111	228	45.60	7	11	5	5	1	01/31/2023	01/31/2023	0
Google Sc...	32	285	57.00	7	16	6	4	2	02/10/2023	02/10/2023	0
Google Sc...	21	48	16.00	5	6	2	2	0	02/10/2023	02/6/2023	0
Google Sc...	2	2	2.00	1	1	1	1	0	02/13/2023	02/13/2023	0
Google Sc...	215	1130	226.00	16	30	10	9	8	02/13/2023	02/13/2023	0

Google Scholar search

Keywords: ethnochemistry

Maximum number of results: 500

Cites	Per year	Rank	Authors	Title	Year	Publication
21	7.00	166	A Adriyawati, E Ut...	Steam-project-based learning integration to improve elementary school students' scientific l...	2020	Universal Journal of ...
4	2.00	189	A Almuhrak, MF ...	Validitas &Praktikalitas: Modul Kitab Asah (Kimia Berbasis Lahan Basah) Terintegrasi AR-Spa...	2021	Science and Computer ...
8	2.67	45	A Dudung	Ethnopedagogy Integration with Mobile Learning to Improve Students' Learning Achieveme...	2020	Universal Journal of Educ...
0	0.00	48	A Fadli	Students' Gender Perspective Analysis in Higher Education Learning	2022	Journal of Xi'an Shiyou U...
2	2.00	105	A Fadli, M Zaki	Exploring Students' Scientific Attitudes Based on Gender Perspective	2022	Journal of Xi'an Shiyou U...
0	0.00	194	A Fadli, SA Acim	Scientific Attitude of Pre-Service Islamic Teachers: Gender and Grade Level Differences	2021	Physics of Fluids
7	3.50	128	A Foster, M Kinzel	SARS-CoV-2 transmission in classroom settings: Effects of mitigation, age, and Delta variant	2021	JPKP (Jurnal Kimia dan Pe...
0	0.00	17	A Gani, E Erlidawa...	Ethnochemistry Study of The Use of Plants as Traditional Medicine In The Community of Sa...	2020	ejournal.polbang.ac.id
0	0.00	183	A Gordon	Increasing the Ethnic and Cultural Diversity of Virtual Classrooms	2022	International Journal of In...
0	0.00	190	A Insiyroh	PENGEMBANGAN MODUL KIMIA BERBASIS RELATING, EXPERIENCING, APPLYING, COOPER...	2020	Jurnal Pengabdian ...
0	0.00	62	A Jusmaya, JKHA ...	THE EFFECTIVENESS OF PROJECT-BASED LEARNING THROUGH ENGLISH VLOGS TO IMPROV...	2022	Berkala Ilmiah ...
0	0.00	215	A Paul, A Panti, A ...	Traditional knowledge of ethno-medicinal practices and its management: a case study of Oh...	2022	AIP Conference Series
0	0.00	100	A Saneva, W Syah...	Palatihan Penyusunan Modul Kimia Berbasis Kearifan Lokal bagi Guru SMA di Sungai Penuh...	2022	International Journal of In...
1	1.00	181	A Sholahuddin, M...	Wetland Ethnoscience Learning Resources: An Overview of Physical Science Concepts	2022	International Journal of In...
7	3.50	165	A Sihalwani, N ...	Project-based learning on ethnoscience setting to improve students' scientific literacy	2021	International Journal of In...
3	1.00	20	A Sivale, IS Singh...	Impact of ethnochemistry on learners' achievements and attitude towards experimental tech...	2020	International Journal of In...
0	0.00	130	A Wisnati, A Alva...	Banarbanar Babun Ajar Transformasi Learning Berbasis Guru Belajar untuk Meningkatkan	2023	Journal of Pedagogical Res...

## Pencarian Data Artikel Jurnal dengan Kata Kunci “Ethnochemistry” Pada Tahun 2018-2023

Harzing's Publish or Perish (Windows GUI Edition) 8.8.4274.8411

Search terms: ethnochemistry from 2021 to 2023, ethnokimia from 2018 to 2023, ethnochemistry from 2018 to 2019, ethnokimia from 2020 to 2020, Integration of indigenous [title] ethnoche..., ethnokimia from 2018 to 2023

Source	Papers	Cites	Cites/y...	h	g	h,no...	hA	acc...	Search date	Cache date	Las...
Google Sc...	126	212	106.00	7	11	6	6	3	01/23/2023	01/23/2023	0
Google Sc...	111	228	45.60	7	11	5	5	1	01/31/2023	01/31/2023	0
Google Sc...	32	285	57.00	7	16	6	4	2	02/10/2023	02/10/2023	0
Google Sc...	21	48	16.00	5	6	2	2	0	02/10/2023	02/6/2023	0
Google Sc...	2	2	2.00	1	1	1	1	0	02/13/2023	02/13/2023	0
Google Sc...	16	47	9.40	4	6	3	3	0	02/13/2023	02/13/2023	0

Google Scholar search

Keywords: ethnokimia

Maximum number of results: 300

Cites	Per year	Rank	Authors	Title	Year	Publication
0	0.00	48	A AP Purnamayanti...	IMPLEMENTATION OF THE NATIONAL STANDARDS OF LIBRARY NO. 12 YEAR 2017 IN SCHO...	2022	Jurnal ...
0	0.00	58	A Gani, E Erlidawa...	Ethnochemistry Study of The Use of Plants as Traditional Medicine In The Community of Sa...	2021	JPKP (Jurnal Kimia dan Pe...
9	4.50	76	A Ilhami, D Diniya...	Analisis kearifan lokal manongkang kerang di kabupaten indragiri hilir, niau sebagai sumber b...	2021	Sosial ...
0	0.00	9	A Insiyroh	... KIMIA BERBASIS RELATING, EXPERIENCING, APPLYING, COOPERATING DAN TRANSFERIRN...	2020	SPIN JURNAL KIMIA & ...
0	0.00	98	A Janyah, D Wahyu...	PENGARUH MODEL PEMBELAJARAN CREATIVE PROBLEM SOLVING TERHADAP KEMAMPUAN...	2022	...: Jurnal Biologi dan ...
0	0.00	96	A Sa'ban, AR Shol...	Faktor Risiko dan Pengobatan Infeksi Helicobacter pylori pada Suku Baduy di Provinsi Banten	2022	Jurnal Pengabdian ...
0	0.00	79	A Saneva, W Syah...	Palatihan Penyusunan Modul Kimia Berbasis Kearifan Lokal bagi Guru SMA di Sungai Penuh...	2022	Jurnal Pengabdian ...
2	2.00	77	A Walid, EW Wina...	The production process of pendap as an integrated science learning media: Ethnoscience stu...	2022	Scientiae Educatia
0	0.00	97	AL Fitriyah	Reog Kendang Dance: Study of Ethnoscience as a Learning Source to Improve Students' Akhli...	2022	Annual International CCo...
0	0.00	95	AN Zahro, W Sum...	The Tradition of Making Lontong Tuyuhan in Rembang Regency as a Science Learning Resou...	2021	Penelitian Pendidikan IPA
0	0.00	108	AP Maeda, P Nin...	Preliminary Study of Chemistry Knowledge through Ethnochemistry Approaches to Commu...	2021	Jurnal Akademika Kimia
0	0.00	115	AZZS FAIZAH	Desain petunjuk praktikum berorientasi Chemo-Entrepreneurship (CEP) pada pembuatan pr...	2020	ejprints.walisongo.ac.id
0	0.00	59	D Mayang Syari	PENGARUH LAINIA PENYEMPRITAN TERHADAP STEK BAHAN GRISENG JAWA (Talinum pani...	2022	Jurnal Tarbiyatuna
6	6.00	29	D Wahyudiati	Implementation of Islamic Education Concept in Ethnochemistry	2021	SPIN JURNAL KIMIA & ...
0	0.00	35	D Wahyudiati	ETHNOCHEMISTRY: ANALISIS RELEVANSI MATERI SISTEM PERIODIK UNSUR DENGAN KEARIF...	2021	SPIN JURNAL KIMIA & ...
0	0.00	44	D Wahyudiati	Ethnochemistry: Exploring the Potential of Sasak and Java Local Wisdom as a Teaching Mate...	2022	Jurnal Pendidikan Kimia
0	0.00	103	D Wahyudiati, D O...	Ethnochemistry: Exploring the Potential of Sasak and Javanese Local Wisdom as a Source of	2023	Jurnal Pendidikan Sastr...

## Pencarian Data Artikel Jurnal dengan Kata Kunci “Etnokimia” Pada Tahun 2018-2023

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- Abumchukou, A A
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- Afrida, Afrida
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- Al Idrus, Syarif Wahidah
- Andriyani, Yuyuk
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- Amin, Lukman
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- Bebi, H R
- Betauban, Martha
- Cáceres-Jensen, Lizethly
- Djuned
- Druker-Ibáñez, Sofia
- ...

ethnochemistry and etnokimia 2018-2023 Edit Settings

Authors	Title	Year	Published In	Added
Abumchukou, A A; Eke, J A; Adhugbu, C N J	Effects of Ethnochemistry Instructional Strategy on Secondary School Students' Achievement in Chemistry in ...	2021	African Journal of Science, Techn...	Feb 28
Ningsih, Purnama; Ijrana, Ijrana; Mulyani, Sri; Patand...	Ethnochemistry Study of Medicine Plants for Liver Disease in The Community of Balane Village	2022	ICOP Conference Series: Earth a...	Feb 28
Ervilla, Ria; Mardiah, Ainun	Local Wisdom of the Aceh Jaya Society in terms of Chemistry Lear...	2022	Proceedings of International C...	Feb 28
Gani, Abdul; Eridawati, Eridawati; Nurmalaeni, Nur...	Ethnochemistry Study of The Use of Plants as Traditional Medicine In The Community of Sanaiaup District, South A...	2022	JOPK (Jurnal Kimia dan Pendidikan ...	Feb 28
Septianto, S; Hasbuan, M P	Effectiveness of Blood Learning Based on the Ethnochemical Approach Module on Improving Science Lit...	2021	Budapest International R...	Feb 28
Druker-Ibáñez, Sofia; Cáceres-Jensen, Lizethly	Integration of Indigenous and Local Knowledge Into Sustainability Education: a Systematic Literature Review	2022	Environmental Education Rese...	Feb 28
JACK, Gladys Uzezi	Problem-Based Versus Lecture-Based Learning Environments: Effect On Students' Attitude And Perform...	2022	Unizak Journal of Educational Res...	Feb 28
Wahyudati, Dwi	Exploring Chemistry Education Students' Critical Thinking Skills and Ethnochemistry-Based Learning Experiences Ba...	2022	Journal of Xi'an Shiyou Universi...	Feb 28
Konyefa, Bridget Izandene; Okigbo, Ebele Chenele	Effect of Ethnochemistry Instructional Approach on Secondary School Students' Achievement in Chemistry in ...	2021	International Journal of Educ...	Feb 28
Wahyudati, Dwi	The Relationship of Ethnochemistry Learning Experience with Students' Scientific Attitudes based on Gender Persp...	2022	Journal of Xi'an Shiyou Universi...	Feb 28
Subriano, Hari; Wahyudati, Dwi; Louise, Isana Supiah Y...	Ethnochemistry in the Chemistry Curriculum in Higher Education: Exploring Chemistry Learning Resources in Sa...	2020	Universal Journal of Educational ...	Feb 28
Zidny, Robby; Sjostrom, Jasper; Elks, Ingo	A Multi-Perspective Reflection on How Indigenous Knowledge and Related Ideas Can Improve Science Educ...	2020	Science Education	Feb 28
Helenaels, Li; Lidaneels, Li; Adriansyah, P N A; Hartina, E	Ethnochemistry-based Adobe Flash Learning Media Using Indigenous Knowledge to Improve Students' Scientific Lit...	2022	JPIE (Jurnal Pendidikan IPA ...	Feb 28
Zidny, Roby; Elks, Ingo	Indigenous Knowledge as a Socio-Cultural Context Of Science to Promote Transformative Education for Sustain...	2018	Building bridges across discipline...	Feb 28
Maedja, Ade P; Ningsih, Purnama	Preliminary Study of Chemistry Knowledge through Ethnochemistry Approaches to Communities	2021	Jurnal Akademika Kima	Feb 28
Sumardi, Lulu; Jamal, M; ...	Begunu: An Ethno-education of Saseh, Indonesia (Exploring ...)	2022	Journal of ...	Feb 28

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Hasil Pencarian Awal Terdapat 43 Data Artikel Jurnal

## Lampiran 3. Surat Validasi Instrumen



**KEMENTERIAN AGAMA REPUBLIK INDONESIA  
UNIVERSITAS ISLAM NEGERI ANTASARI BANJARMASIN  
FAKULTAS TARBİYAH DAN KEGURUAN**

Jalan Jenderal Ahmad Yani Km. 4.5 Banjarmasin 70235  
Telepon: (0511) 3262426; (0511) 6783136  
E-mail: ftk@uin-antasari.ac.id Website: ftk.uin-antasari.ac.id

Nomor : B-198 /Un.14/III.1/PP.00.9/01/2023 24 Januari 2023  
Sifat : Penting  
Lampiran : -  
Hal : Uji Validasi dalam Rangka Penyusunan Skripsi

Yth. **Bapak Alvian Ikhsanul Fatya, S.Pd., M.Si.**  
Banjarmasin

*Assalamu'alaikum Wr.Wb*

Sehubungan rencana penelitian yang akan dilaksanakan oleh mahasiswa kami dalam rangka penyusunan skripsi yang berjudul "**Analisis Bibliometrik Etnokimia pada Pembelajaran Kimia Menggunakan VOSviewer**", maka dengan ini kami mohon izin serta bantuan Bapak/Ibu berkenan memberikan waktu yang diperlukan oleh :

Nama : Resty Utami  
NIM : 190101090092  
Program Studi : Tadris Kimia  
Fakultas : Tarbiyah dan Keguruan  
Alamat : Sebanban III Blok D Rt 08/Rw 04 Ds. Tri Martani, Kec. Sungai Loban, Kab. Tanah Bumbu, Prov. Kalimantan Selatan, Kode Pos 72274

Untuk melakukan uji validasi dalam rangka pengumpulan bahan untuk penyusunan skripsi.

Demikian surat ini kami sampaikan, atas perhatian dan perkenan Bapak/Ibu serta kerjasamanya yang baik kami ucapkan terima kasih.

*Wassalamu'alaikum Wr.Wb*

Wakil Dekan Bidang Akademik  
dan Kelembagaan,  
  
Ahmad Muradi

Tembusan :  
1. Dekan Fakultas Tarbiyah dan Keguruan  
2. ....



**KEMENTERIAN AGAMA REPUBLIK INDONESIA  
UNIVERSITAS ISLAM NEGERI ANTASARI BANJARMASIN  
FAKULTAS TARBIYAH DAN KEGURUAN**

Jalan Jenderal Ahmad Yani Km. 4.5 Banjarmasin 70235  
Telepon: (0511) 3262426; (0511) 6783136  
E-mail: ftk@uin-antasari.ac.id Website: ftk.uin-antasari.ac.id

Nomor : B-281 /Un.14/III.1/PP.00.9/01/2023 31 Januari 2023  
Sifat : Penting  
Lampiran : -  
Hal : Uji Validasi dalam Rangka Penyusunan Skripsi

Yth. **Ibu Ratna Kartika Irawati, S.Pd., M.Pd.**  
Banjarmasin

*Assalamu'alaikum Wr.Wb*

Sehubungan rencana penelitian yang akan dilaksanakan oleh mahasiswa kami dalam rangka penyusunan skripsi yang berjudul "**Analisis Bibliometrik Etnokimia pada Pembelajaran Kimia Menggunakan VOSviewer**", maka dengan ini kami mohon izin serta bantuan Bapak/Ibu berkenan memberikan waktu yang diperlukan oleh :

Nama	: Resty Utami
NIM	: 190101090092
Program Studi	: Tadris Kimia
Fakultas	: Tarbiyah dan Keguruan
Alamat	: Sebamban III Blok D Rt 08/Rw 04 Ds. Tri Martani, Kec. Sungai Loban, Kab. Tanah Bumbu, Prov. Kalimantan Selatan, Kode Pos 72274

Untuk melakukan uji validasi dalam rangka pengumpulan bahan untuk penyusunan skripsi.

Demikian surat ini kami sampaikan, atas perhatian dan perkenan Bapak/Ibu serta kerjasamanya yang baik kami ucapkan terima kasih.  
*Wassalamu'alaikum Wr.Wb*

Wakil Dekan Bidang Akademik dan Kelembagaan,



Tembusan :  
1. Dekan Fakultas Tarbiyah dan Keguruan  
2. ....

## Lampiran 4. Lembar Hasil Validasi dari Validator

**LEMBAR VALIDASI**  
**LEMBAR VALIDASI KUALITAS ARTIKEL JURNAL**

Nama : Alvin Heksamul Fatya, S.Pd., M.Si.  
 Instansi : Tadris Kimia UIN Antasari Banjarmasin  
 Alamat instansi : Jl. A Yani Km 4,5 Banjarmasin  
 Pendidikan : S-2 Kimia

Petunjuk:

1. Mohon berikan tanda centang (√) pada salah satu jawaban yang paling sesuai dengan pendapat Bapak/Ibu, yaitu:
  - Angka 4 berarti : sangat baik/sangat jelas/sangat menarik/sangat layak/sangat sesuai/sangat tepat
  - Angka 3 berarti : baik/jelas/menarik/layak/sesuai/tepat
  - Angka 2 berarti : cukup baik/cukup jelas/cukup menarik/cukup layak/cukup sesuai/cukup tepat
  - Angka 1 berarti : tidak baik/tidak jelas/tidak menarik/tidak layak/tidak sesuai/tidak tepat
2. Untuk jawaban yang mengharapkan saran dan komentar Anda, isilah pada tempat yang telah disediakan.
3. Berikan tanda centang (√) pada skala penilaian berikut sesuai pilihan Bapak/Ibu!

Uraian	Skala Penilaian			
	1	2	3	4
1. Petunjuk pengisian jelas dan mudah dimengerti			✓	✓
2. Ketepatan penjabaran aspek validasi ke dalam komponen penilaian			✓	
3. Ketepatan penjabaran tiap komponen ke dalam berbagai butir pertanyaan				✓
4. Penetapan skala penilaian				✓
5. Kejelasan kalimat pertanyaan				✓
6. Kejelasan kalimat pernyataan kesimpulan				✓
7. Urutan setiap komponen, butir pertanyaan, identitas objek, skala penilaian, dan pernyataan kesimpulan				✓
8. Keterbacaan/bahasa lembar validasi				✓
9. Kemungkinan bisa digunakan sebagai penilaian validitas kualitas artikel jurnal		✓		

Mohon berikan komentar dan saran Bapak/Ibu tentang lembar validasi kualitas artikel jurnal pada kolom di bawah ini.

- Pertimbangan memisahkan komponen jumlah sitasi dari suatu jurnal w/ menandakan kualitas jurnal tersebut sangat berpengaruh atau tidak bagi dunia penelitian.  
- GAQ hampir semua literatur menggunakan Bahasa Indonesia dan bahasa Inggris, mungkin bisa di pertimbangkan w/ "penggunaan tata bahasa/kata/kalimat..."

Lembar Validasi Kualitas Artikel Jurnal

1. Dapat digunakan tanpa revisi
2. Dapat digunakan dengan revisi kecil
3. Dapat digunakan dengan revisi besar
4. Belum dapat digunakan

Banjarmasin, 30 Januari 2023

Penilai,



Alvia Iksanul Fatya, S.Pd., M.Si.  
NIP. 199406162022031001



**LEMBAR VALIDASI  
KUALITAS ARTIKEL JURNAL BERDASARKAN  
SYSTEMATIC LITERATUR REVIEW (SLR)**

Judul : Analisis Bibliometrik Etnokimia pada Pembelajaran Kimia  
Menggunakan *VOSviewer*  
Peneliti : Resty Utami

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**Petunjuk Umum**

Angket dimaksudkan untuk menilai dan mengetahui kualitas dari artikel jurnal relevan dengan penelitian yang akan dilakukan. Angket dibuat dan disesuaikan berdasarkan tahapan pada *Systematic Literatur Review (SLR)*.

**Petunjuk Pengisian**

1. Diharapkan Bapak/Ibu dapat membaca setiap pertanyaan dengan teliti.
2. Diharapkan Bapak/Ibu memilih jawaban dengan memberikan tanda (√) atau (X), dan (Y) atau (T) pada kolom sesuai pendapat Bapak/Ibu.

Keterangan :

Y (Ya) : untuk kategori artikel jurnal yang dapat digunakan karena sesuai minimal dengan 4 kriteria QA dan relevan dengan penelitian yang dilakukan.

T (Tidak) : untuk kategori artikel jurnal yang tidak dapat digunakan dalam proses penelitian sebab tidak relevan dengan penelitian yang sedang diteliti dan dinilai kurang memadai mengenai informasi yang disajikan

√ : untuk artikel jurnal yang sesuai dengan QA

X : untuk artikel jurnal yang tidak sesuai dengan QA

3. Atas kesediaan Bapak/Ibu mengisi angket penelitian ini, saya ucapkan terima kasih.

Nama Validator : Retna Kartika Irawati, M.Pd  
Instansi : UIN Antabani Banjarmasin  
Tanggal Validasi : 27 Februari 2023

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#### **Research Question**

*Research Question* pada penelitian ini berdasarkan pada Fokus Penelitian yang ditentukan, sebagai berikut:

1. Bagaimana visualisasi pemetaan bibliometrik pada jaringan antar kata kunci dalam penelitian etnokimia pada pembelajaran kimia?
2. Apa topik yang paling sering dibahas dalam artikel jurnal etnokimia pada pembelajaran kimia?
3. Bagaimana intensitas publikasi penelitian etnokimia pada pembelajaran kimia?
4. Bagaimana rekomendasi peluang penelitian topik etnokimia pada pembelajaran kimia?

#### **Proses Pencarian**

Proses pencarian literatur berupa artikel jurnal dilakukan dengan bantuan perangkat lunak *Publish or Perish* (PoP) dan diperoleh dari *database Google Scholar*.

#### **Kriteria Inklusi dan Eksklusi**

Kriteria untuk literatur yang dijadikan sebagai sumber acuan dan dinilai relevan dengan topik penelitian, diantaranya:

1. Literatur berbentuk artikel jurnal dimana isinya memuat judul, penulis, tahun, jurnal, kata kunci, abstrak, daftar pustaka.
2. Batas waktu publikasi 5 tahun terakhir dengan rentang waktu Februari 2018-Januari 2023.
3. Literatur membahas tentang etnokimia/*ethnochemistry* pada pembelajaran kimia.
4. Literatur disajikan dalam bahasa Indonesia dan/atau bahasa Inggris.

### Kualitas Penilaian (*Quality Assessment*)

Literatur berupa artikel jurnal yang telah ditentukan sebagai sumber acuan dan dinilai telah relevan dengan topik penelitian akan dilakukan identifikasi berdasarkan kriteria inklusi dan eksklusi. Pertanyaan dibuat untuk melihat kelayakan literatur yang telah dipilih.

1. QA<sub>1</sub> Apakah literatur yang disajikan berupa data artikel jurnal yang isinya memuat judul, penulis, tahun, jurnal, kata kunci, abstrak, daftar pustaka dan jumlah sitasi?
2. QA<sub>2</sub> Apakah literatur yang digunakan sebagai sumber data diterbitkan dalam rentang waktu Februari 2018- Januari 2023 (5 tahun terakhir)?
3. QA<sub>3</sub> Apakah literatur membahas tentang etnokimia/*ethnochemistry* pada pembelajaran kimia?
4. QA<sub>4</sub> Apakah literatur tersebut disajikan dalam tata bahasa Indonesia dan/atau bahasa Inggris yang mudah dipahami?

No	Judul	Penulis	Jumlah Sitasi	QA				Hasil	
				QA <sub>1</sub>	QA <sub>2</sub>	QA <sub>3</sub>	QA <sub>4</sub>	Y	T
1.	Pengembangan Panduan Praktikum Kimia Dasar Terintegrasi Etnokimia untuk Mahasiswa	Hanie Poerwandar, Asmatiningrum, Imam Koirudin dan Kamariah	17	✓	✓	✓	✓	✓	
2.	Indigenous Knowledge as a Socio-Cultural Context Of Science to Promote Transformative Education for Sustainable Development: Insights into a Case Study on The Baduy Community (Indonesia)	Robby Zidny dan Ingo Eilkes	22	✓	✓	✗	✓		✓
3.	A Culturally Responsive Teaching Approach and Ethnochemistry's of Tegal Culture for Developing Chemistry Students' Critical Thinking Skills in Acid-Based Learning	Y Rahmawati, H R Bacti, A Ridwan, S Suhartono and R Rafiuddin	1	✓	✓	✓	✓	✓	
4.	Chemistry Students' Identity Empowerment Through Ethnochemistry in Culturally Responsive Transformative Teaching (CRTT)	Y Rahmawati, A Ridwan, A Rahman dan F Kurmiadewi	9	✓	✓	✓	✓	✓	

No	Judul	Penulis	Jumlah Stasi	QA				Hasil		
				QA1	QA2	QA3	QA4	Y	T	
5.	Analisis Kebutuhan E-Book Interaktif Bilingual Etnokimia dengan Pendekatan Konstruktivisme	Martha Batauban, Henie Poerwandar	2	✓	✓	✓	✓			✓
6.	Implementasi Modul Kimia Pangan Melalui Pendekatan Etnokimia di SMK Negeri Aceh Timur Program Keahlian Tata Boga	Asmaningrum, dan Nasrawati Jofrisal dan Seprianto	4	✓	✓	✓	✓			✓
7.	Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbasis Etnokimia Terhadap Hasil Belajar Kimia Siswa Kelas XI di MA Al-Aziziyah Putra Kapek Gunungsari	Hidayatussani, Saprizah Hadisapura dan Syarif Wahid Al Idrus	5	✓	✓	✓	✓			✓
8.	Effects Of Ethno-Chemistry-Based Curriculum Delivery on Students' Interest in Chemistry in Obolo-Afor Education Zone of Enugu State	Anthonia N. Ugwu	2	✓	✓	✓	✓			✓
9.	A Multi-Perspective Reflection on How Indigenous Knowledge and Related Ideas Can Improve Science Education for Sustainability	Robby Zidny, Jospet Sjöström, dan Ingo Eilks	79	✓	✓	✗	✓			✓
10.	Integrating perspectives from indigenous knowledge and Western science in secondary and higher chemistry learning to contribute to sustainability education	Robby Zidny dan Ingo Eilks	28	✓	✓	✓	✓			✓
11.	Ethnochemistry in the Chemistry Curriculum in Higher Education: Exploring Chemistry Learning Resources in Sasak Local Wisdom	Hari Sutrisno, Dwi Wahyudiati, dan Isana Supiah Yosephie Louise	26	✓	✓	✓	✓			✓
12.	Pengembangan Modul Kimia Berbasis Kearifan Lokal Kota Semarang pada Materi Larutan Asam Basa	Muhammad Riza, R. Ariza Firmansyah, Muhammad Zammi dan Djuniadi Djuniadi	6	✓	✓	✓	✓			✓

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No	Judul	Penulis	Jumlah Sitasi	QA			Hasil		
				QA1	QA2	QA3	QA4	Y	T
13.	Exploring Indigenous Science to Identify Contents and Contexts for Science Learning in Order to Promote Education for Sustainable Development	Robby Zidny, S Solfiarina, Raina Suri Siti Aisyah, dan Ingo Eilks	10	✓	✓	✗	✓		✓
14.	On the Development of Learning Designs for the Inclusion of Indigenous Science in the Context of Chemistry Education to Foster Education for Sustainable Development	Robby Zidny dan Ingo Eilks	0	✓	✓	✓	✓	✓	
15.	Need Analysis for Basic Chemistry Practice Modules Based on Local Wisdom	JoFrisihal, Seprianto, Hendri Saputra, dan Rahmatul Fajri	0	✓	✓	✓	✓	✓	
16.	Identifikasi Potensi Budaya Lokal Berbasis Etnokimia di Kabupaten Bantul	Nur Azizah dan Shidiq Premono	7	✓	✓	✓	✓	✓	
17.	Preliminary Study of Chemistry Knowledge Through Ethnochemistry Approaches to Communities	Ade P. Maedja dan Purnama Ningsih	0	✓	✓	✗	✓		✓
18.	Analisis Keterampilan Abad 21 Siswa dengan Pendekatan Culturally Responsive Teaching Terintegrasi Etnokimia	Runi Robo dan Tamrin Taher	1	✓	✓	✓	✓	✓	
19.	Penerapan Pendekatan Culturally Responsive Teaching Terintegrasi Etnokimia dalam Mengembangkan Keterampilan Siswa Abad 21 pada Materi Hidrolisis di MAN 1 TIKEP	Irfan H. Arif, Asmin Lukman, dan Zulkifli I. Tuara	1	✓	✓	✓	✓	✓	
20.	Etnokimia: Eksplorasi Potensi Kearifan Lokal Sasak Sebagai Sumber Belajar Kimia	Dwi Wahyudiati dan Fitriani Fitriani	10	✓	✓	✓	✓	✓	✓
21.	Ethnochemistry: Analisis Relevansi Materi Sistem Periodik Unsur dengan Kearifan Lokal Sasak	Dwi Wahyudiati	4	✓	✓	✓	✓	✓	✓

No	Judul	Penulis	Jumlah Sitasi	QA				Hasil		
				QA <sub>1</sub>	QA <sub>2</sub>	QA <sub>3</sub>	QA <sub>4</sub>	Y	T	
22.	Effects of Ethnochemistry Instructional Strategy on Secondary School Students' Achievement in Chemistry in Onitsha Education Zone	Abumchukwu, A.A., Eke J.A, dan Achugbu, C.N.J	1	✓	✓	✓	✓	✓		
23.	Effectiveness of Blood Learning Based on the Ethnochemical Approach Module on Improving Science Literation Abilities	Seprianto, dan Molani Paulina Hasibuan	1	✓	✓	✓	✓	✓		
24.	The Design of Vlogs as Ethnochemical Learning Media by Project Based Learning	Hanié Poerwandar Asmaningrum, Jesi Jecsen Pangkendek dan Dewi Natalia Marpaung	2	✓	✓	✓	✓	✓		
25.	Effect of Ethnochemistry Instructional Approach on Secondary School Students' Achievement in Chemistry in Bayelsa State	Konyefa, Bridget Izondeme dan Prof. Okigbo Ebele Chineho	2	✓	✓	✓	✓	✓		
26.	Development of Colloid System Electronic Module Based On Problem Solving Integrated Ethnochemistry for High School Students	Alvin Nur Zahro, Woro Sumarni, dan Cepi Kurniawan	0	✓	✓	✓	✓	✓		
27.	Ethnochemistry Study of Medicine Plants for Liver Disease in The Community of Balane Village	Purnama Ningsih, Ijirana Ijirana, dan Frischilla Feby Palanda	0	✓	✓	✗	✓	✓		✓
28.	Ethnochemistry Study of The Use of Plants as Traditional Medicine In The Community of Samadua District, South Aceh Regency	Adul Gani, Eridawati Eridawati, dan Nurmalasari Nurmalasari	0	✓	✓	✗	✓	✓		✓
29.	Beguru: An Ethno-education of Sasak, Indonesia (Exploring the Principles of Learning Processes & Evaluation)	Lalu Sumardi, M Ismail, Rispaawati rispaawati, dan Dwi Wahyudiati	3	✓	✓	✗	✓	✓		✓
30.	Exploring Chemistry Education Students' Critical Thinking Skills and Ethnochemistry-Based Learning Experiences based on Gender	Dwi Wahyudiati	2	✓	✓	✓	✓	✓		✓

No	Judul	Penulis	Jumlah Sitasi	QA				Hasil	
				QA1	QA2	QA3	QA4	Y	T
31.	Ethnochemistry-based Adobe Flash Learning Media Using Indigenous Knowledge to Improve Students' Scientific Literacy	L. Heliawati, L. Lidiawati, P.N.A. Adriansyah, dan E. Herlina	2	✓	✓	✓	✓	✓	
32.	Ethnochemistry: Exploring the Potential of Sasak and Java Local Wisdom as a Teaching Materials	Dwi Wahyudiati	0	✓	✓	✓	✓	✓	
33.	Implementation of Islamic Education Concept in Ethnochemistry	Dwi Wahyudiati	6	✓	✓	✓	✓	✓	
34.	Ethnochemistry: Analysis Relevance Of Cultural "Pacu Jalur" In Chemical Materials As Learning Sources	Irfandi Irfandi	0	✓	✓	✓	✓	✓	
35.	Etnoquímica na Educação Básica: revisão bibliográfica sobre as produções no Brasil	Raquel Duarte Ferreira, Weder Martins Naitan, dan Kachia Hedeny Techo	0	✓	✓	✓	✗		✓
36.	Problem-Based Versus Lecture-Based Learning Environments: Effect On Students' Attitude And Performance In Chemistry At Secondary School Level	JACK, Gladys Uzezi (PhD)	0	✓	✓	✗	✓		✓
37.	The Relationship of Ethnochemistry Learning Experience with Students Scientific Attitudes based on Gender Perspective	Dwi Wahyudiati	0	✓	✓	✓	✓	✓	
38.	Pre-Service Science Teachers' Views on the Use of Indigenous Chemistry Knowledge in Chemistry Metacognition	Awelani V-MUDAU dan Tavonga TAWANDA	0	✓	✓	✓	✓	✓	
39.	Local Wisdom of the Aceh Jaya Society in terms of Indigenous Cuisine that can be learned in Chemistry Learning in Schools	Ria Ervilita dan Ainun Mardhiah	0	✓	✓	✓	✓	✓	

No	Judul	Penulis	Jumlah Sitasi	QA				Hasil	
				QA1	QA2	QA3	QA4	Y	T
40.	Pelatihan Penyusunan Modul Kimia Berbasis Kearifan Lokal bagi Guru SMA di Sungai Penuh Jambi	Aulia Samova, Wilda Syahri, Yusnidar Yusnidar, dan Afrida Afrida	0	✓	✓	✓	✓	✓	
41.	Analisis Literasi Sains Peserta Didik Melalui Pendekatan Etnopedagogi pada Pembelajaran Kimia	M. Najamudin Nopriadi, Yayuk Andayani, dan Saprizal Hadisaputra	0	✓	✓	✗	✓		✓
42.	Integration of indigenous and local knowledge into sustainability education: a systematic literature review	Sofia Druker-Ibañeza.b dan Lizethly Cáceres-Jensena	2	✓	✓	✗	✓		✓
43.	Ethnochemistry: Exploring The Potential Of Sasak And Javanese Local Wisdom As A Source Of Chemistry Learning To Improve The Learning Outcomes Of Pre-Service Teachers	Dwi Walyudiati dan Devi Qurniati	0	✓	✓	✓	✓	✓	



**Hasil Penilaian Umum**

Secara umum, berdasarkan penilaian kualitas artikel jurnal diperoleh :

	Artikel Jurnal yang dapat digunakan	Artikel Jurnal yang tidak dapat digunakan
Jumlah	31	12

Berdasarkan penilaian artikel jurnal di atas **DAPAT/TIDAK DAPAT** (coret yang tidak diperlukan) digunakan untuk analisis data dalam penelitian menggunakan *VOSviewer*.

**Komentar/Saran**

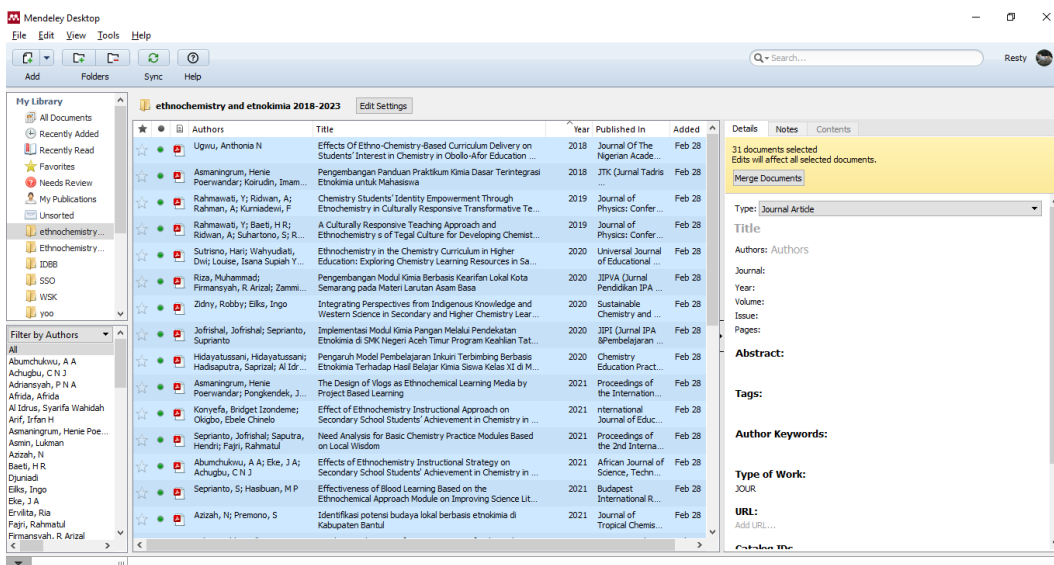
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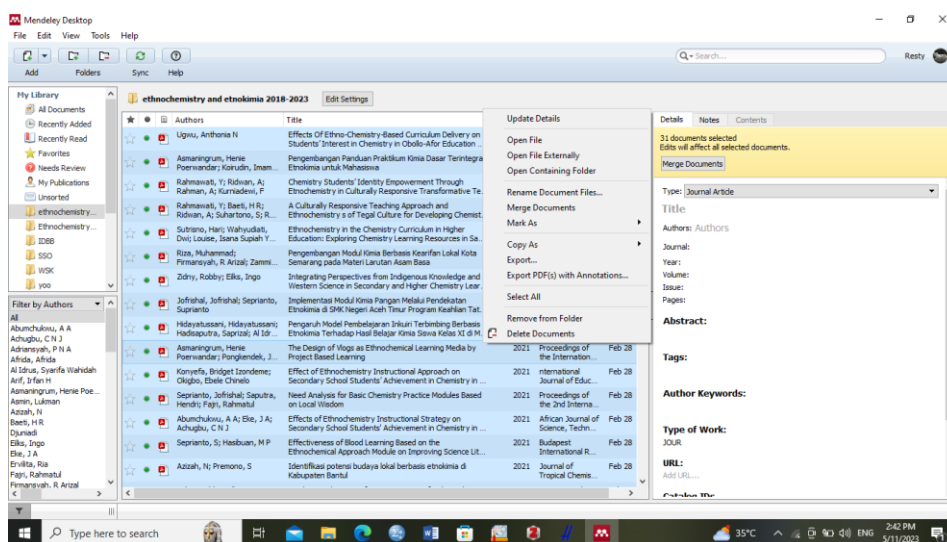


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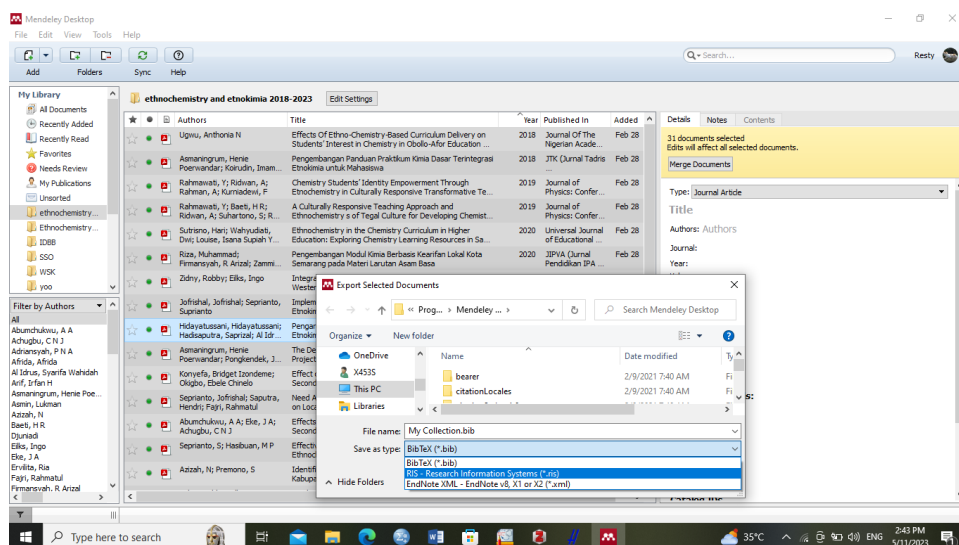
## Lampiran 5. Data Artikel Jurnal yang Dapat Digunakan untuk Analisis



31 artikel jurnal yang dapat digunakan untuk analisis



Memperbaiki Data Artikel Jurnal menggunakan Mendeley Sebelum Dianalisis



## Mengekstrak Data Artikel Jurnal Kedalam Format RIS

# 01 Pengembangan Panduan Praktikum Kimia Dasar Terintegrasi Etnokimia untuk Mahasiswa

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## PENGEMBANGAN PANDUAN PRAKTIKUM KIMIA DASAR TERINTEGRASI ETNOKIMIA UNTUK MAHASISWA

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### ABSTRAK

Penelitian ini bertujuan untuk menghasilkan produk panduan praktikum kimia dasar terintegrasi etnokimia. Penelitian pengembangan dilakukan dalam tiga tahap, yaitu: 1) menganalisis materi (*define*), 2) mendesain *prototype* panduan (*design*), 3) validasi dan uji coba produk (*develop*). Validasi dilakukan oleh ahli materi dan ahli media. Uji coba dilakukan terhadap 17 mahasiswa untuk mengetahui respon dan keterampilan kerja ilmiah mahasiswa menggunakan panduan praktikum. Berdasarkan analisis data dapat diambil kesimpulan bahwa produk panduan praktikum dinyatakan valid oleh ahli materi (rerata 75%) dan ahli media (rerata 86,25%). Panduan dinyatakan layak digunakan, karena menunjukkan respon positif dan capaian keterampilan kinerja ilmiah mahasiswa yang sangat baik.

Kata kunci: pengembangan, panduan, praktikum, kimia dasar, etnokimia.

### ABSTRACT

This study aims to produce ethnochemistry-integrated basic chemistry experiment guide. The development research was carried out in three stages, i.e.: 1) analyzing the material (*define*), 2) designing the guide *prototype* (*design*), and 3) validation and product testing (*develop*). Validation was carried out by content experts and media experts. The experiment guide was tested to 17 students to find out the response and scientific work skills of students using the experiment guide. Based on data analysis, it can be concluded that the experiment guide produced was declared valid by the content expert (average 75%) and media expert (average 86.25%). The experiment guide is stated to be feasible for use, because it shows a positive response and the achievement of students' scientific performance skills is excellent.

Keywords: development, experiment guide, experiment, basic chemistry, ethnochemistry.

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Pengembangan Panduan Praktikum Kimia Dasar Terintegrasi Etnokimia untuk Mahasiswa

## 1. PENDAHULUAN

Mata kuliah kimia dasar merupakan mata kuliah dasar untuk mempelajari ilmu kimia di tingkat universitas. Sebagian mahasiswa menganggap mata kuliah kimia merupakan mata kuliah yang sulit karena kimia bersifat abstrak (Chang, 2005). Agar konsep-konsep kimia dapat dipahami oleh mahasiswa maka pembelajaran kimia di universitas menekankan juga pada pemberian pengalaman belajar secara langsung melalui penggunaan dan pengembangan keterampilan proses dan sikap serta bisa memanfaatkan bahan yang ada di lingkungan sekitar yang mendukung pada proses pembelajaran. Dalam ilmu kimia terdapat dua hal yang sangat berkaitan dan tidak dapat dipisahkan, yaitu ilmu kimia sebagai produk (pengetahuan kimia berupa fakta, konsep, teori, dan prinsip) dan proses (kerja ilmiah) (BNSP, 2006). Kedua hal tersebut dapat dicapai peserta didik salah satunya melalui kegiatan praktikum.

Metode praktikum pada umumnya dirancang secara khusus agar mahasiswa dapat mengembangkan aktivitas belajar, memperoleh fakta dari konsep yang dipelajarinya, mengembangkan keterampilan dasar melakukan eksperimen, kemampuan memecahkan masalah dengan pendekatan ilmiah, meningkatkan pemahaman mengenai materi pelajaran, mengembangkan keterampilan dasar melakukan observasi, mengkomunikasikan hasil observasi secara lisan maupun tulisan dan dapat memfasilitasi rekonstruksi konsep-konsep atau membangun konsep sehingga dosen berperan dalam penguatan dan mengoreksi konsep yang keliru (Murti dkk., 2014).

Panduan praktikum merupakan salah satu sarana yang diperlukan untuk memperlancar kegiatan belajar mengajar di laboratorium sehingga tujuan pembelajaran bisa tercapai dan memperkecil resiko kecelakaan. Panduan praktikum merupakan buku yang memuat topik praktikum, tujuan praktikum, dasar teori, alat dan bahan, prosedur praktikum, lembar hasil pengamatan serta soal-soal evaluasi yang dibuat berdasar tujuan praktikum.

Panduan praktikum merupakan fasilitas yang diberikan oleh dosen agar mahasiswa dapat belajar dan bekerja secara kontinu dan terarah. Pentingnya pengembangan panduan praktikum digunakan yaitu untuk mengaktifkan mahasiswa dan membantu mengembangkan keterampilan proses mahasiswa melalui kegiatan yang ada pada panduan praktikum yang telah dikembangkan (Prayitno, 2017).

Kekurangan atau tidak tersedianya berbagai bahan dan alat kimia seringkali menjadi kendala tidak berlangsungnya suatu topik praktikum. Menghadapi kendala seperti ini, sudah saatnya bagi guru, dosen dan siswa memikirkan jalan keluarnya. Seperti diketahui, bahwa "dunia ini adalah dunia kimia", artinya segala yang ada di dunia ini tidak terlepas dari aspek kimia. Hal ini memberikan inspirasi bahwa lingkungan sekitar sebenarnya merupakan sarana untuk belajar kimia dan untuk menunjukkan fenomena-fenomena kimia seperti yang tertulis dalam materi pelajaran kimia yang diajarkan di kelas.

Saat ini, kearifan lokal masih belum tergarap secara maksimal di tingkat perguruan tinggi. Program Studi Kimia maupun Pendidikan Kimia masih jarang membekali lulusan dengan kompetensi unggulan berbasis kearifan lokal (Darmanto, 2009). Penyelenggaraan pendidikan kimia yang berbasis kearifan lokal akan memberikan ciri khas dan keunggulan lulusan. Selain itu juga akan menjadi ciri dan keunggulan institusi, dan pada akhirnya akan memberi kontribusi pada keunggulan bangsa.

Pengembangan aspek-aspek lokal menjadi kearifan lokal untuk menjadi keunggulan bangsa, jelas membutuhkan peran kimia. Penelitian mengenai kandungan, manfaat, pengembangan bahan alam jelas merupakan ranah keilmuan kimia. Perlu diupayakan penyelenggaraan pendidikan kimia yang berbasis kearifan lokal. Pendidikan sudah seharusnya memperhatikan *local knowledge*, *local culture*, *local skills*, dan *local processes* dalam membekali lulusannya. Sehingga ilmu dan keterampilan yang didapatkan menjadi kontekstual dengan jati diri dan berkelanjutan

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terus menerus. Kurikulumnya juga harus tertuju dan terkonsentrasi pada penyelesaian masalah bangsa (Darmanto, 2009).

Dalam mengembangkan kurikulum, perguruan tinggi harus mempertimbangkan *societal needs*, *industrial needs*, *professional needs* dan keunggulan bangsa atau kearifan lokal. Mata kuliah yang dirancang harus menyesuaikan dengan karakter lulusan yang dicita-citakan akan dihasilkan (Wimbarti, 2009). Kearifan lokal harus diidentifikasi oleh universitas untuk kemudian diberikan ke dalam proses pembelajaran. Integrasi kearifan lokal di dalam pendidikan kimia, juga bisa melalui materi ajar dan konsentrasi keilmuan atau mata kuliah pilihan (untuk tingkat pendidikan tinggi).

Pendidikan kimia berbasis kearifan lokal penting untuk diupayakan. Namun, sejauh ini pendidikan kimia berbasis kearifan lokal masih jarang dilakukan baik di tingkat sekolah menengah maupun perguruan tinggi. Pendidikan kimia yang tidak memperhatikan nilai dan potensi lokal, akan menghasilkan pendidikan yang tidak berorientasi pengembangan masyarakat (Merdekawati, 2012).

Merauke sebagai daerah yang terletak di Papua memiliki potensi budaya lokal yang sangat kaya. Kabupaten Merauke saja terdiri dari lebih dari 10 suku dengan budaya yang berbedabeda-beda, contohnya Suku Marind, Suku Mapi, Suku Muyu, dan sebagainya. Hingga saat ini belum ada penelitian yang mengintegrasikan budaya-budaya masyarakat lokal Merauke ke dalam perangkat pembelajaran.

## 2. METODE PENELITIAN

Penelitian dilaksanakan pada semester genap Tahun Akademik 2016/2017 di Jurusan Pendidikan Kimia FKIP Universitas Musamus Merauke. Subjek penelitian ini adalah mahasiswa Jurusan Pendidikan Kimia yang mengambil mata kuliah praktikum kimia dasar, berjumlah 17 orang yang terdiri dari sepuluh perempuan dan tujuh laki-laki. Penelitian ini merupakan penelitian

pengembangan. Model pengembangan yang digunakan adalah model 4-D Thiagarajan. Menurut Thiagarajan tahapan model pengembangan 4-D meliputi definisi, desain, pengembangan, dan penyebaran (Murdiani, 2012) yang dapat dilihat pada Gambar 1.



Gambar 1. Model 4-D Thiagarajan

Pada penelitian ini dilakukan hingga tahap *develop*. Berikut ini tahapan penelitian yang dilakukan: 1) *Define*: Tujuan dari kegiatan pada tahap ini adalah untuk menetapkan dan mendefinisikan syarat-syarat pengajaran (*instructional*). Melalui analisis ditentukan tujuan dan kendala untuk materi pengajaran (*instruction materials*). 2) *Design*: Tujuan dari kegiatan pada tahap ini adalah mendesain prototipe panduan praktikum kimia dasar. Kegiatan pada tahap ini dapat dilakukan setelah menentukan sekumpulan tujuan *behavior* (*behavior objectives*) untuk perangkat pembelajaran yang telah ditentukan. Pemilihan format dan media untuk bahan dan produksi versi awal mendasari aspek utama pada tahap desain. 3) *Develop*: pada tahap ini dilakukan validasi dan uji coba terbatas untuk mengetahui kelayakan prototipe panduan praktikum kimia dasar. Hasil uji validasi dan uji kelayakan digunakan untuk memperbaiki panduan produk.

Teknik pengumpulan data menggunakan instrumen lembar validasi ahli materi, lembar validasi media, lembar respon mahasiswa, dan rubrik penilaian keterampilan kerja ilmiah.

Penilaian kelayakan panduan praktikum kimia dasar dinilai oleh 2 (dua) orang ahli yang terdiri dari ahli materi dan ahli media. Indikator kelayakan ahli materi ditunjukkan pada Tabel 1. Adapun indikator kelayakan ahli media ditunjukkan pada Tabel 2.

Penilaian kelayakan panduan praktikum kimia dasar dinilai oleh mahasiswa dengan menggunakan angket respon. Indikator angket respon ditunjukkan pada Tabel 3.

Tabel 1. Indikator Kelayakan Ahli Materi terhadap Panduan Praktikum Kimia Dasar

No	Indikator
<b>A. Kebenaran konsep</b>	
1	Isi pedoman praktikum sesuai dengan materi praktikum kimia
2	Penyajian praktikum sesuai dengan runtutan materi praktikum yang diajarkan
3	Tata tertib praktikum sesuai dengan tata tertib dalam laboratorium dan tertib pelaksanaan praktikum
4	Pedoman praktikum berisi simbol-simbol keselamatan kerja laboratorium
5	Kesesuaian tema praktikum dengan tujuan, dasar teori, alat, bahan, cara kerja, dan teknik analisis
<b>B. Tingkat Keterlaksanaan Praktikum</b>	
6	Kegiatan yang dilakukan di panduan praktikum tidak membahayakan
7	Praktikum mudah dilaksanakan dengan ketersediaan bahan dan alat yang mudah didapatkan
8	Kegiatan praktikum sesuai dengan alokasi waktu
9	Kegiatan praktikum dalam panduan membentuk pengalaman langsung
10	Langkah kerja yang disajikan pada panduan praktikum dilakukan secara runtut dan benar

Tabel 2. Indikator Kelayakan Ahli Media terhadap Panduan Praktikum Kimia Dasar

No	Indikator
<b>A. Tampilan fisik</b>	
1	Ilustrasi sampul menggambarkan isi/materi yang diajarkan
2	Desain sampul tidak terlalu banyak menggunakan jenis huruf sehingga mudah dibaca
3	Ukuran huruf pada sampul lebih dominan dan proporsional dibandingkan nama pengarang
4	Penampilan fisik panduan praktikum menarik
5	Komponen panduan praktikum disajikan sesuai dengan format yang dipilih
<b>B. Kebahasaan</b>	
6	Bahasa yang digunakan dalam panduan praktikum komunikatif dan interaktif
7	Bahasa dalam panduan praktikum sesuai dengan perkembangan emosional mahasiswa
8	Pemilihan kata yang digunakan untuk menyusun kalimat tidak menimbulkan makna ambigu
9	Bahasa yang digunakan mudah dipahami dan jelas
10	Ketepatan ejaan dalam penulisan kalimat

Tabel 3. Indikator Respon Mahasiswa terhadap Panduan Praktikum Kimia Dasar

No	Indikator
1	Saya dapat menggunakan pedoman praktikum ini sebagai sumber belajar untuk pelaksanaan praktikum
2	Setelah menggunakan pedoman praktikum ini, saya mendapat kemudahan dalam memahami materi praktikum yang diajarkan
3	Pedoman praktikum membantu saya dalam membuat rumusan masalah dari materi praktikum yang diajarkan
4	Saya dapat membuat hipotesis sebelum praktikum dengan menggunakan pedoman praktikum
5	Langkah-langkah percobaan yang ada dalam pedoman praktikum dapat saya pahami dengan baik
6	Saya melakukan praktikum kimia dasar sesuai dengan petunjuk pada pedoman praktikum
7	Hampir tidak ada kesulitan pada saat saya melakukan praktikum selama menggunakan pedoman tersebut
8	Setelah melakukan praktikum, saya mendapatkan hasil pengamatan sesuai dengan langkah percobaan
9	Hasil pengamatan yang saya lakukan dapat dianalisis
10	Hipotesis yang saya buat dengan hasil analisis saya sesuai dan benar
11	Hipotesis yang sesuai membantu saya dalam menarik kesimpulan yang saya lakukan
12	Saya merasa terbantu dalam melakukan praktikum jika ada pedoman praktikum tersebut

Skor mentah yang diperoleh diubah ke dalam bentuk persentase. Selanjutnya hasil persentase yang diperoleh dikonversi dalam kriteria kelayakan (Murdiani, 2012) berdasar pada Tabel 4.

Tabel 4. Kriteria Kelayakan Panduan Praktikum

Kriteria	Persentase(%)
Sangat Layak	81,26 – 100
Layak	62,51 – 81,25
Cukup Layak	43,76 – 62,50
Tidak Layak	25 – 43,75

Keterampilan kerja ilmiah mahasiswa yang dinilai menggunakan rubrik penilaian dengan indikatornya ditunjukkan pada Tabel 5.

Tabel 5. Indikator Keterampilan Kerja Ilmiah Mahasiswa

No	Aspek Yang Diamati	Skor
1	<b>Kesiapan alat dan bahan</b>	
	Menyiapkan semua alat dan bahan yang diperlukan	3
	Membawa sebagian alat dan bahan yang diperlukan	2
2	<b>Kesiapan pribadi</b>	
	Bekerja dengan tenang sesuai panduan praktikum	3
	Bekerja dengan ragu-ragu namun sesuai panduan praktikum	2
3	<b>Penguasaan langkah kerja</b>	
	Menguasai semua langkah kerja dengan baik dan runtut	3
	Menguasai sebagian langkah kerja dengan runtut	2
4	<b>Penggunaan alat</b>	
	Mengetahui semua nama alat dan fungsinya dengan baik	3
	Mengetahui sedikit nama alat dan sedikit fungsinya	2
5	<b>Menuliskan hasil pengamatan</b>	
	Menemukan hasil dan menuliskan dengan jelas	3
	Menemukan hasil dan menuliskan secara singkat saja	2
6	<b>Membuat pembahasan</b>	
	Membuat pembahasan sesuai hasil pengamatan, lengkap dan benar	3
	Membuat pembahasan sesuai hasil pengamatan, tidak lengkap, benar	2
7	<b>Kemampuan membuat kesimpulan</b>	
	Membuat kesimpulan berdasarkan tujuan percobaan dan benar	3
	Membuat kesimpulan berdasarkan tujuan percobaan dan salah	2

No	Aspek Yang Diamati	Skor
8	<b>Kebersihan alat dan bahan</b>	
	Membersihkan dan mengembalikan alat dan bahan sesuai tempatnya	3
	Hanya membersihkan/mengembalikan alat dan bahan saja	2
9	<b>Keberhasilan praktikum</b>	
	Mahasiswa berhasil melakukan praktikum dengan tepat, cepat, benar dan mandiri	3
	Mahasiswa berhasil melakukan praktikum dengan benar, tepat namun lama	2

Skor mentah yang diperoleh diubah ke dalam bentuk persentase. Selanjutnya hasil persentase yang diperoleh dikonversi dalam kriteria keterampilan kerja ilmiah yang dimodifikasi dari Murdiani (2012) seperti dapat dilihat pada Tabel 6.

Tabel 6. Kriteria Observasi Keterampilan Kerja Ilmiah

Kriteria	Persentase (%)
Sangat Baik	81,26 – 100
Baik	62,51 – 81,25
Cukup	43,76 – 62,50
Tidak Baik	25 – 43,75

### 3. HASIL DAN PEMBAHASAN

Pada tahap pendefinisian penelitian ini dilakukan analisis fasilitas dengan cara inventarisasi bahan dan alat yang terdapat pada laboratorium beserta kondisinya. Kemudian analisis terhadap materi kimia dasar dengan tujuan untuk acuan materi pokok pengembangan panduan praktikum kimia dasar. Hasil yang diperoleh pada tahap ini adalah terdapat 3 (tiga) topik praktikum yang dapat dikaitkan dengan lingkungan dan budaya lokal di Merauke, yang ditunjukkan pada Tabel 7.

Tabel 7. Analisis Topik Praktikum yang Sesuai dengan Lingkungan dan Budaya Lokal Merauke

No	Materi	Alat	Bahan lokal
1	Larutan Elektrolit	Lamp testor, Beaker Glass, Baterai	Air Sungai Maro
2	Laju Reaksi	Beaker Glass, Hotplate, Timer, Termometer	Sarang Semut
3	Perubahan Entalpi	Beaker Glass, Pipet Ukur, Mortar	Tepung Sagu

Pada tahap perancangan dilakukan pengumpulan sumber atau referensi yang terkait dengan materi praktikum kimia yang berupa buku dan jurnal yang berikutnya pemilihan format untuk penulisan panduan praktikum kimia dasar.

Pada tahap desain panduan praktikum kimia dasar draf 1 (satu) sesuai dengan format penulisan yang dipilih, selanjutnya dikoreksi dan divalidasi oleh ahli materi dan media berdasarkan kekonsistenan dengan format penyusunan panduan praktikum kimia dasar. Perbaikan pada panduan praktikum kimia dasar yang menghasilkan draf 2 (dua) selanjutnya divalidasi oleh validator ahli materi meliputi kebenaran konsep materi praktikum. Selanjutnya validasi media oleh validator ahli media meliputi tampilan fisik dan kebahasaan. Dalam validasi media dilakukan perbaikan karena penulisannya masih ada yang kurang jelas. Setelah dilakukan perbaikan pada validasi media

dihasilkan draf 3 (tiga). Panduan praktikum kimia dasar draf 3 (tiga) telah dinyatakan valid dan layak oleh validator ahli materi dan media. Hasil validasi ahli materi dan ahli media ditunjukkan pada Gambar 2.

Penilaian materi dilakukan untuk menentukan kesesuaian materi dan kebenaran konsep sesuai yang diajarkan. Penilaian kelayakan materi terdiri dari sepuluh butir yaitu kebenaran konsep dan tingkat keterlaksanaan praktikum. Validator memberikan penilaian berupa tanggapan positif untuk keseluruhan komponen. Saat validasi produk draf satu mendapatkan persentase 62,50% dengan kriteria cukup layak dan perbaikan pada tata tertib praktikum, penyajian materi yang masih belum runut, kesesuaian tema praktikum dengan tujuan, dasar teori, alat, bahan, cara kerja dan teknik analisis yang belum semua sesuai dengan materi praktikum yang akan dilaksanakan, ada beberapa penambahan alat praktikum dan perbaikan pada penyusunan prosedur kerja. Setelah direvisi, draf dua memperoleh persentase 65,00% dengan kriteria layak. Walaupun dinyatakan layak namun validator materi memberikan masukan untuk perbaikan pada dasar teori untuk lebih terperinci, dan pembuatan diagram prosedur kerja serta format laporan praktikum untuk dilampirkan. Pada revisi draf dua memperoleh persentase 75,00% dan dinyatakan layak untuk digunakan dalam praktikum. Hasil penilaian atau hasil validasi yang mendapatkan persentase diatas 62,50% dapat dinyatakan layak digunakan dari sebuah produk pengembangan (Hermawati, 2016).



Gambar 2. Hasil Validasi dan Uji Kelayakan oleh Ahli

Penilaian media meliputi tampilan fisik dan kebahasaan. Penilaian kelayakan media mengandung sepuluh butir penilaian yang jumlahnya sama dengan butir penilaian materi. Hasil penilaian draf satu untuk kelayakan tampilan panduan praktikum kimia dasar mendapatkan persentase sebesar 57,50% kriteria cukup layak dengan perbaikan pada tampilan fisik ilustrasi sampul yang belum menampilkan keserasiannya dengan judul buku praktikum. Ilustrasi pada sampul hendaknya menampilkan gambar-gambar kearifan lokal yang ada di Merauke yang sesuai dengan tema praktikum, ukuran huruf yang belum serasi, dan penyesuaian penyajian dengan format yang dipilih. Tampilan halaman sampul dapat dilihat pada Gambar 3.

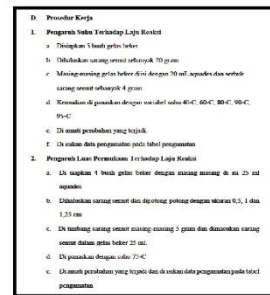


Gambar 3. Halaman Sampul Panduan Praktikum Kimia Dasar

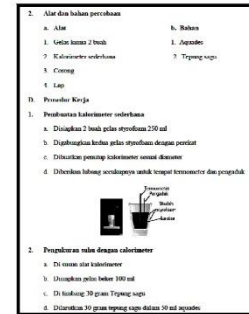
Setelah dilakukan perbaikan, draf dua mendapatkan persentase 77,50%. Walaupun dinyatakan layak namun validator media memberikan masukan untuk perbaikan penyempurnaan pada pemilihan kata dan ejaan yang perlu diperhatikan lagi karena masih ada beberapa penulisan yang belum benar. Setelah dilakukan perbaikan dinyatakan layak untuk digunakan dalam praktikum dengan hasil persentase penilaian 86,25%.

Panduan praktikum yang dikembangkan juga memuat komponen-komponen yang harus ada dalam sebuah petunjuk praktikum. Komponen dalam petunjuk praktikum harus memuat judul praktikum, tujuan praktikum, dasar teori, alat dan bahan, cara kerja, dan evaluasi. Petunjuk praktikum telah dilengkapi dengan tata cara keselamatan kerja untuk mengantisipasi kecelakaan kerja selama di laboratorium.

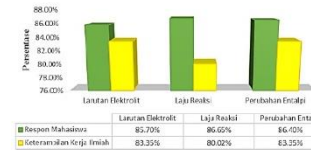
Pada Gambar 4 disajikan kutipan halaman percobaan laju reaksi menggunakan sarang semut dan pada Gambar 5 disajikan kutipan halaman percobaan  $\Delta H$  reaksi menggunakan sampel sagu. Petunjuk praktikum harus memuat aspek keselamatan dalam melaksanakan kegiatan praktikum berupa peringatan yang dituliskan atau lambang-lambang yang digunakan (Maharani, 2013).



Gambar 4. Kutipan Halaman Percobaan Laju Reaksi menggunakan Sampel Sarang Semut



Gambar 5. Kutipan Halaman Percobaan  $\Delta H$  Reaksi menggunakan Sampel Sagu



Gambar 6. Hasil Uji Coba Terbatas

Secara keseluruhan panduan praktikum kimia dasar mendapatkan skor rata-rata sebesar 86,25% yang artinya berada pada kriteria sangat layak. Petunjuk praktikum selain dirancang untuk memberi pemahaman kepada mahasiswa, juga diharapkan dapat membangun kompetensi dan kepercayaan diri mahasiswa, di mana percobaan yang dilakukan merupakan fondasi dari ilmu pengetahuan kimia supaya mahasiswa dapat memahami, menghargai dan mengaplikasikan konsep kimia tersebut (*American Chemical Society*, 2009).

Pada tahap pengembangan dilakukan uji coba terbatas pada subjek penelitian. Instrumen angket respon mahasiswa dan observasi keterampilan kerja ilmiah terhadap panduan praktikum kimia dasar setelah dikonversi diperoleh hasil seperti ditunjukkan oleh Gambar 6.

Pelaksanaan praktikum untuk masing-masing topik berjalan dengan lancar. Angket respon mahasiswa dibagikan saat uji coba terbatas. Berdasarkan hasil pengisian angket respon, mahasiswa mampu memahami materi serta proses pelaksanaan praktikum sesuai dengan produk pengembangan panduan praktikum kimia dasar sehingga mendapatkan respon positif untuk semua topik praktikum yang disusun. Perhitungan persentase respon mahasiswa pada topik praktikum larutan elektrolit, laju reaksi, dan perubahan entalpi secara berturut-turut adalah 85,70%, 86,65%, dan 86,40%.

mendapatkan skor rata-rata sebesar 82,24% yang artinya berada pada kriteria sangat baik. Hal ini sejalan dengan hasil penelitian Handayani dkk. (2014), yang menyatakan bahwa aktivitas siswa selama kegiatan praktikum dikategorikan tinggi dan hasil belajar ranah kognitif, afektif, dan psikomotor menunjukkan hasil yang baik setelah menggunakan penuntun praktikum. Dengan demikian untuk meningkatkan keterlibatan siswa secara aktif terhadap belajar dan berusaha menemukan konsep sendiri dalam proses pembelajaran adalah dengan kegiatan praktikum. Disarankan dilakukan penyempurnaan produk sebelum menjadi produk akhir untuk disebarluaskan.

#### 4. KESIMPULAN

Hasil penelitian menunjukkan panduan praktikum kimia dasar terintegrasi etnokimia yang dikembangkan memperoleh persentase rata-rata uji kelayakan oleh ahli materi 75,00% dan oleh ahli media 86,25%. Persentase rata-rata respon mahasiswa pada saat uji coba terbatas diperoleh 86,25% pada kategori sangat layak, sehingga dapat disimpulkan bahwa produk pengembangan layak digunakan untuk proses pembelajaran.

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## 02 A Culturally Responsive Teaching Approach and Ethnochemistry s of Tegal Culture for Developing Chemistry Students' Critical Thinking Skills in Acid-Based Learning

### A culturally responsive teaching approach and ethnochemistry integration of Tegal culture for developing chemistry students' critical thinking skills in acid-based learning

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**Abstract.** The aim of this study was to develop students' critical thinking skills through a Culturally Responsive Teaching (CRT) approach and ethnochemistry of Tegal culture. The teaching approach focused on exploring the culture and local wisdom in Tegal Culture, especially in Acid-Base such as the Nginang, Moci, and Jamasan traditions from chemistry perspectives integrated into CRT. The study employed a teaching model consisting of five phases: self-identification, cultural understanding, collaboration, critical reflections, and transformative construction. The study involved 35 year 11 students from a secondary school in Balapulang Tegal. A qualitative methodology approach was employed using observation, interviews, a critical thinking test, and reflective journals as data collection methods. The results show that the integration of ethnochemistry in a CRT approach engaged students in developing their critical thinking skills by developing a conclusion, making connections, conceptual understanding, and interpretation with the critical thinking skills test which shows 40% of students reached level 3 (Satisfactory). In addition to the students engaging in the cultural identity empowerment, meaningful chemistry learning experiences, and team work, the students were challenged in developing their critical thinking skills.

#### 1. Introduction

Meaningful chemistry learning occurs when content is related to context and everyday phenomena, from a students' perspective [1,2]. Problems occur in chemistry learning when chemical concepts do not align with the context of students' experiences, the curriculum concepts that must be mastered, and the learning of chemistry that tends to memorize [3-5]. A related problem is that chemical learning has rarely been used by the teacher as an opportunity to optimize students' critical thinking skills.

A learning approach that can assist students in linking chemical material with the culture found in the surrounding environment is through a Culturally Responsive Teaching approach that allows teachers to conduct a series of meaningful activities for students that helps them practice thinking critically [6]. This approach is challenged by the differences in cultural background and student characteristics that are reflected in the skills students bring to learning activities [7]. Therefore, the research focused on engaging students in understanding chemistry concepts through meaningful learning experiences by integrating Culturally Responsive Teaching as a teaching approach. This study aimed to develop critical thinking skills through the Culturally Responsive Teaching (CRT)

approach and ethnochemistry of Tegal culture. The teaching approach focused on exploring the culture and local wisdom in Tegal Culture, especially in Acid-Base such as the Nginang, Moci, and Jamasan tradition from chemistry perspectives integrated into CRT.

#### 2. Methods

The study employed a teaching model consisting of five phases: self-identification, cultural understanding, collaboration, critical reflections, and transformative construction. The study involved 35 year 11 students from a secondary school in Balapulang Tegal, Indonesia. A qualitative methodological approach was employed with observation, interviews, critical thinking test, and reflective journals as data collection.

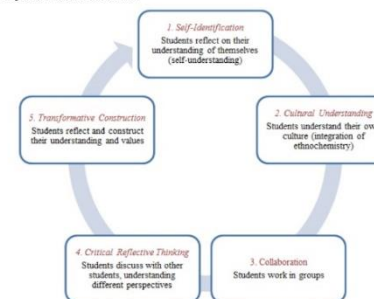


Figure 1. Culturally responsive teaching phases.

In the first stage of the process, students understand themselves and their backgrounds. This is done via a learning style questionnaire, self-identity, and playing games knowing the characteristics of students. In the second stage of the process students engaged in cultural understanding and construction of knowledge through accessing ethnochemistry articles. In the next steps, students collaborate to discuss the concept and cultural perspective. At the fourth stage, the students presented the results of the project to the class-based ethnochemistry and cultural background of each group. The last stage of the research process involved students changing their values and understanding. In this study, reflective journals were used and critical thinking tests conducted on the values and perspectives of students who experienced changes during the learning process.

#### 3. Result and discussion

The result show that the integration of ethnochemistry in CRT approach engaged students in developing their critical thinking skills. The test showed that 40% students reached level 3 (Satisfactory). In addition students engaged in cultural identity empowerment, meaningful chemistry learning experiences, and working in teams. The students were challenged to develop their critical thinking skills as display in a graph figure 2.

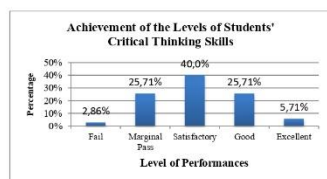


Figure 2. Students' critical thinking skills.

Based on the figure above, it can be seen that most students had enough critical ability to formulate the subject matter and uncover the facts needed. They were able to; determine the concept used, know all information can be used, detect bias, and work on the questions as planned. They were less able to express logical arguments, re-examine answers using other methods, and to draw clear conclusions. The 5 criteria for measuring critical thinking skills SCT11020 are as follows:

### 3.1. Identification of questions

In the learning process, culture issues were discussed by using ethnochemistry articles, thereby encouraging students to increase their curiosity regarding the issues under study. The results indicated that students were able to clearly and consistently identify and formulate the important principles of the topics. This can be seen from a participant's response regarding the learning process:

*"Acetic acid has a weak electrical conductivity, the molecules of vinegar release only a few  $H^+$  ions, so the lights dim and bubble the air produced is very little, from the results I identified from the table it can be concluded that the higher the price of  $K_a$ , the stronger the acid. The acid sequence from the strongest to the weakest is fluoride acid, nitric acid, formic acid, and acetic acid" (Students Interview 14, January 31, 2018, XI MIPA 3, 12.00-13.00).*

*"Most students can identify the theories of Acid-base, distinguish strong acids and weak acid well" (Observer Note 2, January 22, 2018, XI M Science 3, 10.15-12.00).*

Students felt motivated to ask questions when issues from ethnochemistry articles were discussed. The questions raised by students were useful in clarifying their understanding of the issues. Results showed that the average student could identify questions without confusing the topics.

Teacher : How can you identify the strong-weak acid?

Student 10 : I know which one is strong, the other is weak depend on how price  $K_a$ , electrical conductivity, also how it ionize. Strong acid such as chloride and sulphate acid, weak acid such as acetid acid. I want to ask why the arrow of weak acid is two while if the arrow of strong acid is one, I am still confused.

Student 27 : It is relating with the strength of ionization. Isn't it miss?

Teacher : Yes. The arrow is the sign of how its separates into ions. You must learn more it in book or any sources. Tomorrow we will discuss more about it.

The questions raised by the students were important because the other participants could add information from the questions and from the answers given. On the critical thinking skills tests,

identifying problems in subject questions could be said to score high. Based on the results of the study, it can be seen that students mastered 80.57% of the skill of identifying problems in the question.

### 3.2. Conceptual understanding

In CRT learning, students integrate an understanding of the concepts of acid-base with culture applications to everyday life such as Jamasan Tradition, Ngingang, and Moci. The results of the study show that the average conceptual understanding of students was more developed, meaning that students could provide ambiguous responses and the content used had improved. The following is one sample from a student's critical thinking test:

*"It turns out that the function of tohor chalk for ngingang as Tegal tradition in order to keep our teeth in accordance with the concept of acid-base,  $Ca(OH)_2$  can release ions hydroxides according to the theory of acid-base according to Arrhenius in everyday life" (Student Interview 8, January 22, 2018, XI MIPA 3, 12.00-13.00).*

*"I have to describe the essay problem so I have to master the concept of the question" (Student Reflective Journal 6, 131 January 2018, XI Mathematics 3, 7:00-8:30).*

From the test results above, it can be seen that students can respond to the problems using an appropriate and adequate understanding of the content. The student's statement is in accordance with the concept acid-base of Arrhenius. This aligns with the culture issues learning objectives proposed by [8]. By introducing something they know into the learning process students find it easier to construct their knowledge. The practice forms a pedagogical bridge that connects previous knowledge with new knowledge, known as the unknown, which goes from abstract to reality [9]. On tests of critical thinking skills, understanding the subject concept can be considered strong. Based on the results of the study, it can be seen that students have mastered 73.14% of the conceptual understanding skills aspect.

### 3.3. Connection of ideas

The research project results show that in the application of CRT learning, students' ability to integrate various ideas such as culture, scientific concepts, health and the concepts of acid-base when discussing ethnochemistry articles began to be observed. The statement below shows students were able to connect several ideas when discussing an issue:

*"Student 17 linked ethnochemical articles with the tradition of ngingang carried out by her grandmother when there was a celebration at her house" (Researcher Notes, 10 January 2018).*

The statement above shows that participants were able to identify a strong relationship between ideas when discussing cultural issues. Students could also connect an acid-base concept with soil problems as explained in the worksheet sample below:

*"if we measuring soil pH by testing it with litmus paper showing the color blue so that the soil conditions showed values of acidity greater than seven or alkaline and when mixed with ZA fertilizer it was already true according to the concept of acid-base because it will neutralize each other" (Student 10, 31 January 2018).*

On tests of critical thinking skills the skill of connecting between subject concepts can be unsatisfactory. Based on the results of the study, it can be seen that students mastered only 58.86% of the skill aspect connecting between concepts.

### 3.4. Assumptions

The learning process to address culture issues encouraged participants to actively express their opinions or assumptions in accordance with the views of each group. Students collaborated (worked in groups) to discuss the concept and cultural perspective. In addition to collaborating in groups, students also collaborate with teachers. This is evident from the following observation sheet:

*"Some of the students answered questions about the estimated aspirin more absorbed in the stomach than in the intestine" (Researcher Note, January 22, 2018).*

Participants were challenged to develop their critical questions through curiosity in a case. Group discussions allow individuals to get more a comprehensive solution [10] and provided opportunities for students to communicate [10,11]. The statement below shows students were able to make right assumptions in discussing the issue:

Teacher : *What is your opinion on this issue? (How aspirin works in the body)*

Student 35 : *Aspirin is absorbed in the stomach and in the small intestine, but is absorbed more in the small intestine*

Teacher : *Why you assume that?*

Student 35 : *Because aspirin is acidic it will be more easily absorbed by alkaline solutions so it will be more neutral*

In the test of critical thinking skills, the aspect of higher-order thinking skills can be said have an unsatisfactory response. Based on the results of the study, it can be seen that students only controlled 52.57% of the skills aspect.

### 3.5. Conclusions

During the learning process, participants were observed drawing conclusions based on the results of discussions.

*"Always measure the pH of the plantation, so that the land can be planted well and where the land can flourish" (student 10, 31 January 2018).*

*"Conclusion is that Pak Slamet's land is acidic because the litmus paper turns red, while the soil in the land is said to be base because it changes the color of the litmus to blue" (student 13, 31 January 2018).*

The participants' conclusions are correct based on the data and are consistent with the group's views on the issues raised. On tests of critical thinking skills the aspects of drawing conclusions can be said to have an unsatisfactory answer. Based on the results of the study, it can be seen that students only controlled 42.86% of the aspects of drawing conclusions.

Learning is associated with developing students who are open-minded and intrigued by their surrounding cultures that make them want to learn more deeply. In addition, learning helps students build chemical concepts holistically [12]. It makes students' thoughts and insights more extensive and related to each other, not only from one aspect but related to each other. In addition, giving story questions integrated with Tegal culture, also enabled students to think more critically. This is supported by observers and researchers' notes as follows:

*"Learning activities are able to arouse the curiosity of students because they often discuss cultural issues related to the material being studied. In addition, this can be seen from the increasing number of students who dare to ask questions and are no longer shy during the learning process.*

*Researchers play an active role in motivating and guiding students in straightening the answers given" (Observer note 1, January 24, 2018).*

The Culturally Responsive Teaching integrated ethnochemistry raised issues related to Tegal culture. Ethnochemistry examines culture from a chemical perspective so that students can better understand the application of chemical concepts in everyday life. Students will be more motivated to actively express opinions in discussion about controversial topics through their experiences in chemistry learning [13]. Most students already know the typical culture of Tegal but do not know the chemical concepts contained in it. Students assume that ancient people did not study chemistry, however, the culture was in accordance with chemistry concepts. This discovery makes students more curious and want to know more about their culture. Curiosity can stimulate students' critical questions [14]. They become increasingly aware of the importance of chemical concepts in everyday life is proven to be applied in their regional culture. Students feel responsible for preserving the culture they have. This causes students to think more critically when they come across a cultural issue.

### 4. Conclusion

Culturally Responsive Teaching integrated with Tegal ethnochemical culture on acid-base material can accommodate various learner characteristics and helped students better understand the chemical concepts and their application in their cultural traditions. This approach has made students begin to reflect on themselves to develop their cultural identity in understanding themselves and others. Students found a connection between the concept of acid-base chemistry and traditional chemistry through story. In addition, the learning experience encouraged students to be more critical and independent. Learning is associated with developing students who are open-minded and intrigued by culture so as to make changes in their values and perspectives following the learning process. Students are increasingly aware and responsible for their culture, and they are increasingly active in their learning. The learning process encouraged participants to use their intellectual abilities and, as such they develop critical thinking skills equal to 40% or level 3 (Satisfactory). Achievement of the highest indicators was: identify the question at issue (80.57%) and lowest: inferences (42.86%).

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## 03 Chemistry Students' Identity Empowerment Through Ethnochemistry in Culturally Responsive Transformative Teaching (CRTT)

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### Chemistry students' identity empowerment through ethnochemistry in culturally responsive transformative teaching (CRTT)

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**Abstract.** The paper portrays the second year report of a three-year longitudinal study of ethnochemistry integration in Culturally Responsive Transformative Teaching (CRTT) teaching model in secondary schools. The CRTT develop based on Culturally Responsive Teaching (CRT) as an approach that includes students' characteristics and cultural references in all aspects of learning and transformative learning framework. The study developed CRTT teaching model in the first year of study and consists of five phases of self-identification, cultural understanding, collaboration, critical reflections, and transformative construction. The qualitative methodology approach has been employed with observation, interviews, and reflective journals as data collection. The CRTT teaching model was implemented in chemistry classrooms from two secondary schools. The study involved 68 students of year-10 in the topic of electrolyte and non-electrolyte solution. The data was analyzed from the basic principles of cultural identity category. The results showed that the integration of ethnochemistry in CRTT teaching model has engaged students in empowerment their cultural identity and nationalism, cultural differences awareness, and learning identity development. The teaching model is also relevant to the policy of national curricula of nationalism in relation to character and culture identity development.

#### 1. Introduction

Indonesia with its diversity in values, beliefs and practices consists of more than 17,000 islands and more than 300 ethnic groups [1]. In the classroom, cultural background differences affect students' values and ways of thinking and teacher-student interaction. According to [2], teachers need to understand their students' cultural background to engage them in learning experiences. Therefore, it is important to develop 'cultural awareness', not for perpetuating division but for developing understanding of diversity. It is important to equip the students to understand cultural differences as pointed out by [3], students need to have knowledge and skills to engage in differences of age, gender, sexual orientation, class, region, religion, race, ethnicity, ability, and nationality. Meanwhile, the process of globalization and cross-cultural interaction between ethnic groups influence the students' cultural identity and character. [4] stated that education should be able to develop students' competence and maintain their cultural identity. As related to student learning, students' learning stages can be identified as, rote learning, in-depth meaning making, and learning as a cultural phenomenon [5]. However, the study of Indonesia's cultural diversity in relation to chemistry learning for creating meaningful learning experiences has not been widely explored. Therefore, it is important to engage students with their cultural background.


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The culturally-based teaching approaches is important in developing social and cultural identity. One of teaching approaches that can integrate culture in the classroom is Culturally Responsive Teaching (CRT) which an approach employs students' cultural references for students' learning engagement [4]. According to Gay [6], CRT applies the cultural knowledge, prior experiences, and performance styles of diverse students to create meaningful learning experiences for these students through their strengths. Multidimensional CRT involves content of curriculum, context of learning, classroom climate, relationships of student-teacher, instructional techniques, and assessments. Students can also participate actively in their own performance evaluations by being better human beings and more successful learners [6]. In the context of learning chemistry from cultural perspectives, ethnochemistry can be integrated. Ethnochemistry as a part of ethnoscience looks at culture from a chemistry perspective which involves a cross-discipline of social sciences and humanities perspectives [7]. In this study, the integration of ethnochemistry in CRT as one way to integrate scientific inquiry within students' cultural background. CRT could empowers students by using cultural referents to develop knowledge, skills, and attitudes [8]. In the culturally responsive teaching, teachers play an important role in engaging students in these ways of knowing. In learning within cultural phenomenon, students will have the opportunity to engage not only Western Science but also their own culture. Students should have abilities to harmonise their own culture (their everyday language) aligns with Western science Learning outcomes and experiences [8]. According to [9], cultural processes involves the dynamic process because of its personal meanings and subjectivity. Therefore, teachers could engage students in their personal worlds by integrating culture in science learning [7].

Chemistry, is one branch of science that studies materials that exist in the universe, the interactions among them and changes in energy-related or caused by the changes of nature [10-12]. In chemistry learning, students are expected to understand chemistry concepts in order to solve problems through building their individual knowledge [13-14]. However, in order to achieve this, students face challenges as many chemistry concepts are considered complex and difficult to contextualize with student lives [15]. In addition to the characteristic of chemistry learning is intact and meaningful if it is associated with the three levels of macroscopic, microscopic and symbolic [16-18]. However, the research shows that generally, students experience difficulties with chemistry because of their inability to visualize the structure and process at the submicroscopic level and connect it with the other chemical representative levels [19].

In the Indonesia context, several problems are evident as related to learning chemistry generally. Linking abstract concepts with students' daily lives, an overloaded curriculum, and rote learning or memorizing all contribute to the problem of effective chemistry education [20]. It is expected that students not only understand chemistry concepts, but also relate the issues to chemistry and play an active role in solving problems, either in the form of ideas or actions. Thus, to achieve these objectives, learning chemistry must be able to be a means of developing students' abilities in social life; to resolve the kinds of problems that require the chemistry teacher to be more creative in applying chemistry to contextual issues in everyday life to create meaningful learning experiences. In relation to chemistry education in Indonesia, one of the main aims in Curricula 2013 is to develop students' scientific inquiry and national character through meaningful chemistry learning experiences. In addition, curriculum 2013 enhances student-centered learning in accordance with their background, characteristics, and a students' prior knowledge and the teacher should act as a facilitator in learning so that students can engaged in their learning experiences [21].

Therefore, this research focuses on the integration of Culturally Responsive Transformative Teaching (CRTT) teaching model which has been developed in the first year of study. The CRTT teaching model is developed based on the principles of CRT and transformative learning consists of five phases of self-identification, cultural understanding, collaboration, critical reflections, and transformative construction. The previous study of CRT approach in chemistry learning has empowered students in chemistry learning [22]. In this paper, the integration of ethnochemistry in CRTT teaching model was explored in the concept of electrolyte and non-electrolyte solution in year-10 chemistry classrooms. In this paper, the implication of CRTT teaching model is explored in relation to students' identity.

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## 2. Methods

The research employed a qualitative method with observation, interviews, reflective journals, and document analysis as data collection. The research was conducted at secondary schools in year 10 in one public school and one private Islamic school, in relation to the concepts of electrolyte and non-electrolyte solution. The participants consist of 68 students from two classrooms in each school. The study consisted of three main phases: 1) exploring classroom and students' cultural background through observations and interviews, 2) CRTT teaching model development, and 3) CRTT implementation by exploring students' identity. The CRTT teaching model involves 5 main steps of self-identification, cultural understanding, collaboration, critical reflective thinking, and transformative construction [22]. In these five steps, students had opportunities to develop self-understanding of their character, their learning style, and their cultural identity. They also learned about others and collaborated as shown in the model below.

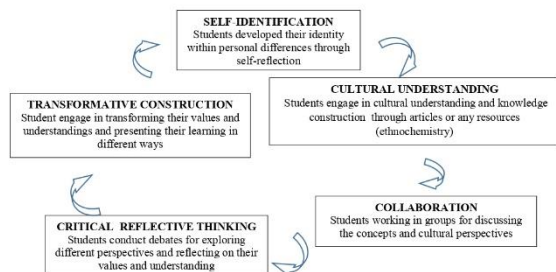


Figure 1. Culturally Responsive Transformative Teaching (CRTT) teaching model

The process above (figure 1.) provides opportunities for teachers and students in exploring their identity and respecting differences. It also involves personal and social learning.

## 3. Results and Discussion

The study results show the process of integrating ethnochemistry in a CRTT teaching approach in the context of chemistry learning. The researchers worked with the teachers to integrate the model for engaging students. Discussions are explained in two parts according to the model of integration and are followed by the implications that can be made on student empowerment in chemistry learning.

### 3.1. Culturally Responsive Transformative Teaching (CRTT) Teaching Model

In the first step of **self identification and cultural understanding** was the process by exploring students' diverse backgrounds through an in-depth interview. It was found that 80% of students were born in Jakarta, however, most of their parents came from Java which is a different ethnic group. The students reflected on their cultural identity within different roles as family members and as students. The researcher conducted classroom observations before implementing the CRTT so as to understand

classroom culture. For **cultural understanding, the content integration** principle by [23] was employed by providing learning materials associated with the students' cultural background, daily lives, and the chemistry curricula. There were two articles of Jeruk Nipis and Green Coconut Water in relation to the concepts of electrolyte and non-electrolyte solution. Besides, they had to explore their own cultural practices in relation to chemistry concepts, the presented in the classroom. The stories have been developing in different chemistry curricula for engaging students in learning their culture from chemistry perspectives. Students are expected to find the relation of chemistry concepts and of the electrolyte and non-electrolyte solution that they find in the story. Through this content integration, the teacher can develop positive teacher-student relationships through positive relationships between teachers and students. Teachers must believe in their students' ability and provide them with valuable experiences into the classroom [23].

After students have reflected on themselves the next step in the research process was the **collaboration** with teachers and students. In this step, the teachers developed positive student-student interactions by implemented different teaching models. Students engaged in active discussions and collaborations within a group. Teachers provided time for the students to interact with their peers in positive interactions helping them to improve collaboration and communication skills. The next phase, after collaboration, was **critical reflective thinking and transformative construction**. Debates were conducted so that the students could explore different perspectives and reflect on their values and understanding. After reflecting, students engaged in transforming their values and understanding and presenting them in different ways by reflecting on the question *How have the values and perspectives that they hold transformed because of the learning experiences?* The question is relevant to the five ways of being involved in transformative learning, as expressed by [24]: cultural-self knowing (self-realisation), relational knowing (opening to difference), critical knowing, visionary and ethical knowing (over the horizon thinking), and knowing in action (making a difference). These ways of knowing provide opportunities for students to understand themselves and develop the cultural awareness of appreciating differences, especially in collaborating with others.

### 3.2. Students Identity Empowerment in Chemistry Learning

The CRTT approach has impacted on student empowerment in chemistry learning through cultural identity and nationalism, cultural differences awareness, and learning identity development. These aspects were found in each of the different schools. The following case study in each school will be explored in detail other papers.

**3.2.1. Cultural identity and nationalism.** The ethnochemistry approach not only develops knowledge, but also cultural identity and nationalism. According to [25], identity is a learning process which is constructed with the emotions involvement by the students. The study is relevant according to the definition of cultural identity as development by [26] which describes identity as self-understanding of the social and cultural. When students collaborated with other students they developed their identity was socially constructed in a social/cultural context which included sharing beliefs, relationships, customs, symbol systems (language), knowledge, physical settings, and objects [27]. According to [28], identity involves all factors that constitute our lives, including genetic makeup, our parents, culture, experiences (bad and good, love and suffering). In the following statement students show their cultural identity after it was integrated with the learning culture.

*"We learned our own which I realized that it is important to maintain my culture and understand others"*  
(Student Interview, School A, February 1, 2017)

*"In the chemistry learning, the students were engaged and asked the critical questions regarding the cultural practices of Green Coconut Water in the culture"*  
(Observation, School B, January 30, 2017)

*"We have to maintain our indigenous knowledge, especially the traditional medicine, so it can compete with modern medicine"*  
(Students' Reflective Journal, School B, January 30, 2017)

In addition to introducing the idea of bringing their indigenous knowledge into the chemistry classroom, [5] the idea of pluralism in learning science relates to the interaction between students' culture and the Western science. Students also face different cultural experiences of their own experiences (and the cultures of science itself). Therefore, learning should recognize this border crossing of cultural experiences. [5] proposes a different idea of enculturation by engaging students through their own identity which recognizes the equity of all students. In addition, it will help teachers to engage students in their personal worlds [9].

The integration of ethnochemistry was an innovation in the chemistry classrooms in this study. The students felt the learning environment was different to the usual chemistry learning environment where practice in solving the mathematics problems in chemistry was the norm. The CRT approach stimulated their curiosity and motivated them to, not only learn chemistry concepts but also identify different cultural practices. Below is a statement from a student who showed curiosity in the ethnochemistry. The students look more enthusiastic when exploring the chemistry concepts in the cultural practices. Their motivation was stimulated by integrating ethnochemistry in the learning because it is related to everyday thinking. Nanochemistry has stimulated the students' learning motivation by describing the chemistry concepts as applied in cultural traditions which make students more interested in chemistry learning. This has led to meaningful learning experiences as recognized by studies of student understanding that support solutions through the use of meaningful learning experiences [29-30]. In this study, students engage in a new learning approach, environment, and in relation to students' daily lives.

*"We were engaged with the application of chemistry concepts in everyday life, especially in relation to our culture"*  
(Students Interview, School B, January 30, 2018)

The CRT approach provides opportunities for students in respecting others' cultures and uses these opportunities for their learning. Culturally responsive teachers develop intellectual, social, emotional, and political learning by "using cultural referents to impart knowledge, skills, and attitudes" [31] explains that culturally responsive teachers not only focus on students' scores, but also cultural identity [3]. In addition to integration, the culture of society and everyday life also relates to nationalism. In relation to this, students stimulated to develop their nationalism, students explained that they become engaged with Indonesia culture. Because of the impact of globalization, they came to understand that they have a limited understanding of their own culture which is considered to be a loss of their cultural identity [28].

**3.2.2. Cultural Differences Awareness.** The students also learned the different cultures they have to complete the project of exploring their own culture in relation to chemistry concepts. Therefore, at the same time, they have to work with others from different cultures in completing the tasks.

*"It's exciting that I learned other cultures and worked together to complete the task"*  
(Student Reflective Journal, School A, February 1, 2017)

*"I realized we are different, it should be a problem, but I prefer working with others who care about others and willing to complete the task"*  
(Student Interview, School B, February 6, 2017)

Based on the above statement from either interviews or reflective journals, the students expressed how they felt when cooperating with each other. They also said they learned to understand and appreciate each other. They realize that it was challenging for working with others who shared differences. They have to learn to collaborate with others, develop empathy and communicate clearly in order to succeed in group working.

Grouping students based on the differences in gender, achievement levels, and ethnic groups helped students develop their empathy with others. Attitudes to listen and respect others' opinions are the characteristic of empathy of accepting another person's perspective, be able to listen to others and be sensitive to the others' feelings. Cultural competence is the ability to successfully teach students who come from different cultures. It helps to develop students' personal and interpersonal awareness, and a set of skills of effective cross-cultural teaching [32]. The teachers tried to understand students' differences and provide different learning experiences. Students developed attitude to be sensitive to others which is demonstrated through the following statement.

*"Even though I prefer to work with my close friends as I know them closely, but working with others has helped to understand others and learn new things"*  
(Students Interview, School A, February 6, 2017)

Students indicated that they became more used to talk and getting to know their classmates' character which leads to being good collaborators. In addition, the teaching approach which was implemented helped students to develop their self-confidence. Students appeared confident when discussing in groups by expressing opinions and conveying information held to classmates. In addition to the above, there are suggestions that culturally responsive learning has stimulated students to develop responsibility. The learning process, using cooperative discussions, engaged them in understanding the task objectives to be completed.

**3.2.3. Learning Identity.** Students understand that they have developed their understanding of their identity as the learners. They were realized that they usually learn chemistry from textbook and followed the teachers' instructions. Becoming active learners became challenging since they have to move from their comfort zone from the passive learners to the active learners. In addition to the teachers are empowered to bring culture alongside chemistry concepts helped students develop their knowledge. Teachers should engage students to construct their own knowledge through active processes [33]. In addition [34] stated that the students need to develop their knowledge by interact with their environment.

Students learned to develop their learning identity through their own culture. In this teaching model, students have to collaborate with others in order to construct their understanding of electrolyte and non-electrolyte solution. Even though, the students still focused on learning to the test and giving the right answers. In this stage, the students have been challenged by critical and creative thinking in facing the given problems.

*"It is exciting that we had different learning experiences, from practicum, debate, and learning cultures. We are challenged to solve the problem given"*  
(Student Reflective Journal, School A, February 8, 2017)

*"We are not only sitting in the classroom, we are thinking. We feel free to express our ideas"*  
(Student Interview, School B, February 15, 2017)

*"We criticize the problem solution to find out the best, it becomes important to argue in discussion"*  
(Student Reflective Journal, School A, February 1, 2017)

The statements demonstrate that the students showed their engagement while solving a problem. Students stated that during the lesson the teacher assigns students to develop their critical voices in the debate. The above statements show that it is important for students to build an effective understanding of chemistry concepts as according to [35], it is important for students to retain new knowledge with their critical thinking which required them to be active learners.

Finally, integrating cultural ethics and values into the chemistry learning should be developed in relation to empowering students' identity development within character education. The problem is not in the usefulness of knowledge but in how to help them in using their knowledge for their future roles. The previous study showed that the students faced the challenges in shifting the learning from focusing into exams [36]. Teachers should facilitate students in understanding their identity by approaching with the contemporary context of problems, interests, issues, and concerns. However, both teachers and students need to shift their values and beliefs in their perspectives of teaching and learning.

#### 4. Conclusion

The CRTT teaching model has been implemented in this study which consists of the five main steps of self-identification, cultural understanding, collaboration, critical reflective thinking, and transformative construction. The students showed empowerment in developing their cultural identity and nationalism, cultural differences awareness, and learning identity. The learning experiences have stimulated their learning motivation and curiosity in order to develop their knowledge of chemistry and culture. The implementation of CRTT stimulated students' awareness of the role of chemistry in their everyday lives, especially in their culture that also affected their cultural understanding. In applying this approach, the teacher should develop their creativity and ability to prepare the learning resources for students, especially in ethnochemistry topics. This approach also provides the opportunity for parents to participate in students learning as part of the learning community.

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## 04 Implementasi Modul Kimia Pangan Melalui Pendekatan Etnokimia di SMK Negeri Aceh Timur Program Keahlian Tata Boga

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### IMPLEMENTASI MODUL KIMIA PANGAN MELALUI PENDEKATAN ETNOKIMIA DI SMK NEGERI ACEH TIMUR PROGRAM KEAHLIAN TATA BOGA

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**Abstrak.** Implementasi modul pembelajaran dalam penelitian ini merupakan bagian dari pengembangan modul berbasis etnokimia. Penelitian ini bertujuan untuk melihat pengaruh implementasi modul kimia pangan berbasis etnokimia terhadap siswa melalui analisis pemahaman terhadap konsep kimia terintegrasi, analisis efektivitas proses pembelajaran di dalam kelas, serta tingkat pemahaman dan kesadaran siswa terhadap etnokimia dan proses sains. Jenis penelitian bersifat kuantitatif deskriptif dengan pendekatan komparatif menggunakan metode eksperimen dengan grup kontrol. Penentuan sampel dilakukan dengan teknik random sampling yang diambil pada salah satu Sekolah Menengah Kejuruan di Aceh Timur Program Keahlian Tata Boga. Pengumpulan data dilakukan melalui penilaian evaluasi hasil belajar siswa dengan menggunakan soal *multiple choice*, pengukuran efektivitas pembelajaran dan pemahaman etnokimia menggunakan lembar observasi dan lembar wawancara terstruktur. Hasil penelitian diperoleh hasil belajar siswa pada kelas eksperimen secara rata-rata lebih tinggi dibandingkan kelas kontrol, meskipun hasil pengujian statistik dengan menggunakan uji *t* tidak menunjukkan perbedaan signifikan. Skor hasil observasi efektivitas pembelajaran pada kelas eksperimen lebih tinggi dibandingkan kelas kontrol yaitu sebesar 89,532 dengan kriteria sangat baik. Pengukuran terhadap pemahaman etnokimia siswa setelah penerapan modul diperoleh peningkatan sebesar 40 poin dibandingkan sebelum penerapan modul. Hal ini menunjukkan peningkatan pemahaman dan kesadaran siswa terhadap etnokimia dan proses sains yang berlangsung di dalamnya serta dapat memperkuat justifikasi bahwa modul pembelajaran dengan pendekatan etnokimia sangat baik diterapkan sebagai bahan ajar.

**Kata Kunci:** SMK, Etnokimia, Kimia

**Abstract.** Implementation of learning modules is part of the development of ethnochemical based modules. This study aims to find out the effect of the implementation of ethnochemical-based food chemistry modules on students through analysis of student understanding of integrated chemistry concepts, analysis of the effectiveness of learning processes in the classroom, and the level of understanding and awareness of ethnochemistry and the scientific process. This type of research is quantitative descriptive with a comparative approach using an experimental method with a control group. The sample determination was done by random sampling technique taken at one of the Vocational Schools in East Aceh on Food Expertise Program. Data collection is done through evaluating student learning outcomes using multiple choice questions, measuring learning effectiveness and understanding of ethnochemistry using observation sheets and structured interview sheets. The research results obtained student learning outcomes in the experimental class were on average higher than the control class, even though the results of statistical using *t* test did not show a significant difference. The score of the observation result of learning effectiveness in the experimental class is higher than the control class that is equal to 89,532 with very good criteria. Measurement of students' understanding of ethnochemistry after the application of the module obtained an increase of 40 points compared to before the application of the module. This shows an

increase in students' understanding and awareness of ethnochemistry and the scientific process that take place in it and can strengthen the justification that learning modules with ethnochemical approaches are very well applied as teaching material.  
**Keywords:** Vocational School, Ethnochemistry, Chemistry.

#### PENDAHULUAN

Pembelajaran kimia di Sekolah Menengah Kejuruan (SMK) termasuk dalam kelompok mata pelajaran adaptif. Kelompok mata pelajaran adaptif dimaksud sebagai pendukung mata pelajaran produktif, di mana siswa dituntut untuk tidak hanya menguasai proses tindakan namun mampu juga untuk menguasai proses sains yang sedang berlangsung pada suatu tindakan, artinya pembelajaran adaptif bertujuan untuk membangun dasar ilmu pengetahuan pada siswa sesuai dengan bidang produktif pada masing-masing kejuruan. Kedudukan kelompok mata pelajaran adaptif saling berkaitan dengan kelompok produktif dan normatif yang merupakan model kurikulum di SMK yang dirancang untuk menciptakan lulusan yang mampu bersaing di dunia usaha dan industri. Arah perkembangan revolusi industri 4.0 mengakibatkan arus globalisasi menjadi tidak terbendung, proses integrasi budaya luar yang terus masuk dan mulai menjadi *life style* pemuda tanah air mulai menggerogoti budaya lokal, fenomena ini berdampak pada merosotnya budaya lokal (Wahana, 2015). Dampak dari arus globalisasi dan revolusi industri 4.0 ini mengakibatkan persaingan kerja semakin ketat baik lokal maupun global. Pemerintah Republik Indonesia Melalui Kementerian Pendidikan Nasional mengeluarkan Keputusan Direktur Jenderal Pendidikan Dasar dan Menengah Nomor 330/D.05/KEP/KP/2017 tentang Kompetensi Inti dan Kompetensi Dasar Mata Pelajaran Muatan Nasional, Muatan Kewilayahan, Dasar Bidang Keahlian, Dasar Program Keahlian dan Kompetensi Keahlian menyatakan bahwa muatan kewilayahan termasuk aspek yang wajib ada dalam kurikulum SMK.

Mata pelajaran muatan kewilayahan merupakan aspek yang wajib dipelajari pada kurikulum SMK. Aspek tersebut umumnya termuat dalam kelompok mata pelajaran normatif. Aspek muatan kewilayahan berguna untuk meningkatkan pemahaman siswa terhadap nilai-nilai nasionalisme dan pengetahuan tentang budaya masing-masing siswa. Salah satu pendekatan yang layak untuk memenuhi aspek tersebut adalah melalui kajian etnosains. Etnosains adalah suatu sistem pengetahuan dan pembelajaran untuk mengkaji proses-proses sains yang berlaku pada suatu budaya (Zidny, dkk., 2020) etnosains merupakan kajian yang luas dan terdiri dari berbagai aspek budaya pada masyarakat (Ibrahim, dkk., 2016) sistem ini terdiri atas beberapa kajian yang lebih spesifik seperti etnomatematika (D'Ambrosio, 1985; Rosa & Orey, 2011), etnobiologi (Brain, 1980), etnobotani (Harshberger, 1896), etnofisika (Hartini, dkk., 2018), etnokimia (Singh, 2016), etnomedisinal (Marasinghe, 2016).

Etnokimia merupakan kajian baru dalam bidang kimia, kajian ini merupakan perpaduan antara kajian ilmu kimia dengan antropologi budaya dalam bentuk studi terhadap penerapan teknologi budaya pada suatu kelompok masyarakat tertentu yang telah diturunkan secara turun temurun dan menjadi suatu konsep baku pada masyarakat tersebut. Rosa & Oray (2011) mendefinisikan etnokimia sebagai suatu perilaku budaya tertentu pada suatu kelompok masyarakat yang terkait secara kimia. Pembelajaran berbasis etnokimia merupakan suatu pendekatan berbasis kultural yang dapat memberikan kontribusi terhadap perkembangan ilmu pengetahuan alam berbasis lingkungan seperti *green chemistry* (Zidny, dkk., 2020).

Penerapan pembelajaran berbasis etnokimia digunakan untuk menumbuhkan kesadaran siswa dalam memahami proses-proses kimia yang ada di kehidupan sehari-hari. Kemampuan untuk menghadirkan pengalaman yang diperoleh siswa di luar kelas dalam bentuk hasil pengamatan dan laporan, diharapkan menjadikan siswa yang mempunyai



kemampuan dalam menguasai kajian-kajian ilmiah secara literasi. Rahmawati, dkk. (2017) melaporkan bahwa penerapan pembelajaran kimia berbasis budaya di dalam kelas dapat menciptakan pengalaman belajar bagi siswa sehingga secara tidak langsung siswa dapat mengenal ilmu kimia dalam sudut pandang budayanya. Dorsah & Okyer (2020) menambahkan, pembelajaran sains dapat dilakukan dengan pendekatan budaya yang dihadirkan ke dalam kelas, sehingga dapat menghilangkan persepsi yang keliru terhadap suatu peristiwa alamiah yang sering terjadi disekitar siswa atau dalam komunitas budayanya. Selain dapat membantu proses penguatan dan pengembangan konsep-konsep, pembelajaran berbasis budaya juga dapat mengarahkan pandangan guru dan siswa untuk dapat menerapkan proses pembelajaran dengan pendekatan kontekstual, *reflektif dan eksplisit* (Celik, 2020).

Penelitian sebelumnya tentang inventarisasi aspek etnokimia yang berlaku dalam suatu kelompok masyarakat telah dilakukan oleh Nursaadah, dkk. (2017) yang menginventarisasi aspek budaya pada masyarakat Baduy Luar dan Dalam di Jawa barat. Lebih spesifik, Seprianto & Jofrishal (2019) melakukan penelitian untuk menginventarisasi kajian etnokimia pada masyarakat Aceh, khususnya Aceh bagian timur, hasil temuan dilaporkan bahwa kajian etnokimia yang dimiliki masyarakat Aceh sangat banyak, di antaranya dalam bidang obat-obatan, teknologi tepat guna, aditif dalam makanan dan produk olahan makanan khas Aceh.

Propinsi Aceh kaya akan keragaman makanannya, kekhasan produk olahan makanan di propinsi Aceh umumnya menggunakan bahan dari rempah dan tumbuhan yang memiliki khasiat bioaktif. Potensi ini dapat dikaji melalui aspek etnokimia khususnya dalam kajian ilmu pangan dan ilmu gizi. Kajian etnokimia tersebut dapat dikembangkan dan dikaji proses kimiawi yang berlangsung. Pada beberapa produk olahan pangan dan penerapan teknologi pengolahan pangan di Aceh, telah melibatkan proses kimiawi, seperti proses produksi minyak kelapa dari hasil fermentasi kelapa (*minyek simplah dan minyuk pliek u*) seperti peran kadar air dalam *pliek u*, kandungan asam lemak bebas, peran bilangan iod, bilangan peroksida, hidrolisis dan oksidasi minyak (Arpi & Niviasari, 2013), proses dehidrasi pada belimbing wuluh yang dikeringkan (*asam sunti*), penggunaan asam cuka pada olahan daging (*sie reuboh*), proses pengawetan ikan kering (*keumamah*) melalui penambahan abu dapur dan proses pembuatan *pisang sale* (Silvini, dkk., 2020). Aspek-aspek kimia tersebut tanpa disadari oleh siswa telah ada disekitar mereka dan bahkan telah berlangsung jauh secara turun temurun dalam tradisi pengolahan produk olahan makanan di Aceh selama puluhan tahun.

Kajian kurikulum SMK dan observasi dilakukan pada beberapa SMK di Aceh timur sebagai bagian dari analisis kebutuhan untuk pengembangan modul. Berdasarkan analisis tersebut, diperoleh bahwa beberapa program kompetensi, mata pelajaran kimia tidak tersedia dan tidak diajarkan, pada program kompetensi kuliner khususnya program keahlian boga, mata pelajaran kimia tidak diajarkan secara khusus, konsep kimia diajarkan secara integratif dalam mata pelajaran IPA. Sehingga pemahaman siswa terhadap proses-proses kimia yang berlangsung dalam kehidupan dan proses aplikatif pangan lainnya tidak diketahui dan sering diabaikan atau bahkan tidak disadari keberadaannya. Hasil analisis kebutuhan dilaporkan bahwa 25% siswa di SMK Negeri Aceh Timur tidak mengenal beberapa produk pangan Aceh dan 78% siswa tidak menyadari proses kimia yang berlangsung dalam beberapa produk pangan tersebut (Jofrishal & Seprianto, 2018). Permasalahan tersebut menjadi landasan untuk mengembangkan modul kimia pangan melalui pendekatan etnokimia.

Penerapan modul sebagai bahan ajar pelengkap bagi siswa telah banyak dilakukan dengan berbagai pendekatan dan terbukti dapat meningkatkan kreativitas (Lahra, dkk., 2017), keterampilan proses sains (Furqan, dkk., 2016), hasil belajar (Husna, dkk., 2020) kemampuan berpikir tingkat tinggi dan kognitif (Puspitasari & Nugroho, 2020) peserta didik. Penggunaan modul kimia pangan dengan pendekatan etnokimia diharapkan mampu untuk

meningkatkan pemahaman siswa terhadap konsep-konsep kimia yang ada dalam kehidupan sehari-hari serta dapat meningkatkan kemampuan literasi sains siswa.

Berdasarkan uraian di atas, maka penelitian ini bertujuan untuk mengetahui pengaruh proses implementasi modul kimia pangan berbasis etnokimia terhadap siswa dengan cara melakukan analisis tingkat pemahaman mereka pada konsep kimia yang terintegrasi dalam proses etnokimia dan analisis efektivitas proses pembelajarannya. Selanjutnya, dengan menggunakan modul kimia berbasis etnokimia dan mengetahui tingkat pemahaman dan kesadaran siswa terhadap etnokimia dan proses sains yang teraplikasi di dalamnya. Modul kimia pangan ini nantinya dapat menjadi bahan ajar untuk mengenalkan produk-produk pangan kekhasan daerah melalui pembelajaran kimia pangan dan ilmu gizi serta menumbuhkan kesadaran dan pemahaman siswa mengenai proses-proses kimia yang berlangsung di dalam proses pembuatan produk pangan tersebut.

## METODE

Penelitian dilakukan pada salah satu SMK di Kabupaten Aceh Timur, untuk bidang kompetensi tata boga. Jumlah populasi sebanyak 100 orang dengan sampel 60 orang pada kelas X dari dua kelompok yang berbeda. Sampling dilakukan melalui teknik random untuk siswa pada kelas X yang mempunyai kemampuan yang sama. Jenis penelitian adalah kuantitatif deskriptif, sedangkan pendekatan yang digunakan adalah komparatif, pendekatan ini bertujuan untuk membandingkan kelas kontrol dan kelas eksperimen. Teknik pengumpulan data dilakukan dengan instrumen tes berupa soal kimia berbentuk *multiple choice*. Pengukuran hasil tes dilakukan dengan menghitung rata-rata nilai pada setiap kelas, kelas eksperimen mendapat perlakuan melalui proses pembelajaran dengan menggunakan modul kimia pangan berbasis etnokimia, sedangkan kelas kontrol mendapat perlakuan dengan menggunakan modul kimia pangan umum. Pengukuran tingkat pemahaman terhadap materi kimia dan pemahaman terhadap nilai aspek budaya dilakukan dengan membandingkan hasil *post test* dan *pre test* pada masing-masing kelas. Analisis statistik yang digunakan adalah uji t dengan jenis *independent sample t test* berbeda varian (*unequal variance*), perbedaan varian ditentukan dengan menggunakan uji F. Pengukuran efektivitas proses pembelajaran dilakukan dengan menggunakan teknik observasi, yaitu dengan menggunakan lembar observasi terstruktur untuk melihat aktivitas siswa selama proses pembelajaran. Teknik analisis data untuk hasil observasi adalah dengan menggunakan persentase perolehan hasil observasi per skor maksimal, hasil perhitungan dikategorikan berdasarkan tingkat persentase tertentu dari kriteria sangat baik hingga gagal (Arikunto, 2006). Pengukuran terhadap pemahaman budaya dan kesadaran terhadap proses sains yang berlangsung diperoleh dengan menggunakan teknik wawancara. Wawancara dilakukan dengan menggunakan lembar panduan wawancara terstruktur yang diterapkan kepada responden. Hasil awal wawancara berupa narasi, kemudian direvisi dan dikategorikan dalam bentuk jumlah persentase kelompok.

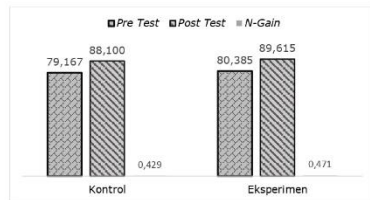
## HASIL DAN PEMBAHASAN

Penelitian ini merupakan bagian dari tahapan penelitian sebelumnya tentang pengembangan modul kimia pangan pada tahap implementasi. Pada tahap ini, hasil belajar, efektivitas proses pembelajaran dan pemahaman siswa terhadap konsep etnokimia diukur dan dianalisis untuk melihat pengaruh penerapan modul dalam proses pembelajaran.

### 1) Hasil Belajar Siswa

Salah satu cara pengukuran efektivitas implementasi modul dalam proses pembelajaran adalah dengan pengukuran terhadap kemampuan siswa dalam memahami

materi (Astuti, 2016). Materi dalam modul terdiri atas materi kimia dan materi etnokimia yang disajikan secara terintegrasi. Pengukuran terhadap kemampuan pemahaman konten telah dilakukan pada kelas eksperimen dan kontrol, masing-masing kelas memperoleh perlakuan yang berbeda. Pada kelas kontrol siswa di berikan bahan ajar buku kimia pangan yang umum dan sering digunakan oleh guru sedangkan pada kelas eksperimen siswa diberikan bahan ajar berupa modul etnokimia pangan. Keberhasilan pengukuran terhadap tingkat pemahaman konsep kimia dalam kajian ilmu pangan ditentukan berdasarkan hasil *post test* dan *pre test* siswa. Masing-masing kelas memperoleh soal yang sama yaitu soal kimia dengan konsep unsur dan senyawa, konsep asam-basa, reaksi-reaksi kimia, karbohidrat, protein, lemak dan sifat koligatif larutan. Pada Gambar 1 dapat dilihat perbedaan perolehan hasil belajar siswa pada kedua kelas. Hasil pengukuran *pre test* siswa pada kelas kontrol diperoleh selisih hasil sebesar 8,933 atau meningkat 11,284% dibandingkan hasil *post test* pada kelas tersebut. Sementara itu, hasil *pretest* pada kelas eksperimen diperoleh selisih sebesar 9,230 atau meningkat sebesar 11,482% dibandingkan hasil *post test*. Hasil ini sesuai dengan temuan penelitian yang dilaporkan oleh Furqan, dkk. (2016) dan Husna, dkk. (2020), bahwa dengan menerapkan modul bahan ajar dapat meningkatkan hasil belajar siswa. Kelebihan penggunaan modul bersifat *self instructional* ini, dijelaskan oleh Demirci (2009) bahwa perbedaan hasil belajar ini dipengaruhi oleh pendekatan konstruktivisme yang diterapkan pada siswa pada kelas eksperimen, di mana perbedaan ini menunjukkan adanya peningkatan dan perbedaan pemahaman siswa terhadap konsep-konsep tertentu antara siswa dengan penerapan modul dibandingkan penggunaan buku teks (Ugur & Fitnat, 2008).



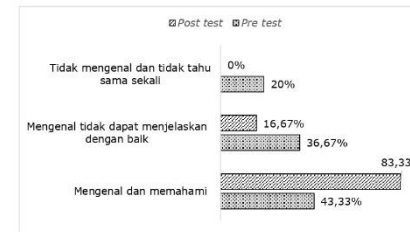
Gambar 1. Hasil *pre test*, *post test* dan *N-Gain* pada kelas kontrol dan eksperimen.

Analisis secara statistik digunakan untuk memperkuat asumsi signifikansi komparatif pada kedua kelas, penentuan hipotesis statistik dilakukan dengan menentukan rincian terhadap definisi  $H_0$  dan  $H_1$ . Pada  $H_0$  hipotesis yang disusikan adalah "tidak terdapat perbedaan secara signifikan pada kedua kelas" sedangkan untuk  $H_1$  hipotesis statistiknya adalah "terdapat perbedaan yang signifikan pada kedua kelas". Dengan anggapan kedua data berdistribusi normal, maka dilakukan pengujian *t test* dengan jenis independent *t test* pada kedua arah. Agar operasi dapat dijalankan dengan optimal, terlebih dahulu ditentukan perbedaan varian dari kedua sampel. Penggunaan uji *F* dilakukan untuk memperoleh keadaan varian yang akan diukur, berdasarkan hasil pengukuran diperoleh  $F_{hitung} = 1,892$  dan  $F_{tabel} = 3,172$ , karena  $F_{hitung} < F_{tabel}$  maka kedua data tidak mempunyai varian yang sama (*unequal variance*). Setelah memperoleh hasil uji varian pada sampel,

maka ditentukan rumus uji *t* yang digunakan adalah rumus *spareded varians*, dengan  $df = 46$  dan  $\alpha = 0,05$  maka hasil uji *t* diperoleh sebesar 0,277 sedangkan nilai pada tabel *t* diperoleh sebesar 1,679. Dengan demikian, didapat bahwa nilai  $t_{tabel} > t_{hitung}$ , sehingga  $H_0$  diterima dan  $H_1$  ditolak. Artinya tidak terdapat perbedaan yang signifikan pada kedua kelas, meskipun tidak terdapat perbedaan secara signifikan, status perolehan nilai pada kedua kelas dapat dikategorikan terdapat perbedaan.

## 2) Pemahaman Etnokimia

Analisis pemahaman etnokimia dilakukan sebagai upaya memperkuat hipotesis penelitian, pengukuran dilakukan untuk mengukur pemahaman siswa terhadap budaya lokal dan kesadaran akan proses sains yang berlangsung di dalamnya. Proses untuk mendapatkan informasi tentang penguasaan siswa terhadap konsep budaya khususnya kuliner dan kaitannya dengan konsep kimia dilakukan dengan menggunakan wawancara terstruktur. Proses wawancara dilakukan diluar jam belajar secara personal. Jumlah responden sebanyak 30 orang dengan latar belakang budaya umumnya dari suku Aceh, dan beberapa dari suku Jawa. Data hasil analisis pemahaman etnokimia siswa seperti pada Gambar 2 dibawah. Berdasarkan hasil wawancara terhadap siswa pada kelas eksperimen setelah penerapan modul, diperoleh bahwa sebanyak 83,333% (25 orang) responden mengenal aspek budaya kuliner serta memahami proses sains yang terlibat di dalamnya sedangkan sebanyak 16,667% (5 orang) responden mengenal aspek budayanya namun tidak dapat menjelaskan dengan baik proses sains yang berlangsung di dalamnya. Perolehan hasil ini lebih baik dari wawancara yang dilakukan sebelum proses penerapan modul dilakukan. Hasil wawancara sebelum penerapan diperoleh bahwa sebanyak 43,333% (13 orang) responden mengenal aspek budaya kuliner serta memahami proses sains yang terlibat di dalamnya, 36,667% (11 orang) responden mengenal namun tidak dapat menjelaskan dengan baik dan 6 orang atau 20% tidak mengenal dan tidak tahu sama sekali. Hasil ini menunjukkan bahwa penerapan modul pembelajaran kimia pangan berbasis etnokimia sangat baik untuk digunakan sebagai modul pembelajaran konsep kimia terintegrasi budaya untuk mengenalkan budaya pada generasi muda disamping untuk mengajarkan konsep kimia dan menumbuhkan kesadaran sains siswa.



Gambar 2. Perbedaan tingkat pemahaman siswa sebelum dan sesudah penerapan modul etnokimia

### 3) Efektivitas Proses Pembelajaran

Analisis terhadap efektivitas proses pembelajaran dengan menggunakan modul dan tanpa modul dilakukan untuk melihat efektivitas modul dalam menunjang proses pembelajaran di dalam kelas. Pengukuran efektivitas, dilakukan dengan menggunakan lembar observasi proses pembelajaran. Penilaian dilakukan terhadap aktifitas siswa selama proses pembelajaran yang terdiri atas kemampuan menyampaikan pendapat, memecahkan masalah, merumuskan kesimpulan dan keaktifan siswa secara umum. Pada Tabel 1, ditampilkan data hasil pengukuran efektifitas pembelajaran pada kelas kontrol dan kelas eksperimen. Nilai disajikan dalam bentuk skor dengan kriteria "buruk" (30-39) hingga "sangat baik" (80-100), hasil observasi terhadap efektivitas proses pembelajaran, diperoleh skor rata-rata untuk kelas kontrol sebesar 80,940 dengan kriteria sangat baik sedangkan kelas eksperimen memperoleh nilai rata-rata sebesar 89,532 dengan kriteria sangat baik. Meskipun memperoleh perolehan nilai observasi yang sama-sama dikategorikan sangat baik, efektivitas pembelajaran pada kelas eksperimen lebih tinggi dari kelas kontrol. Hal ini dilihat berdasarkan aktivitas diskusi kelompok yang dilakukan siswa pada kelas eksperimen nampak lebih hidup dibandingkan kelas kontrol.

Tabel 1. Hasil pengukuran efektivitas proses pembelajaran

No	Kelas	Penilai 1	Penilai 2	Rerata
1	Kontrol	79,780	82,100	80,940
2	Eksperimen	89,532	89,532	89,532

Sesuai dengan tujuan akhir pengembangan modul yaitu untuk memudahkan siswa dalam menguasai konsep ilmu kimia melalui pendekatan budaya, peningkatan hasil belajar berbanding lurus dengan pemahaman budaya yang dikuasai siswa. Siswa dapat lebih mudah menghubungkan konsep ilmu kimia yang didapat di kelas dengan pengalaman yang dirasakan sehari-hari. Penelitian ini didukung oleh laporan yang dipublikasikan oleh Rosa & Orey (2011) dan Ajayi, dkk. (2017) di mana dengan menerapkan modul dan pembelajaran melalui pendekatan etnokimia dapat meningkatkan efektivitas pembelajaran di kelas dan hasil belajar siswa. Peningkatan aktivitas pembelajaran ini pula dapat meningkatkan kompetensi siswa secara kognitif, afektif dan psikomotorik (Febriana, dkk., 2014; Rahmawati, dkk., 2017).

### KESIMPULAN

Berdasarkan hasil implementasi modul terhadap penguasaan materi kimia, pemahaman budaya dan efektivitas pembelajaran, dapat disimpulkan sebagai berikut:

1. Hasil belajar siswa pada kelas eksperimen secara rata-rata lebih tinggi dibandingkan kelas kontrol, meskipun hasil pengujian statistik tidak menunjukkan perbedaan signifikan.
2. Skor hasil observasi efektivitas pembelajaran pada kelas eksperimen lebih tinggi dibandingkan kelas kontrol yaitu sebesar 89,532 dengan kriteria sangat baik.
3. Pengukuran terhadap pemahaman etnokimia siswa setelah penerapan modul diperoleh peningkatan sebesar 40 point dibandingkan sebelum penerapan modul yang menunjukkan peningkatan pemahaman dan kesadaran siswa terhadap etnokimia dan proses sains yang berlangsung di dalamnya.

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# 05 Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbasis Etnokimia Terhadap Hasil Belajar Kimia Siswa Kelas XI di MA Al-Aziziyah Putra Kapek Gunungsari

## CHEMISTRY EDUCATION PRACTICE

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### PENGARUH MODEL PEMBELAJARAN INKUIRI TERBIMBING BERBASIS ETNOKIMIA TERHADAP HASIL BELAJAR KIMIA SISWA KELAS XI DI MA AL-AZIZIYAH PUTRA KAPEK GUNUNGSARI

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#### Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran inkuiri terbimbing berbasis etnokimia terhadap hasil belajar kimia siswa kelas XI di MA Al-Aziziyah Putra Kapek Gunungsari Tahun Ajaran 2019/2020. Jenis penelitian ini adalah eksperimen semu dengan desain penelitian *pre-test dan post-test Nonequivalent Control Group Design*. Populasi dalam penelitian ini adalah seluruh siswa kelas XI MIA di MA Al-Aziziyah Putra Kapek Gunungsari. Kelas XI MIA 1 dipilih sebagai kelas eksperimen dan kelas MIA 2 sebagai kelas kontrol dengan teknik sampling jenuh. Kelas eksperimen diberikan perlakuan berupa pembelajaran dengan menggunakan model pembelajaran inkuiri terbimbing berbasis etnokimia sedangkan kelas kontrol dengan menggunakan model konvensional. Instrumen yang digunakan dalam penelitian ini adalah tes pengetahuan kognitif tipe pilihan ganda. Hasil uji hipotesis dengan menggunakan uji Mann Whitney (Uji U) menunjukkan bahwa  $Z_{hitung} < Z_{tabel}$  ( $1,41 < 1,99$ ) pada taraf signifikansi 5 % yang berarti  $H_0$  diterima dan  $H_a$  ditolak. Hasil dapat disimpulkan bahwa tidak ada pengaruh model pembelajaran inkuiri terbimbing berbasis etnokimia terhadap hasil belajar kimia siswa kelas XI di MA Al-Aziziyah Putra Kapek Gunungsari tahun ajaran 2019/2020.

**Kata Kunci:** Inkuiri Terbimbing, Etnokimia, Hasil Belajar

#### The Effect of Guided Inquiry Learning Based Ethnochemistry on Learning Outcomes of Class XI Students in MA Al-Aziziyah Putra Kapek Gunungsari Academic Year 2019/2020

#### Abstract

This research aims to study the effect of ethnochemistry-based guided inquiry learning models on chemistry learning outcomes of class XI students in MA Al-Aziziyah Putra Kapek Gunungsari Academic Year 2019/2020. The research was quasi-experimental with *Pre-test and Post-test Nonequivalent Control Group Design*. The populations were all students of class XI MIA at MA Al-Aziziyah Putra Kapek Gunungsari. Class XI MIA 1 was chosen as an experimental class and MIA 2 class as a control class using saturated sampling techniques. The experimental class was given treatment by using ethnochemistry guided inquiry learning models whereas the control class was treated by conventional models. A multiple choice type cognitive knowledge test was used as a research instrument. The results of hypothesis testing using the Mann Whitney test (U Test) show that  $Z_{count} < Z_{table}$  ( $1.41 < 1.99$ ) at a significant level of 5 % which means that  $H_0$  is accepted whereas  $H_a$  is rejected. In conclusion, there is no influence of ethnochemistry-based guided inquiry learning model on chemistry learning outcomes of class XI students at MA Al-Aziziyah Putra Kapek Gunungsari Academic Year 2019/2020.

**Keywords:** Guided Inquiry, Ethnochemistry, Learning Outcomes

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Hidayatussani, Hadisaputra, Idrus

#### PENDAHULUAN

Kimia merupakan cabang ilmu pengetahuan alam yang sangat penting karena sangat erat hubungannya dalam kehidupan sehari-hari. Namun, memiliki karakteristik materinya yang bersifat abstrak, melibatkan konsep-konsep teori, hitungan dan penggunaan rumus (Chang, 2005). Hal ini menyebabkan sebagian besar siswa menganggap kimia sebagai mata pelajaran yang sulit dan membosankan. Selain itu, pembelajaran kimia di sekolah masih bersifat konvensional (berpusat pada guru). Hal ini berdampak pada rendahnya hasil belajar siswa dan sikap siswa terhadap pelajaran kimia negatif (Nortia, 2012).

Berdasarkan hasil observasi dan wawancara dengan guru mata pelajaran kimia di MA Al-Aziziyah Putra bahwa rendahnya hasil belajar kimia siswa di MA Al-Aziziyah Putra. Hal ini dapat dilihat dari data ringkasan hasil Ulangan Tengah Semester siswa kelas X MIA pada Tabel 1.

**Tabel 1.** Nilai Rata-Rata Ulangan Tengah Semester Mata Pelajaran Kimia Siswa Kelas X MIA di MA Al-Aziziyah Putra Kapek Gunungsari

No.	Kelas	Nilai Rata-rata	Jumlah siswa
1.	X MIA 1	58,71	31
2.	X MIA 2	60,17	30

Rendahnya hasil belajar siswa tersebut terkait dengan komponen-komponen pembelajaran kimia di Sekolah, diantaranya kurikulum, media, pendekatan, model dan evaluasi (Yupani, 2012). Proses pembelajaran yang sering digunakan di Sekolah yaitu menggunakan metode ceramah dan diskusi dua arah yang lebih terpusat pada guru. Pembelajaran kimia selama ini dimulai dengan guru menyampaikan materi, kemudian siswa diberikan tugas untuk dikerjakan di rumah (PR) sebagai bahan belajar di rumah yang kemudian dijawab bersama-sama dengan cara maju kedepan dan menjelaskannya. Selain itu, pembelajaran dengan praktikum jarang dilakukan. Siswa hanya sebagai penerima informasi, sehingga membuat siswa kurang berpikir atau dengan kata lain pembelajaran dirasakan kurang bermakna. Guru juga menantikan siswa menuliskan beberapa konsep kimia, sehingga membuat guru siswa

dapat menyelesaikan permasalahan-permasalahan dalam bentuk soal dengan baik. Partisipasi siswa dalam pembelajaran kimia yang rendah menunjukkan masih banyak siswa yang belum aktif mengikuti pembelajaran di kelas (Alfiana dkk, 2019).

Beberapa faktor penyebab rendahnya hasil belajar tersebut, maka sangatlah penting bagi pendidik untuk memahami karakteristik materi, siswa dan penilaian model pembelajaran. Dengan demikian, pembelajaran akan lebih variatif, inovatif dan konstruktif dalam membimbing siswa (Yupani, 2012). Tujuan pembelajaran dapat tercapai ditentukan oleh banyaknya faktor, salah satunya didukung oleh penggunaan model pembelajaran yang sesuai. Salah satu model pembelajaran yang mengeksplorasi pengetahuan awal siswa adalah model pembelajaran inkuiri terbimbing berbasis etnokimia pada materi hidrokarbon.

Pembelajaran inkuiri merupakan pembelajaran yang berpusat pada siswa (Suyati, 2010). Model pembelajaran inkuiri melibatkan siswa secara maksimal dalam proses pembelajaran dan keterkaitan kegiatan secara logis dan sistematis serta mengembangkan sikap percaya pada diri siswa (Syarifuddin, 2018). Penerapan model pembelajaran inkuiri terbimbing adalah model pembelajaran yang menekankan pada pengalaman-pengalaman belajar yang mendorong siswa dapat menemukan konsep-konsep dan prinsip serta pembelajaran yang melibatkan beberapa metode pembelajaran untuk memberikan pengalaman belajar yang bermakna untuk siswa (Hayati, 2019).

Tujuan dasar inkuiri yaitu mengembangkan kemampuan berpikir siswa secara sistematis, logis dan kritis atau mengembangkan kemampuan intelektual sebagai bagian dari mental, akibatnya dalam pembelajaran inkuiri, siswa tidak hanya diminta agar menguasai pelajaran, akan tetapi siswa dapat menggunakan potensi yang dimilikinya (Trianto, 2014). Muminingsih, 2016 menyatakan pembelajaran inkuiri yang berorientasi pada penyelidikan dapat meningkatkan hasil prestasi belajar siswa.

Statistik model inkuiri terbimbing yaitu (1) Orientasi merupakan langkah membina suasana pembelajaran yang responsive, (2) Merumuskan masalah merupakan tahapan dimana siswa akan diajak untuk merumuskan masalah dengan proses berpikir, (3) Merumuskan hipotesis, hipotesis adalah

jawaban sementara dari suatu permasalahan yang sedang dikaji, (4) Mengumpulkan data adalah aktivitas mengambil informasi dalam rangka menguji kebenaran hipotesis yang diajukan, (5) Menguji hipotesis adalah proses menentukan jawaban yang dianggap diterima sesuai dengan data atau informasi yang diperoleh dari upaya siswa untuk mengumpulkan data, dan (6) Merumuskan kesimpulan adalah proses mendeskripsikan temuan yang diperoleh berdasarkan hasil pengujian hipotesis (Hartono, 2014).

Pembelajaran kimia yang memperhatikan kearifan lokal merupakan salah satu hal yang perlu diperhatikan dalam pengembangan kurikulum di Indonesia, khususnya dalam kurikulum kimia tingkat Sekolah Menengah Atas dan Lembaga Pendidik Tenaga Kependidikan (Sudamin, 2015). Kearifan lokal adalah segala nilai, konsep dan teknologi yang telah dimiliki suatu bangsa sebelum mendapat pengaruh asing (Sedyawati, 1986). Sedangkan menurut Rahyono (dalam Atmaja, 2011) kearifan lokal merupakan butir-butir kecerdasan atau kebijaksanaan asli yang dihasilkan oleh suatu masyarakat budaya. Jadi kearifan lokal adalah segala nilai, konsep dan teknologi yang asli yang memang telah dimiliki oleh suatu masyarakat budaya yang diterapkan dalam kehidupan sehari-hari.

Model pembelajaran inkuiri terbimbing berbasis etnokimia (kearifan lokal) dapat menciptakan lingkungan belajar yang kondusif untuk mempermudah pembelajaran karena mengaitkan antara budaya lokal dan materi kimia (Wiyanto 2017). Pembelajaran inkuiri bermuatan kearifan lokal merupakan model pembelajaran yang bertujuan untuk menciptakan lingkungan-lingkungan untuk mempermudah pembelajaran dengan mengaitkan antara budaya dan materi kimia. Model pembelajaran inkuiri bermuatan kearifan lokal mengajak siswa untuk berinteraksi langsung dengan budaya lokal dan menggali ilmu pengetahuan yang ada pada budaya lokal tersebut (Imansari, 2017).

Berdasarkan latar belakang di atas, maka judul dari penelitian yang akan dilakukan yakni "pengaruh model pembelajaran inkuiri terbimbing berbasis etnokimia terhadap hasil belajar kimia siswa kelas XI di MA Al-Aziziyah Putra Kapek Gunungasari."

#### METODE PENELITIAN

Penelitian ini dimulai dengan tahap perencanaan penelitian dari bulan Mei 2019 dan pelaksanaan penelitian pada bulan Juli 2019 bertempat di MA Al Aziziyah Putra Kapek Gunungasari pada siswa kelas XI MIA tahun ajaran 2019/2020.

Jenis penelitian yang digunakan dalam penelitian ini adalah eksperimen semu bentuk *Pre-test and Post-test Nonequivalent Control Group Design*. Rancangan penelitian dilakukan pada dua kelas, yaitu satu kelas sebagai kelas eksperimen dan satu kelas lainnya sebagai kelas kontrol. Kelas eksperimen diberi perlakuan berupa pembelajaran dengan model pembelajaran inkuiri terbimbing berbasis etnokimia sedangkan pada kelas kontrol menggunakan model pembelajaran konvensional.

Variabel yang diamati dalam penelitian ini berupa variabel bebas dan variabel terikat. Variabel bebas merupakan variabel yang mempengaruhi atau yang menjadi sebab perubahannya (Sugiyono 2015), variabel yang dimaksud adalah model pembelajaran inkuiri terbimbing berbasis etnokimia. Variabel terikat merupakan variabel yang dipengaruhi atau menjadi akibat, variabel yang dimaksud adalah hasil belajar. Pembelajaran materi hidrokarbon pada kedua kelas.

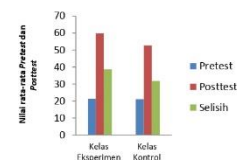
Populasi dalam penelitian ini adalah seluruh siswa kelas XI MIA MA Al Aziziyah Putra Kapek Gunungasari yang terdiri dari dua kelas, yaitu XI MIA 1, XI MIA 2 yang seluruhnya berjumlah 58 siswa. Sampel yang digunakan sebanyak 2 kelas yaitu kelas XI MIA 1 sebagai kelas eksperimen dan XI MIA 2 sebagai kelas kontrol. Sampel ditentukan setelah uji homogenitas terlebih dahulu, sehingga diperoleh sampel yang homogen. Metode sampling yang digunakan dalam penelitian ini sampling jenuh.

Penelitian ini menggunakan instrumen berupa tes hasil belajar dalam bentuk pilihan ganda. Instrumen yang telah disusun terlebih dahulu diuji validitas dan reliabilitasnya. Uji validitas ada dua yaitu validitas isi dan validitas empiris. Validitas isi dengan menggunakan rumus Aikens'V sedangkan untuk validitas empiris menggunakan korelasi biserial. Uji reliabilitas soal dengan menggunakan KR-20 kriteria tertentu. Peningkatan hasil belajar akan diobservasi berdasarkan nilai *pre-test* dan *post-test* dengan

melihat sejauh mana peningkatan nilai yang dilihat dari selisih nilai *pre-test* dan *post-test* menggunakan *N-gain*. Uji hipotesis dalam penelitian ini menggunakan uji-U, dilakukan setelah data diuji normalitas dan homogenitas terlebih dahulu.

#### HASIL DAN PEMBAHASAN

Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran inkuiri terbimbing berbasis etnokimia terhadap hasil belajar kimia siswa pada materi pokok hidrokarbon. Penelitian ini dilakukan pada siswa kelas XI MA Al Aziziyah Putra Kapek Gunungasari tahun ajaran 2019/2020. Nilai rata-rata hasil *pre-test* dan *post-test* kelas sampel disajikan pada Gambar 1.



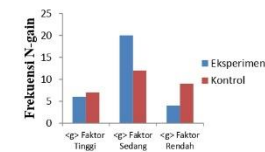
Gambar 1. Data Hasil *Pre-test* dan *Post-test*

Berdasarkan Gambar di atas menunjukkan bahwa peningkatan hasil belajar kelas eksperimen lebih tinggi daripada kelas kontrol. Hal ini karena model pembelajaran inkuiri terbimbing berbasis etnokimia memberikan kesempatan pada siswa untuk menemukan sendiri konsep yang ada pada materi yang dipelajarinya (Triyanto, 2014).

Materi yang dipelajarinya dikaitkan dengan fenomena-fenomena yang sering dijumpai siswa dalam kehidupan sehari-harinya, sehingga siswa tertarik dan bersemangat dalam belajar serta lebih mudah memahami materi hidrokarbon (Pamungkas, 2017). Menurut Novak (2007) menyatakan bahwa rekonstruksi konseptual dapat terjadi jika terjadi pembelajaran yang bermakna. Kearifan lokal merupakan kegiatan yang mengaitkan sains asli (pengetahuan yang berkembang di masyarakat) menjadi sains ilmiah (Rahayu dan Sudamin, 2015). Dengan demikian siswa menjadi lebih bersemangat,

mudah memahami materi, dan lebih lama mengingat materi pelajaran.

Berdasarkan kualifikasi nilai raport kelas eksperimen dengan nilai rata-rata 59,80 termasuk kedalam kategori cukup sedangkan untuk kelas kontrol dengan nilai rata-rata 52,73 kategori kurang. Selain itu dilihat juga dari tingkat pemahaman siswa terhadap materi yang diberikan dapat diperoleh melalui besaran rata-rata *N-gain* ternormalisasi <math>\langle g \rangle</math> pada kedua kelas sampel. Kelas eksperimen lebih besar daripada kelas kontrol yaitu 0,49 dan 0,40. Hal ini didukung oleh frekuensi data nilai *N-gain* siswa dari kedua kelas sampel ditunjukkan pada Gambar 2.



Gambar 2. Sebaran Frekuensi Nilai N-Gain Siswa

Berdasarkan Gambar 1.2 di atas menunjukkan bahwa siswa pada kelas eksperimen lebih optimal dalam memahami materi dibandingkan kelas kontrol. Meskipun pemahaman siswa pada kedua kelas dalam kategori belum memuaskan.

Berdasarkan hasil uji statistik data hasil *post-test* didapatkan nilai  $\chi^2_{hitung}$  untuk kelas XI MIA 1 dan XI MIA 2 berturut-turut adalah 114,73 dan 176,84 kemudian keduanya dikonsultasikan dengan  $\chi^2_{tabel}$  dengan taraf signifikansi 5% ( $dk = 5$ ) diperoleh  $\chi^2_{tabel}$  sebesar 11,07. Oleh karena kedua kelas memiliki nilai  $\chi^2_{hitung} > \chi^2_{tabel}$  maka data hasil *post-test* diasumsikan tidak terdistribusi normal.

Uji homogenitas varians dihitung dengan menggunakan uji-F. Nilai  $F_{hitung}$  yang diperoleh adalah 1,81 dengan nilai  $F_{tabel}$  pada taraf signifikansi 5% sebesar 1,89. Nilai  $F_{hitung}$  (1,81) <  $F_{tabel}$  (1,89) pada taraf signifikansi 5% maka data yang diperoleh merupakan data yang homogen.

Pengujian hipotesis dilakukan dengan menggunakan uji Mann-Whitney (Uji-U).

Diperoleh nilai  $Z_{hitung} = 1,41$ . Nilai  $Z_{hitung}$  dikonsultasikan dengan harga  $Z_{tabel}$  pada taraf signifikansi 5 % dan dk = 58 yaitu sebesar 1,99. Nilai  $Z_{hitung} < Z_{tabel}$  hal ini menunjukkan bahwa uji hipotesis berada pada daerah penerimaan  $H_0$  yang menyatakan bahwa "Model pembelajaran inkuiri terbimbing berbasis masalah tidak memberikan pengaruh yang lebih baik daripada model pembelajaran konvensional terhadap hasil belajar kimia siswa kelas XI di MA Al Aziziyah Putra Kapek Gumung Sari."

Hasil penelitian ini tidak sejalan dengan penelitian yang telah dilakukan oleh Wijayanti dkk (2014) tentang penggunaan model pembelajaran inkuiri terbimbing berbasis kearifan lokal.

Faktor-faktor yang menyebabkan tidak ada pengaruh penggunaan model, diantaranya ketidakdaksipaan sebagian siswa dalam melakukan proses pembelajaran inkuiri yang menuntut siswa untuk berperan aktif dalam proses pembelajaran sehingga siswa masih membutuhkan penyesuaian saat proses pembelajaran. Selain itu, siswa masih terbawa dengan metode yang biasa digunakan oleh guru di Sekolah. Siswa tidak terbiasa dengan belajar mandiri. Hal ini dapat dilihat pada proses pembelajaran siswa masih membutuhkan bantuan guru dalam memecahkan masalah. Siswa lebih cenderung melakukan pembelajaran secara individu bukan secara berkelompok, sehingga siswa yang memiliki minat belajar rendah sulit berinteraksi secara aktif. Siswa bergantung dan menyerahkan tugas kepada sebagian anggota saja yang seluasnya diselesaikan bersama semua anggota kelompok.

Masalah yang mendasar yang diduga menjadi penyebab ketidakberhasilan penelitian ini yaitu pelaksanaan sintak pembelajaran inkuiri terbimbing belum terlaksana dengan maksimal atau baik. Hal ini disebabkan karena jani pembelajaran kimia hanya sedikit yang terbagi dengan waktu yang lain. Salah satu kelemahan inkuiri terbimbing menurut Shoimin (2014) yaitu membutuhkan waktu yang lama.

Pertama, tahap orientasi semua siswa diharapkan dapat terlibat aktif dalam

pembelajaran dengan kelompok. Namun, tidak semua siswa terlibat aktif dalam pembelajaran.

Kedua, tahap merumuskan masalah yang diharapkan siswa sudah mulai proses berpikir terkait dengan masalah yang diberikan. Namun, tidak semua siswa memiliki kemampuan dalam memecahkan masalah.

Ketiga, tahap merumuskan hipotesis yang diharapkan siswa bersama anggota kelompok merumuskan jawaban sementara dari permasalahan yang diberikan. Proses diskusi tidak berjalan dengan baik karena beberapa siswa dalam kelompok tidak terlibat aktif hanya sebagian kecil siswa yang mencoba merumuskan hipotesis.

Keempat, tahap mengumpulkan data dimana mengharuskan siswa untuk berperan aktif dalam mencari sumber informasi terkait materi yang dipelajari. Namun, tahap ini juga tidak terlaksana dengan maksimal, tidak semua siswa terlibat aktif dalam mencari informasi dan hanya satu atau dua kelompok saja yang terlihat kompak dalam berdiskusi.

Kelima, tahapan menguji hipotesis diharapkan mampu melatih siswa untuk berani mengungkapkan pendapatnya sendiri. Menurut Suheman (2008), belajar tidak cukup dengan hanya mendengar dan melihat tetapi harus dengan melakukan aktivitas (membaca, bertanya, menjawab, berkommentar, mengerjakan, presentasi, mengkomunikasikan dan diskusi). Pada tahap ini hanya satu dan dua siswa yang berani mengangkat tangan untuk memberikan sanggahan. Sementara siswa yang lain melakukan kegiatan lain seperti menyelesaikan pertanyaan yang belum selesai, mengobrol atau hanya diam mengamati saja.

Faktor lain yang menyebabkan tidak berhasilnya penelitian ini yaitu pertama, karena kelemahan dari model pembelajaran inkuiri terbimbing itu sendiri. (1) Pembelajaran dengan inkuiri memerlukan kecerdasan siswa yang tinggi. Bila siswa kurang cerdas hasil pembelajarannya kurang efektif. (2) Guru dituntut mengubah kebiasaan mengajar yang umumnya sebagai pemberi informasi menjadi fasilitator, motivator, dan pembimbing siswa dalam belajar. (3) Karena dilakukan secara kelompok, kemungkinan ada anggota yang kurang aktif. (4) Membutuhkan waktu yang lama dan hasilnya kurang efektif jika pembelajaran ini diterapkan pada siswa kelas yang kurang mendukung (Shoimin, 2014).

Kedua, kurangnya sarana dan prasarana belajar. Sebagaimana yang dikatakan oleh Sanjaya (2010) bahwa kelengkapan sarana dan prasarana akan membantu siswa yang memiliki kemampuan lemah dan membantu guru dalam menyelenggarakan pembelajaran.

Ketiga yaitu sistem kegiatan pembelajaran di Pondok Pesantren itu sendiri. Menurut Mukhlis (2011) yaitu (1) Belajar kimia dirasa tidak ada gunanya selain hanya untuk ujian akhir nasional, (2) Kimia dirasa sulit karena pembelajaran hanya menontoni tanpa adanya variasi dengan praktiknya, karena praktiknya dirasa sangat kurang. (3) Siswa cenderung malas bertanya pada guru karena diolok teman dan merasa tidak bisa sehingga menjadi malas bertanya, (4) Siswa lebih memilih untuk bertanya kepada tenannya dikarenakan waktu bertemu dengan teman lebih banyak daripada dengan guru. (5) Partisipasi siswa selama pembelajaran cenderung hanya mencatat dan mendengarkan penjelasan guru, (6) Siswa sulit untuk mengajukan pertanyaan dan pendapat bahkan cenderung diam. Akibatnya interaksi guru dengan siswa berlangsung satu arah sehingga suasana pembelajaran menjadi membosankan dan (7) Siswa kurang dapat memperhatikan guru karena terlalu lelah dan bosan dengan banyaknya kegiatan yang ada selama dan pergaulan yang sempit pada pondok.

#### KESIMPULAN

Berdasarkan hasil penelitian dan pembahasan, maka dapat disimpulkan bahwa model pembelajaran inkuiri terbimbing berbasis etno kimia tidak memberikan pengaruh yang lebih baik daripada model pembelajaran konvensional terhadap hasil belajar kimia siswa kelas XI di MA Al-Aziziyah Putra Kapek Gumung Sari.

#### SARAN

Berdasarkan keunggulan dan kelemahan penelitian ini, terdapat beberapa saran untuk penelitian selanjutnya yaitu meskipun secara statistik tidak berbeda secara signifikan, namun dilihat dari peningkatan hasil belajar dan aktivitas belajar siswa kelas eksperimen lebih tinggi daripada kelas kontrol. Maka dalam pembelajaran penanaman model pembelajaran inkuiri terbimbing berbasis etno kimia lebih baik daripada model pembelajaran konvensional.

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## 06 Effects Of Ethno-Chemistry-Based Curriculum Delivery on Students' Interest in Chemistry in Obollo-Afor Education Zone of Enugu State

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### EFFECTS OF ETHNO-CHEMISTRY-BASED CURRICULUM DELIVERY ON STUDENTS' INTEREST IN CHEMISTRY IN OBOLLO-AFOR EDUCATION ZONE OF ENUGU STATE

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#### Abstract

*This study determined the effectiveness of incorporating ethno-chemistry practices into curriculum delivery on students' interest in chemistry. It adopted a quasi-experimental non-equivalent pre-test-post-test control group design. Three research questions and three hypotheses formulated guided the study. The population of the study consisted of 1,329 senior secondary two (SSII) chemistry students in Obollo-Afor education zone of Enugu state in 2016/2017 academic session. Using stratified simple random sampling technique, 137 students from four co-educational schools in the study area were selected. Chemistry interest scale (CIS) was used for data collection. This was developed by the researcher and validated by experts in test and measurement and chemistry educators from Michael Okpara University of Agriculture, Umudike. The reliability CIS was established as 0.79 using crambachalpha technique. The research questions were answered using mean and standard deviations while hypotheses were tested at 0.05 level of significance using ANCOVA. The findings of the study revealed that students' interest in chemistry improved significantly with the incorporation of ethno-chemistry practices into curriculum delivery. The findings also revealed that female students' interest improved better than their male counterparts with incorporation of ethno-chemistry practices. It was recommended among other things that curriculum planners should endeavour to enrich curriculum contents with ethno-chemistry practices from different localities in subsequent curriculum review to help the young ones appreciate and sustain their culture for future.*

#### Introduction

The concept 'curriculum' as a field of study is central to the attainment of educational goals of the nation and as such its delivery process to learners becomes an issue of great concern to stakeholders in education. The essence of designing a curriculum in science education is to promote positive learning

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outcomes and give teachers the "road map" to effective curriculum delivery (Opam, 2008). Curriculum delivery is the implementation stage in the curriculum process. It is a critical stage because it is at this stage that the teacher who is the major implementer through varieties of teaching methods and strategies, activities and experiences imparts the curriculum contents (knowledge, skills and attitudes) to the learner. It is at this delivery stage of the curriculum that the learners are actually engaged with the planned learning opportunities for their change in the right direction all towards the attainment of the educational goals of the nation. One of the major factors of consideration in the implementation stage of the curriculum is teaching methods, strategies, techniques and approaches employed in the process.

Teaching methods and strategies are among the chief determinants of achievement and interest in science. Aniodoh and Eze (2014) posited that teaching techniques and instructional strategies used in chemistry classrooms have been described as inappropriate and uninspiring. It has been revealed that the poor achievement in chemistry is blamed on poor teaching strategies adopted by chemistry teachers over the years (Oloruntegbe & Oduntunji, cited in Giginna & Nweze, 2014). Methods and strategies of teaching adopted by teachers significantly influence students' understanding, interest and achievement in the learning process especially in science subject like chemistry. Through application of varieties of teaching strategies, a great teacher does not only inspire the students but also helps them to learn meaningfully. In the field of sciences like chemistry, students should be encouraged to learn meaningfully so as to be able to apply the knowledge in solution of life problems.

It has been observed that for learning to be meaningful and effective in chemistry classroom, the teacher should be able to select an appropriate teaching strategy that will be able to stimulate the interest of the learners and get learners actively engaged in the process of learning (Ezeh, cited in Aniodoh & Eze, 2014). The theory of meaningful learning propounded by David Ausubel around (1963) has contributed immensely towards the teaching and learning of science today. According to Ausubel cited in Ugwu and Diovu, (2016), meaningful learning occurs when there is interaction between the learners' appropriate elements in the knowledge that already exists and the new materials to be learnt. Suffice it to say that new knowledge to be acquired must relate to the learners frame of reference in existence. This frame of reference most times are found in the indigenous knowledge and practices acquired by the learner through his experiences and interactions with the environment. Such practices with science undertone are referred to as ethno

science and by extension ethno chemistry when it has to do with chemical practices.

The term 'ethno' is a very broad term that refers to the social-cultural context and therefore includes language, jargon, and codes of behaviour, myths and symbols (Rosa and Orey cited in Singh & Chibuye 2016). According to Rosa and Orey, ethno-chemistry is all about member of a group within a cultural environment identified by their cultural traditions, myths and specific ways to reason and to infer. When attached to chemistry, ethno chemistry is described as the various chemistry related cultural and community practices (Singh & Chibuye, 2016). It is described as the chemical practices of identifiable cultural groups and is studied as chemical ideas found in the culture, they added. Odo (2013) also defined ethno chemistry as a unique system of indigenous knowledge about matter, its characteristics, interactions with other forms of matter and application articulated with a particular culture.

Indigenous peoples traditional education processes were carefully constructed around observing natural processes, adapting modes of survival, obtaining sustenance from plants and animal world using natural materials to make their tools and implements (Barhardt & Kawigley cited in Ugwu & Diovu, 2016). According to them, the indigenous views of the world and approaches to education has been brought into jeopardy with the spread of western societal structures and institutionalized forms of cultural transmission. In the same vein, Odo (2013) opined that the native knowledge of traditional societies including Nigeria has obviously been disdainfully attended to as inferior, retrogressive and backward in relation to the knowledge from western civilization. This bastardizes their culture and consequently affects the development of the community of the indigenous people.

Community development according to Hillman cited in Amimu, (2012) is the method of helping local communities to become aware of their resources in such a way as to satisfy some of their needs, and in so doing, acquire the attitude, experience and cooperative skills for repeating this process using their own initiatives. But with the neglect of these indigenous knowledge and practices, community development tends to be hampered. Besides, Ugwu and Diovu (2016) submitted that the abandonment of the indigenous knowledge and practices of the society in science for academic ways of teaching and learning makes the science of chemistry abstract. Therefore, incorporating the indigenous knowledge and practices (ethno-chemistry) in the delivery of chemistry curriculum content as a teaching strategy may enhance the understanding of chemistry concepts.

The science of chemistry is very essential and central to the study of many science disciplines like medicines pharmacy, biochemistry, and engineering to mention but a few. Chemistry curricula incorporate many abstract concepts, which are central to further learning in both chemistry and other sciences (Taber, 2002). The knowledge and skills in this central science is utilized in almost all the sectors of the economy (Singh and Chibuye, 2016). The fact that chemistry is full of life and life is full of chemistry cannot be underestimated (Achimgu, 2009). Most of our daily activities are chemistry. It is the science of everyday life, for instance the daily brushing of teeth, bathing and washing with soap and detergents respectively involves chemistry. Consequently, Umar cited in Danjuma (2009) opined that the study of chemistry is vital to mankind because it will be difficult to imagine life without chemistry. Unfortunately, it has been observed that students lack interest in the subject possibly due to its abstract nature. This lack of interest is confirmed by the number of students that drop chemistry at the end of senior secondary one (SS1) (Imo cited in Ezeliora, 1999). Agu in Njoku (2003) submitted that going by the poorest result achieved by students of chemistry at O' level, it is deduced that students lack interest in chemistry since students' interest significantly correlates with their academic achievements in school subject; it has significant influence on their learning outcome. Interest too determines the zeal with which students study and solve their academic problems. Hence, the application of teaching strategies that can enhance students' interest and improve understanding becomes imperative.

Some researchers have conducted some studies on the effects of ethno science on achievement and interest of students in learning. Okwara & Upu (2017) worked on effects of ethno-science instructional approach on students' achievement and interest in upper basic science and technology in Benue State. Their findings revealed increase in both achievement and interest with ethno-science instructional approach. Also Abonyi (2002) worked on effects of ethno-science based instructional package on students' interest in science and reported a positive effect of the package on students' interest in science. According to Singh and Chibuye (2016), who worked on effects of ethno-chemistry practices on secondary school students' attitude towards chemistry, the findings were still in favour of ethno-chemistry and they added that "the inclusion of knowledge related to ethno-chemistry practices may instil a sense of ownership about the concept and improve students' attitude in chemistry". Still on the efficacy of ethno-chemistry practices, Said-Ador (2017), revealed that integration of ethno-chemistry practices into the curriculum may in addition to helping in preservation and appreciation towards the quality of the students' cultural heritage, provide students'

meaningful learning. Hence, the investigation into the effectiveness of ethno-chemistry-based curriculum delivery on students' interest in chemistry as the focal interest of this study.

In spite of the immeasurable intrinsic and utility values of chemistry in all spheres of human activities, its importance in the social and economic sphere of any nation, students lack interest in the subject and consequently achieve low in chemistry examinations. This lack of interest which have resulted to poor achievement is blamed on inappropriate and uninspiring teaching techniques used by teachers for years (Aniodoh & Eze, 2014). Considering the importance of the science of chemistry in life generally and in the social and economic life of a nation, it becomes pertinent to look for teaching strategies that should enhance students' interest, understanding and achievement in the subject. It is expected that in the delivery of chemistry curriculum content, teachers should always employ appropriate teaching methods and strategies among other means not only to enhance understanding and achievement but also to foster interest in the subject.

The following research questions and hypotheses guided the study:

1. What is the mean interest scores of chemistry students when ethno-chemistry practices is incorporated into curriculum delivery and when they are not?
2. What is the mean interest scores of male and female chemistry students when ethno-chemistry practices is incorporated into curriculum delivery?
1. There is no significant difference in the mean interest scores of students taught chemistry using ethno-chemistry based curriculum delivery strategy and those taught using the conventional curriculum delivery strategy
2. There is no significant difference in the mean interest scores of male and female students taught chemistry using ethno-chemistry based curriculum delivery strategy.
3. There is no significant interaction effect of gender and instructional strategies on students' interest in chemistry?

The null hypotheses were tested at 0.05 level of significance

#### Method

The study adopted a quasi-experimental research design. Specifically, pre-test post-test non-equivalent control group design was employed. This design is considered appropriate as intact classes were used and according to Nworgu (2006), it helps to control extraneous variables. Out of 1,329 SS II chemistry students in the 54 senior secondary schools in Obollo-Afor education zone, 137 students made up of 77 males and 60 females from four

intact classes in 2016/ 2017 academic session formed the sample size. This was done using stratified random sampling technique. Using simple random sampling technique, two intact classes were assigned to experimental and control groups.

The chemistry teachers in the sampled schools were used as research assistants and the teachers for the experimental groups were trained on how to incorporate ethno-chemistry practices into the lesson using the lesson plans developed by the researcher but without incorporation of ethno chemistry practices for the control groups. The validated instrument used for data collection was chemistry interest scale developed by the researcher and was given face validation.

All the students were both pre and post tested with CIS. The two groups were taught separation techniques, change of state, acids, bases and salt and neutralization reactions for 12 weeks. Data collected were analysed using mean and standard deviation for research questions and analysis of covariance (ANCOVA) for testing the hypotheses at 0.05 level of significance.

#### Results

**Table 1: Mean and standard deviation of students' scores in both experimental and control groups**

Group		No. of Students	Mean Interest	Mean Interest Gain	Standard Deviation
Experimental	Pre-test	62	38.47	18.40	6.04
	Post-test	62	56.87		6.62
Control	Pre-test	75	41.13	6.48	7.54
	post-test	75	48.61		5.51

Table 1 shows that the mean interest gain for the experimental group is 18.40 while that of the control group is 6.48 indicating the superiority of the experimental group over the control group in chemistry interest scale.

**Table 2: Mean and Standard Deviation for the experimental and control groups across gender**

Group	Gender	No. of students	Mean ( $\bar{x}$ )	Standard Dev.	Mean Interest Gain	
Experimental	Male	Pre-interest	37	50.03	6.056	14.43
		Post-interest	26	64.46	8.664	
	Female	Pre-interest	22	31.73	7.304	17.86
		Post-interest	22	55.59	8.233	

Control	Male	Pre-interest	33	33.64	7.713	17.39
		Post-interest	33	52.03	8.512	
	Female	Pre-interest	30	34.13	6.329	15.17
		Post-interest	30	49.30	5.658	

Table 2 shows the mean interest scores of male and female students in both the experimental and control groups. The mean interest gain for the male and female students in the experimental group are 20.90 and 17.86 respectively, while that of the control group are 17.39 and 15.17 for males and females respectively.

**Table 3: Analysis of Covariance (ANCOVA) for differences between the mean interest scores of students in the experimental group and those in the control group**

Sources	Sum of squares	df	Mean square	f	Sign f
Corrected model	2577.433 <sup>a</sup>	4	4644.358	18.261	0.000
Intercept	8939.276	1	8939.276	253.338	0.000
Pre-test	230.736	1	230.736	6.539	.012
Method	1364.548	1	1364.548	38.671	0.000
Gender	.022	1	.022	.001	0.980
Method*Gender	27.808	1	27.808	.788	0.376
Error	4657.750	132	35.286		
Total	382692.000	137			
Corrected Total	7235.182	136			

Table 3 revealed that f value of 38.671 is significant at 0.000 for methods at 1 and 136 degrees of freedom (df), because 0.000 is less than 0.05 significant level set for the hypothesis. The null hypothesis is therefore not accepted. There is significant difference in the mean interest scores of those taught chemistry with incorporation of ethno-chemistry practices and those taught with conventional method.

The findings also revealed a no significant difference for gender at 1 and 136 degrees of freedom (df), since f value of 0.001 is not significant at 0.980 for gender at 1 and 136 degree of freedom (df). This is because 0.980 is more than 0.05 significant level earlier set for the hypothesis, therefore the hypothesis is upheld. That is, there is no significant difference in the mean interest scores of male and female chemistry students taught with incorporation of ethno-chemistry practices.

The findings also revealed that f value of (0.788) is not significant at 0.376 for the interaction between methods and gender at 1 and 136 degrees of freedom (df) since 0.376 is more than .05 significant level set for the hypothesis. Hence, the null hypothesis is upheld and so there is no significant interaction effect of teaching strategies and students' gender on the mean interest scores of chemistry students.

#### Discussion

The results of the study revealed that the treatment group obtained a higher mean interest score than their control group counterpart due to incorporation of ethno-chemistry practices into curriculum delivery. This was confirmed by hypothesis testing. The superiority of the treatment group over the control group may not be unconnected with the nature of ethno-chemistry practices. It is culture-based.

The findings of this study is in agreement with the findings of Ugwu and Diovu (2015) who reported a positive change in the students' achievement in chemistry due to incorporation of indigenous knowledge and practices in chemistry lessons. It also agrees with Singh and Chibuye (2016) who reported a positive change in students' attitude to chemistry due to ethno chemistry practices.

The finding is equally in agreement with Abonyi, (2002) who reported that ethno-science based instructional package is effective in fostering interest in students in sciences. The superiority of ethno-chemistry based curriculum delivery strategy over the conventional curriculum delivery strategy may be due to cultural background of the ethno-chemistry practices. It incorporates the ideas from the child's environment. According to Abonyi (2002), ethno science based instruction uses ideas, concepts, objects and materials from the child's environment which tends to make learning more interesting and clearer.

In the case of gender, the finding of this study revealed that male students has a higher mean interest score in the experimental group than their female counterparts in CIS although the difference was not significant. These were further confirmed by one ANCOVA result in table 4 which revealed that gender was not a significant factor on students' mean interest scores when taught with ethno-chemistry based curriculum delivery strategy. The result of this study is in line with the views of previous researchers like, (Nwosu, 2001 and Nwagbo, 2011) who found out that gender had no significant influence on acquisition of science process skills among secondary school biology students. It also agrees with Mani, (2002) who submitted that there was no significant difference in the performance of male and female students in all the schemata

except in the schemata of correlation reasoning in which males performed better than the females. The findings also revealed that there was no interaction between teaching methods and gender of the subjects to influence students' mean interest scores in chemistry. This was further confirmed by ANCOVA result in table 4 which showed that the interaction effect between teaching methods and gender of the students were not significant, implying that gender did not combine with teaching methods to affect the students' mean interest scores in chemistry. This result is in agreement with the findings of Mari (2002), Ibe (2004) and Nwagbo, 2011 who found no significant interaction between instructional methods and gender on performance and, acquisition of science process skills respectively.

#### Conclusion

From the results of the study, the following conclusions were drawn:

1. Ethno-chemistry curriculum delivery is more effective than the conventional curriculum delivery in enhancing students' interest in chemistry as witnessed in the hypothesis testing which showed statistical significant difference in the mean interest scores of students.
2. There is no statistically significant difference in the mean interest scores of male and female students using ethno-chemistry curriculum delivery implying that gender has no effect on students' interest even with the use of ethno-chemistry curriculum delivery.
3. Although ethno-chemistry curriculum delivery is superior to conventional curriculum delivery in fostering interest in chemistry in both males and females, there is no statistically significant interaction between gender and instructional approach on students' interest in chemistry.

#### Recommendations

Based on the findings of this study, the researcher made the following recommendations:

- (1) Curriculum planners should work towards enriching the contents of the curriculum with ethno-chemistry practices from different localities in their curriculum review so as to help the young ones appreciate and sustain their culture for the future.
- (2) Chemistry teachers should endeavour on their own to inculcate ethno-chemistry practices in the locality in their chemistry teachings as advanced organisers to help students understand the concepts better and develop interest and achieve high in the subject.

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# 07 Integrating perspectives from indigenous knowledge and Western science in secondary and higher chemistry learning to contribute to sustainability education



## Integrating perspectives from indigenous knowledge and Western science in secondary and higher chemistry learning to contribute to sustainability education

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### ABSTRACT

In this paper, we suggest integrating perspectives from indigenous and Western science into chemistry learning. Doing so is suggested to enhance students' views on sustainability issues. Integrating indigenous and Western views can provide students with insight into using multiple perspectives. Cross-disciplinary knowledge offers ways to solve problems more holistically and to promote respect for different worldviews. This claim is supported by a case study writing a lesson plan incorporating indigenous science in secondary and tertiary chemistry education. The study was carried out in Indonesia and used a socio-scientific issues-based, sustainability-oriented approach and the context of the Buhay community. University student teachers ( $n = 73$ ) and upper secondary school students ( $n = 40$ ) participated in this study. The study focuses on pesticide use, including a discussion of alternative, green pesticide use in an indigenous community. The lesson focuses on the role of different perspectives taken from indigenous and Western science and connects the issue with chemistry concepts from general and organic chemistry. A post-intervention questionnaire (on Likert scale items and one open-ended question) was used to explore students' feedback regarding the lesson's experiences and attitudes towards the lesson plan. Data were analyzed using descriptive statistics and text analysis. Our findings indicate that students' perceptions of the lesson was positive and that the lesson was considered to be interesting and relevant. Learning by integrating perspectives of indigenous and Western science about students' insight. It showed them that chemistry learning can be enriched by an interconnected system of worldviews in order to find solutions to sustainability issues.

### 1. Introduction

Delivering scientific content to students is the aim of chemistry education, however, a societal perspective to the application and impacts of chemistry also needs to be included (Hofstein et al., 2011). Modern chemistry teaching should prepare students for societal participation, including the development of an environmentally reflective attitude among students (Sjostrom et al., 2016). One way to achieve this goal is to integrate sustainability-related socio-scientific issues (SSIs) into chemistry lessons. This can help students to understand the role of chemistry in society and prepare them to become future responsible citizens (Hollweg and Rauscher, 2007; Mada and Eilks, 2009; Sallier, 2011). The need for the inclusion of societal issues in chemistry learning

has already been addressed by several different national science education standards (e.g., the National Curriculum in the UK and AAS in the US (NC, 2004; American Association for the Advancement of Science, 1993)). This has also become part of international educational policy in general (UN, 2015) and, more specifically, with a direct reference to sustainability and green chemistry (UNEP, 2019).

Over the last twenty years, several cases were published which discussed the integration of chemistry education with sustainability issues. Some of them were following the socio-critical and problem-oriented chemistry lesson approach (Mada and Eilks, 2009). The studies addressed bioethanol usage (Bauerband and Eilks, 2011), learning about and evaluating plastics (Bauerband and Eilks, 2012), life-cycle analysis (Bauerband and Mada, 2014), and comparing traditional and

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green pesticides (Correia et al., 2020). According to these studies, the integration of sustainability topics into chemistry education works well when focusing on controversial societal issues with direct links to science and technology (Bauerband et al., 2012; Sallier, 2014). This approach has also been suggested to make chemistry learning more authentic, interesting and relevant for students (Ottaway et al., 2013) in Western science classrooms. In Indonesia, socio-scientific issues-based (SSI) and sustainability-oriented education have been contextualized in inquiry-based chemistry learning which is suggested to have positive effects on students in terms of their perceived ability, interest, commitment and value (Rahayu et al., 2018). Socio-scientific issues are also suggested to enrich aspects of socio-cultural and geographical aspects which have different characteristics in various countries (Ottaway and Coll, 2013). Research on SSI and sustainability-oriented education in Indonesia is, however, still very limited.

This paper reports on a split of SSI and sustainability-oriented education. It looks, in the case of Indonesia, at a country with indigenous communities and societal views about integrating science into their indigenous lifestyles. It is suggested that multiple perspectives on scientific worldviews could make a strong connection between indigenous and Western science, sustainability issues, cultural values, and the relevance of science learning (Ottaway, 2013; Stachly et al., 2013; Zidny et al., 2020). Western science in this paper is understood as Western science knowledge and alternative Western thinking which is shaped by modern Western societies (Zidny et al., 2020). It is understood in its contemporary dominant interpretation of science in Western countries which is the literature is generally described as Western modern science. To avoid the impression that indigenous science is suggested as not being modern, we are using the term Western science in this context throughout this paper. It also needs to be said that although it has been suggested to name the science of indigenous communities as indigenous science (with an upper case I) to draw respect to the knowledge of indigenous communities we decided to use indigenous science (with a lower case i), here abbreviated as IS in this title the most often used term in the literature. This study aims to explore students' perceptions and experiences toward a teaching intervention which integrates the perspective of indigenous and Western science in socio-scientific issues based and sustainability-oriented learning.

### 2. Background

#### 2.1. Pesticides as a controversial issue for chemistry learning

One controversial sustainability issue which has already been tested for chemistry learning is the use of pesticides (Correia et al., 2020). The use of conventional pesticides, such as glyphosate, has been discussed by the mass media and in public debate for a long time. Pesticides undoubtedly help to increase agricultural output. However, they also lead to the risk of producing undesirable impacts on human health and the environment. The debate on the utilization of agricultural pesticides as a sustainability issue in education must be informed by these main viewpoints borrowed from the dimensions of sustainability: ecological, economic and societal sustainability (Bauerband et al., 2012).

From an ecological standpoint, pesticides pose a potential risk to human health and other organisms. They also may have undesirable environmental side effects such as decreasing biodiversity. Pesticides can occur here in soil or water, then harm more or less plants, animals, fish, and other wildlife species (Damas and Edler-Gibbs, 2014). Recent research revealed pesticide side effects which can disrupt aquatic microbial environments (Matti et al., 2017) and can have led to sub-lethal effects leading to decreases in bee populations in agricultural ecosystems (Eggen et al., 2019). Some reports also examined the persistence of pesticides and the possibility of atmospheric pollution (Chatterjee et al., 2018, 2017; Tash et al., 2009).

In economic and societal terms, it is impossible to deny that the use of pesticides has led to an increase in global production and yields of

agricultural products. Pesticide consumption has increased in recent years, especially in the agricultural sector, where high productivity is necessary to cover market demand (Dugga et al., 2019). Economic and environmental losses, however, also result from the use of pesticides and must be weighed against their benefits. For instance, the investigation of the application of pesticides in the United States has shown major economic and environmental losses. More than nine billion US dollars are spent each year on environmental and public health costs (Pimentel, 2003). The societal implications of pesticide use need to consider the need to increase food production in order to feed the global population. The world must find enough food to feed people where the human population increases every year. There is a continuing debate about the use of pesticides all over the world today. The UN Food and Agriculture Organization (FAO) estimates that up to 40% of global crop yields are lost each year, due to pests (Fryg et al., 2013). This issue raises the question of whether food production can be guaranteed without the use of conventional pesticides such as glyphosate (Correia et al., 2020).

A discussion of sustainability issues surrounding pesticides considers benefit-risk factors. Such a discussion which contrasts the benefits and risks as portrayed in the public media offers a fruitful starting point for chemistry learning about sustainability. This has been the case when using a socio-scientific issues-based approach like the socio-critical and problem-oriented curriculum model for chemistry education (Mada and Eilks, 2009). The issue of pesticides fits well with the criteria used to select topics for this curricular model (Eilks et al., 2013). It is authentic, relevant, open to evaluation, allows for open discussion, and deals directly with questions from science and technology. For Indonesia, the topic of pesticide use is closely related to the socio-economic and geographical background of the country which has a significant agricultural production. Although pesticide use is not a common topic in chemistry curricula at the high school and undergraduate level in Indonesia, this content is suggested to be relevant to Indonesian students because of Indonesia's large agricultural economy and that the question of pesticide use has potential to directly influence students' lives and should have meaning to them (Ottaway and Coll, 2013).

#### 2.2. Chemistry learning and indigenous knowledge

So far, the implementation of socio-critical and problem-oriented chemistry education (Mada and Eilks, 2009) is mostly restricted to Western chemistry classrooms. Application has so far been restricted to incorporating Western scientific views into chemistry learning. Often, this does not integrate cultural components, which is also the situation in many countries worldwide (e.g., Ireland, 2018; Shadlow et al., 2017). The question, therefore, arises whether such cultural components can enrich teaching and learning. This is especially relevant in countries where different cultural perspectives, values, and worldviews exist, for example, in countries with indigenous communities.

In this paper, we suggest adding relevance and meaningfulness to chemistry learning by considering the application of science in different cultural and socio-economic environments. In some regions of the world, for example in Asia, there are indigenous communities which still maintain their unique and diverse cultural traditions. Indigenous communities generally have unique knowledge about their direct surroundings, which is orally passed on in various forms of indigenous science (IS). In some literature, IS is also conceptualized under different names such as traditional ecological knowledge (TEK) (Eisen and Dierker, 2014) or ethnoecology (Prasad, 2017).

The wisdom of indigenous knowledge is often based on a second respect for nature, due to indigenous peoples' relationship and responsibility towards their natural environment (Grimmon and Smith, 1992). The practice of indigenous science generally centers around the utilization of natural resources in order to fulfill needs in the areas of agriculture, medicine, land and forest management, or water and soil management (Grimmon and Eilks, 2013). We would suggest that indigenous science offers rich and authentic contexts for science learning which can

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potentially interest students who live in the corresponding environments or coexist with indigenous communities, especially in times of globalisation. Indigenous perspectives can contribute to understanding the relationship between socio-cultural and environmental ethics. They can also help to better reflect upon Western views of science in order to develop more holistic perspectives (Srivady and Williams, 2016). This is seen as necessary for relevant science education for sustainability (Gjermani et al., 2016). It has also been suggested that indigenous knowledge provides chances to reflect upon views of nature and science in contemporary (Western) science education. This can aid in the development of better-balanced, more holistic worldviews, intercultural understanding, and sustainability (Zidny et al., 2020).

### 2.3. Connecting learning about pesticide use with indigenous knowledge

In the recent debate on more green and sustainable chemistry, the search for agricultural pest management in a more sustainable manner came to the attention of chemists and environmentalists. Approaches have been tried which include integrated pest management and biological control of pests (Metcalfe and Lackmann, 1994). The use of green pesticides is currently one of the most popular options for dealing with pest problems without causing negative effects in the environment (Gospe and Huan, 2013). Natural plant compounds are selected to develop green pesticides as an alternative to synthetic pesticides, due to their ecological compatibility (Bikal et al., 2017). Phytochemical compounds which can be employed as green insecticides include essential oils, alkaloids, flavonoids, glycosides, esters and fatty acids (Altemani et al., 2017; Carrillo et al., 2015; Bikal et al., 2017; Roul, 2009). The utilization of plant extracts as bio-pesticides for pest control has already been used by indigenous communities. Studies in IS and edubotany have explored the potential use of phytochemical compounds showing pesticide activity (Gospe Ajana, 2017; Miliadi et al., 2015; Valsarayan and Chandan, 2015; Wadood, 2013). In this respect, IS found in local communities should be considered as a source of knowledge and inspiration for developing sustainable approaches towards pest control.

Related to the chemistry context, a case study analyzing IS in Indonesia revealed that indigenous communities apply various principles and concepts from chemistry in a sustainable fashion. We can call this 'ethnochemistry' (Zidny and Bilka, 2018). The communities merge science with their socio-cultural context regarding values, philosophy and environmental ethics. The application of indigenous knowledge in the Baduy community is based on mutually agreed principles and norms to maintain the sustainability of life in the community for both present and future generations. The Baduy have a philosophy that has a determination (*pihukuh*) to preserve nature, that is, "The mountain is not allowed to be destroyed, the river is not allowed to be destructed. If it is long, it is not allowed to cut and if it is short, it is not allowed to be connected." The essence of the Baduy's determination means that humans are not allowed to change anything that could cause damage to nature. As a sustainable approach to pest control, the Baduy use natural compounds extracted from plants as bio-pesticides, which we can consider to be green pesticides. In the process of pest control, the Baduy community has paddy treatment activities which they call "ngabaran paji". This treatment uses a blend of local plant ingredients as bio-pesticides known in the local language as "samara pangkahuman". These ingredients have a function as botanical pesticides to control pests in their paddy plantations. In accordance with their culture and belief, the production of bio-pesticide ingredients is accompanied by a traditional ceremony. The story of the life journey of the Baduy and a fairy tale about Nyi Pohaci Sanghyang Ari (the rice god) are presented in the ceremony (Senojji, 2011). IS is generally in line with the principles of green and sustainable chemistry. This includes using biodegradable chemicals and avoiding environmental pollution. IS also offers valuable perspectives which can complement Western scientific views in order to achieve sustainability (Zidny et al., 2020).

The recognition of IS might enrich the debate about the global use of

conventional pesticides. The issue of the use of potentially harmful synthetic pesticides is a concern in both agriculturally developed and developing countries, such as Indonesia. Studies indicated that the residues of harmful pesticides such as organochlorine pesticides (OCPs) can be found in food products (Shafiqi et al., 2013) and contaminated rivers (Isworo et al., 2015) in Indonesia. We suggest that learning about pesticide use connected with IS will provide students with new insights. They will realize how using multiple perspectives and trans-disciplinary knowledge can lead to solving problems more holistically. This will also allow them to better contribute to collective decisions about the future. Another argument is to enrich chemistry learning by systems thinking (Mahaffy et al., 2018). Systems thinking means that chemistry education looks at the interconnection of chemistry with other systems. These include human societies, nature, biospheres, socio-economics, politics, legal systems and knowledge borrowed from other disciplines (Mullin et al., 2016). Reorientation of chemistry education around systems thinking can enhance learners' understanding of chemistry concepts and principles in a rich social context. It can also address the impact of chemistry on global problems and advance sustainable development (Mahaffy et al., 2018).

The case study presented below provides an illustration of the ideas presented above. It describes the implementation of a teaching unit which incorporates science-related indigenous knowledge into sustainability-oriented chemistry education for students at the secondary and tertiary levels. The chemistry concepts behind the use of bio-pesticides produced from natural products are believed to better learning in the classroom. The case below shows a regional example from Indonesia, but also promotes education for sustainable development (ESD) and intercultural learning. An educational design framework was used which introduces IS as both content matter and context for science education (Fig. 1) (Zidny et al., 2020). The framework uses the ESP pedagogical approach in connection with science education based on socio-scientific issues (Dornseifer et al., 2012). It combines social-cultural contexts, local wisdom, and the philosophical aspects of IS in the same sense that socio-critical sustainability issues do. Socio-cultural aspects of IS can be used in ESD as potential contexts to achieve science learning. This encourages teachers and students to develop enhanced respect for local cultures. It also provides pathways for teaching and learning locally relevant knowledge and skills, as well as promoting ESD simultaneously.

### 3. Integrating IS and chemistry learning in Indonesia

#### 3.1. Research background, sample and method

The case study in this paper is part of a larger educational design project which aims at incorporating IS and perspectives of sustainability into modern chemistry education in Indonesia. The framework of the project (Fig. 1) was adapted from the Model of Educational Reconstruction (MER) (Duit et al., 2005). MER links together the analysis of content structure, research on teaching and learning, and the development and evaluation of instruction. The research framework further integrates multiple perspectives on science worldviews in order to arrive at stronger connections between IS and Western science, sustainability issues, cultural values and the relevance of science learning (Murray, 2015; Stuckey et al., 2013; Zidny et al., 2020). The phenomenon or process of IS serves as a source for socio-scientific and cultural issues, which are suggested to promote higher levels of relevance for science education.

Within the research framework, the study in this paper attempts to investigate students' perception and experiences during a teaching unit which introduces pesticide sustainability issues based upon IS and Western perspectives. The learners' responses are considered of significant value for the development and evaluation of potential future curricular design. The study was conducted at the university and upper secondary school level in Indonesia. The total number of participants

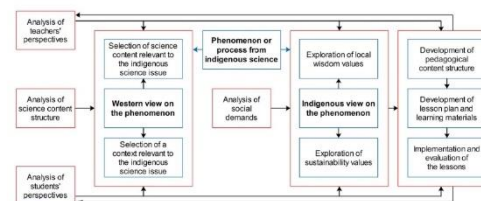


Fig. 1. Educational design framework to incorporate indigenous knowledge into science education (Zidny et al., 2020).

included two classes of university chemistry student teachers (N = 73) and 40 students in upper secondary school (12th grade, science majors). These groups of learners were chosen because all groups learn at institutions which are located near the Baduy indigenous community, an indigenous tribe on Java in Indonesia. The study involved two groups of participants to grasp students' feedback toward the complexity of the issue at different levels of education, which is suggested important to better understand developing teaching and learning design. After the intervention, students answered a questionnaire about their perceptions and learning experiences. The questionnaire was validated prior to the intervention by discussions with experts.

The research instrument for the study was a questionnaire administered after completion of the teaching unit. It contained ten Likert-scale items and one open-ended question. The development of the questionnaire involved a professor with relevant knowledge and experience in chemistry education. After the revision process, the questionnaire was translated into Indonesian language and reviewed by three Indonesian researchers in the field of chemistry education. Furthermore, the questionnaire was pilot tested by a small group of students, then revised before finally being used in this research.

In the questionnaire, the Likert-based items focused on: 1) students' interests, 2) their motivation for the topic, 3) the perceived relevance in the context of both their personal learning and the chemistry curriculum, 4) their concern about sustainability, and 5) the perspectives for IS and Western science to work together to solve sustainability issues and promote intercultural learning. Cronbach's alpha as a measure of reliability of the Likert questionnaires was 0.75 (between acceptable and good). The final, open-ended question focused on the student's opinions regarding both the topic and the overall learning process.

The students' answers to the Likert items were subject to descriptive statistics, which attempts to obtain a general description of the feedback given about the teaching and learning design. The percentage distributions for agreement levels to the statements were calculated. Such analysis is typical in research-based design studies, in which the main objective is to yield cyclical improvement of instruction (Bodner et al., 1999).

The open-ended question was analyzed using DisplayR text analysis software. This software has the ability to create word cloud visualization and calculate sentiment analysis scores. (Both software and instructions are available online at <https://www.displayr.com/>). With the help of word clouds, every word or phrase in a student's response to the questionnaire can be visualized. This is based on the size of words and the corresponding frequency with which the word is mentioned. The process of cleaning and processing the texts (translating to English, correcting spelling, stop-word removal, performance stemming, replacing words/synonyms) was conducted to concentrate the unique words or phrases found in the analysis into a manageable and meaningful collection.

Sentiment analysis in a survey is a technique which measures the overall attitude towards a particular topic or product. In terms of educational purposes, it can be used to analyze students' attitudes towards learning experiences, based on their feedback to the open-ended question (e.g., Liu et al., 2019; Yu et al., 2019). DisplayR uses an R algorithm to analyze the text by scoring the words as positive (+1 scores), negative (-1 scores), or neutral (0 scores). For example, the word "interests" would generate a score of 1 instead of -1. The score calculation in the text or statement such as "I am really interested (+1) with the lesson, it was fun! (-1)" would yield a score of 2. The final sentiment score is the sum of all the scores. The average sentiment score represents student attitudes and shows whether learners express positive or negative sentiments towards a given lesson.

#### 3.2. Teaching intervention

The teaching unit centered around sustainability issues of pesticide use, compared to an alternative green pesticide selected from IS. During 2½ hours of teaching time, tasks were given to the students in the form of a set of worksheets, which encompass four activities. In the first session, the students' preconceptions were explored to find their *a priori* understanding of pesticides, pesticide function, and the difference between synthetic and natural pesticides. Their knowledge of green pesticides was also examined. After this, the students wrote down their answers and explored them in a class discussion. A video entitled "Do we really need pesticides?" from TEDx (by Fernan Pérez-Gálvez) was presented to give the students new insights into sustainability issues surrounding pesticide use. The video has subtitles in Indonesian and 22 other languages. It can be found on the internet under the link (<https://vml.sed.com/lessons/do-we-really-need-pesticides-fernand-perez-galvez-watch>). This video discusses the history of the development of pesticides, the pros and cons surrounding pesticides, and global issues regarding the persistence of common synthetic pesticides in the environment. It also emphasizes the role of scientific developments when it comes to solving the problems of pesticide use. In this part of the lesson, students were given the task of watching the video and analyzing the controversial issues related to pesticide use. After that, the participants completed a worksheet, which examined the risks of using conventional pesticides and presented several ideas for avoiding potential risks. The learners were asked to decide which group they would join: the group supporting the utilization of synthetic pesticides or the group refusing to do so. Then the class was divided along these lines and expressed their arguments regarding their position in a class debate. The teacher guided the students as they explored their answers in an interview and in the class discussion.

In the next step, a discussion about multiple perspectives was initiated. An alternative view from a local indigenous context was



introduced and contrasted with the developments of modern science in order to possibly resolve the issue. A short video on the utilization of natural pesticides in the indigenous community, the Baduy tribe, presented this context. Furthermore, the students read an article entitled "Indigenous Biopesticide: Bio-rational control of pest insects in the Baduy Community". This article provided information about the Baduy agricultural system, their cultural values and philosophies about conserving nature, and information about their indigenous biopesticides. The learners were then given the task of discussing the alternative solution from the indigenous perspective, which offers the sustainable approach of using green pesticides from plant extracts. During the task, the students analyzed the risks and benefits of using natural (green) pesticides derived from local plants. Then they were guided by the teacher through a class discussion of their arguments.

In the end, the students were asked to apply concepts from chemistry in order to explain the different alternatives offered. The relationship between chemistry and pesticide use was connected to the three relevant dimensions of chemistry education: the personal, societal and professional context (Stuckey et al., 2013). In terms of the societal context, the students analyzed the case of DDT synthetic pesticides on the environment. In the personal context, chemistry content was related to the potential effects of pesticides on personal health. The professional context asked the students to explain the chemical phenomena in IS from a scientist's point of view. Reflection was also carried out to find which chemical content was necessary for students to master these questions. This content analysis was based on the school curriculum and the general chemistry textbook. The structure of the unit is given in Table 1. The connection between problem-solving, the aspects of chemistry education's relevance, and chemical content are shown in Table 2.

### 3.3. Findings

Students' responses to the Likert-items in the questionnaire could be categorized into three main areas: (a) student interest and motivation for the topic (items 1, 5, and 6), (b) perception of relevance to students and the chemistry curriculum (items 3, 9, and 10), and (c) student views on the integration of IS and Western science to solve sustainability issues and to foster intercultural learning (items 4, 2, 9 and 7).

The feedback from the student teachers (Fig. 2) and upper secondary school students (Fig. 3) reveals almost the same distribution of answers. In terms of the students' interest and motivation, most of the students were interested in the lesson (over 90% agreed or mostly agreed among

**Table 1**  
The teaching unit.

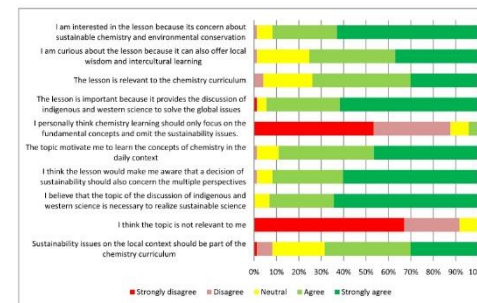
Activities	Tools and Tasks	Time (min)
<ul style="list-style-type: none"> <li>The students explore their a priori knowledge about pesticides and green pesticides.</li> </ul>	Worksheet 1	15'
<ul style="list-style-type: none"> <li>The students watch a video about global issues regarding the risks of conventional pesticides in the environment. Then they express their arguments in writing and through a discussion.</li> </ul>	Video from TEDx: "Do we really need pesticides?" Worksheet 2	45'
<ul style="list-style-type: none"> <li>The learners consider an alternative approach borrowed from IS, based on an article. Then they review and discuss the arguments.</li> </ul>	Article and video about pesticides from the Baduy community Worksheet 3	45'
<ul style="list-style-type: none"> <li>The participants apply chemistry concepts to answer questions about the topic.</li> </ul>	Worksheet 4	30'
<ul style="list-style-type: none"> <li>The students describe their own perceptions of the topic and the incorporation of alternative views taken from IS.</li> </ul>	Questionnaire	15'

**Table 2**

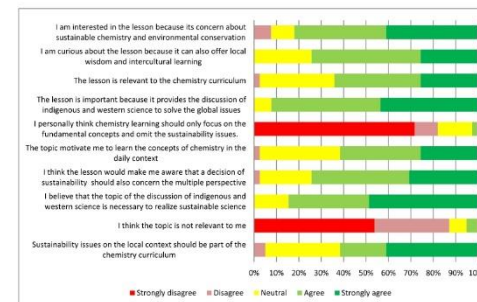
The connection between problem-solving, aspects of chemistry relevance and chemical content.

Aspects of relevance	Problem-solving	Chemical content
<b>Societal context:</b> The social issue of pesticides (a case study on DDT) on the environment	DDT (Dichlorodiphenyltrichloroethane) is a synthetic insecticide belonging to the family of organic halogen compounds. Although it was very useful, it is related to environmental degradation because of great stability. DDT also can be accumulated in the fatty tissues of living organisms for long periods of time and exhibits toxicity.	- Structure of Matter (molecular structure) - Chemical bonding (polarity, stability or reactivity of compounds) - Organic chemistry (aromatic compounds, functional groups)
<b>Personal context:</b> The issue of pesticides that endanger human health	DDT In your understanding, what makes DDT resistant to environmental degradation? Please give an explanation (connected with chemical structure and stability)	- Structure of Matter (molecular structure) - Chemical bonding (polarity, stability or reactivity of compounds) - Organic chemistry (aromatic compounds, functional groups)
<b>Professional context:</b> How do students explain the chemical phenomena about IS from a scientist's point of view?	In your understanding, what causes DDT to be accumulated in the fatty tissues of living organisms and exhibit toxicity? Please give an explanation (connected with chemical structure and solubility)	- Structure of Matter (molecular structure) - Chemical bonding (polarity, stability or reactivity of compounds) - Organic chemistry (aromatic compounds, functional groups)
<b>Professional context:</b> How do students explain the chemical phenomena about IS from a scientist's point of view?	Indigenous knowledge of bio-rational pest insects may be used as an alternative to synthetic pesticides. The Baduy community located in Banten (Indonesia) uses plants as natural pesticides to protect their crops (read the article). Please give a scientific explanation regarding the phenomena processes of indigenous people to answer the question: a) The Baduy community uses natural pesticides extracted from local plants to protect their rice crops. Some plants contain secondary metabolite compounds, which exhibit "strong scent" to repel pest insects. In your understanding, what functional groups are responsible for these properties? b) To manufacture their crude extract of natural/botanical pesticides, the Baduy people use fermented suga palm juice. What compounds might be found from these solvents? Please give an explanation. c) Please predict what kind of chemical compounds (based on polarity) can be extracted using these solvents? Please give an explanation. d) In your understanding, how do chemical structures and analyze bioactive compounds in plants? Please explain the process.	- Structure of Matter (molecular structure) - Chemical bonding (oxidation reaction) - Chemical analysis

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**Fig. 2.** Undergraduate chemistry teacher's experiences from the lesson.



**Fig. 3.** Upper secondary school student's experience toward the lesson.

the student teachers; 80% among the secondary school students, respectively). Both groups of participants did not like chemistry learning which solely focuses on content matter and lacks any relationship to the societal issues surrounding sustainability (90%/90%). The student teachers were more motivated by the topic (90%) than secondary school students (60%).

Student responses to the relevance of the lesson to the chemistry curriculum and their personal learning experiences generally indicated a positive perception of the topic. Based on their personal learning experiences, both groups of students felt that the topic was relevant. Approximately 90% disagreed or strongly disagreed with the statement that the topic had no relevance for them. Over 70% of student teachers

agreed or strongly agreed that the lesson was relevant to the chemistry curriculum. The same acknowledgment was echoed by nearly 65% of the upper secondary students. A majority in both groups (over 60%) agreed or strongly agreed on the importance of sustainability issues in chemistry lessons.

Student feedback on integrating IS and Western science in chemistry learning revealed significant support for the idea. Both groups of students (over 90%) agreed or strongly agreed that comparing IS and Western science is useful for addressing global issues. A majority of the student teachers supported decision-making based on multiple perspectives to realize sustainable science (over 90% agreed or strongly agreed). This point of view was also stated by approximately 80% of

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# 08 Ethnochemistry in the Chemistry Curriculum in Higher Education: Exploring Chemistry Learning Resources in Sasak Local Wisdom

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## Ethnochemistry in the Chemistry Curriculum in Higher Education: Exploring Chemistry Learning Resources in Sasak Local Wisdom

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**Abstract** Understanding the concept of chemistry can not only be done directly by studying chemistry, but even chemistry will also be more easily understood if contextualized with culture, because the concept of chemistry is very analogous to culture (Ethnochemistry). This paper will discuss Ethnochemistry in the local wisdom of the Sasak tribe, West Nusa Tenggara, Indonesia contained in the *Merarik* (wedding) tradition. In this tradition, there are social, moral and spiritual values such as the concept of giving and receiving, cooperation, mutual respect, and the concept of a mutual need to achieve stability. These concepts have very strong relevance to the theory of chemical bonds which includes the concept of electron stability, electron configuration, positive and negative ions, and the theory of chemical bond formation so that it can be concluded the theory of chemical bonds has interconnection with local wisdom of Sasak tribe (Ethnochemistry). The concept of material and its changes integrated into local Sasak wisdom are reflected in the use of chemical elements from various types of metals such as gold, silver, bronze, copper, brass, and various other metals for the manufacture of traditional ceremonial tools and traditional Sasak arts. Likewise, the concept of material change is found in food processing, traditional art tools and cultural products of the Sasak tribe. Thus the application of ethnochemistry in chemistry learning can act as a natural laboratory & learning media so as to make chemistry

learning more enjoyable and relevant to students' daily lives (contextual-based learning).

**Keywords** Ethnochemistry, Chemistry Curriculum, Sasak Local Wisdom, Learning Resources

### 1. Introduction

Ethnochemistry is a variety of cultural practices that describe the chemical practices of cultural groups that are chemically related and can be identified as studies of chemical ideas that can be found in any culture [1]. In addition, ethno refers to group members in cultural environments identified by cultural traditions, codes, symbols, and myths to consider and conclude concepts [2]. The use of cultural products as learning resources has a positive influence on student learning outcomes, as previous research shows that the use of cultural products as learning resources has an influence on improving students' abilities [3]. Research related to Ethnochemistry also has an effect on improving student scientific attitudes [4] and also a positive response to human rights [5]. Likewise, with the tradition of *Merarik* the Sasak tribe has very strong relevance to the theory of chemical bonds so that it can be used as a learning resource that can facilitate

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students to understand the material of chemical bonds (contextual learning).

The philosophy and basic principles of the *Merarik* tradition in the Sasak tribe such as the concept of giving and receiving, cooperation, mutual respect, and the concept of a mutual need to achieve stability have strong relevance to the theory of chemical bonds. These philosophies and principles are directly related to the theory of chemical bonds such as: the concept of stable electron/electronic configuration is stable, the concept of positive ions and negative ions, the theory of chemical bond formation, inter-atomic bonds consisting of ionic bonds, polar covalent bonds, non-polar covalent bonds, covalent coordination bonds, metal bonds, bonds between molecules consists of the theory of the formation of hydrogen bonds and Van der Waals bonds [6]. Based on the explanation above, it is very important to conduct the Ethnochemistry study to integrate chemistry with local wisdom from certain communities. The aim is to make it easier for students to understand chemical concepts, as well as efforts to preserve cultural heritage.

As for Basic Chemistry 1 material that has relevance to Sasak local wisdom, namely: chemical bonds, substances and materials, the periodic system of elements, and atomic structure. In general, the local wisdom values contained in this tradition are the concepts of mutual giving and receiving, mutual need, social solidarity, compassion, and cooperation. These local wisdom values have very deep relevance to the concept of chemical bond theory which is studied or analyzed from various viewpoints of chemical bond theory such as the concept of electron stability, stable electron configuration, and the theory of chemical bond formation. However, the integration of ethnochemistry with the curriculum, learning tools and in the preparation of teaching materials is still very rare [7,8,9,10]. This has an impact on students' ability to understand the concepts of matter and matter, atomic structure, the periodic system of elements, and low chemical bonds and lead to misconceptions [8]. One of the best solutions to solve these problems with ethnochemical integration in the curriculum must be placed in the context of student life with cultural heritage as the substance of scientific investigation (natural laboratories) [11, 12, 13, 14,15], so that through the integration of Basic Chemistry 1 material with Sasak local wisdom that has been it has never been done, it is hoped that it can support the effective implementation of 21st century learning.

Efforts to link chemistry learning with local culture, especially Sasak culture, are very urgent to do as an alternative in linking Basic Chemistry 1 chemistry with the context of student life that is reflected in the practice of daily life or Sasak cultural heritage. In addition, the form of culture as physical culture in the form of artifacts, handicrafts and traditional arts of the Sasak tribe can be used as a natural laboratory that can directly observe the phenomena that occur related to chemical concepts that are found in everyday life so that it has a positive impact

on increasing understanding of concepts, attitudes, scientific skills, morals, and spiritual values needed by students to be able to compete in the face of the industrial revolution era.

### 2. Research Methods

The research method used is qualitative research with data collection techniques through observation, in-depth interviews, documentation, and curriculum analysis. Data collection activities were carried out by exploring local Sasak wisdom which could be used as a learning resource in Basic Chemistry course 1 by referring to the ethnochemistry approach.

Study of literature activities that have been carried out include: (a) identifying the competencies that students must achieve in learning chemistry in higher education, (b) analyzing the implementation of chemistry learning in higher education, (c) analyzing the relevance of Sasak cultural local wisdom with chemistry learning, (d) analyzing the relevance of Sasak local wisdom with the model problem-based learning (PBL model), (e) analyzing the relevance of Sasak local wisdom with Basic Chemistry 1 material, (f) identifying student characteristics, (g) analyzing the urgency of developing student scientific attitudes & science process skills, and (g) analyzing research results relevant as a theoretical study to support the results of the research conducted.

The data obtained at this stage is in the form of qualitative data and is analyzed using qualitative data analysis techniques proposed by Miles & Huberman, which consists of three stages, namely data reduction, data presentation (data display), and drawing a conclusion (conclusion drawing). The data analysis activity was continued with the analysis of content, values, learning outcomes, and competencies that must be achieved by chemistry education students at the tertiary education level in Indonesia.

### 3. Results and Discussion

#### The Relevance of Basic Chemistry 1 with Sasak Local Wisdom in terms of Analogy, Representation, Apperception, Visualization and Interpretation Perspective

Cultural forms are grouped into 3 forms [26], namely: (1) the form of culture as an idea, idea, value or norm; (2) the form of culture as a social system is an activity or pattern of human action when interacting in community life; and (3) cultural forms in physical form which are objects of human work that are concrete or tangible (artifacts, handicrafts, and arts). Referring to the three forms of culture, Basic Chemistry 1 has a close relationship with the local wisdom of Sasak culture in

terms of analogy, representation, perception, visualization, and interpretation that can be applied during learning so that it makes it easier for students to understand the concept of chemistry with cultural utilization as a natural laboratory.

The concept of analogy is a way of relating a comparative relationship to a concept that has linkages between concepts to explain a related meaning [27]. In addition, the analogy is a correspondence relationship between two different domains that have the same meaning (analog domain). The analog domain is a domain that resides in memory and contains an analogous representation of the analogous target [28]. The concept of analogy is a process of transferring information from analog to target with the main procedure of finding the correspondence between two analog systems [29]. The two concepts have different domains but have a relevant meaning (metaphorical analogy between domains). For example, the use of examples of everyday life situations that are analogous to chemical concepts is called interdomain analogy [30]. The relevance of the analog domain concept allows students to construct knowledge and experiences independently and involves students to analyze the knowledge gained through the analogy process [31].

The application of the analogy approach can make it easier for students to understand specific concepts, develop problem-solving skills, and integrate new knowledge and experiences gained with previous knowledge [32]. The results of previous research also prove that the application of analogical concepts in learning is very effective in helping students to understand concepts that are relevant to everyday life associated with abstract chemical materials such as the form of organic compounds, atomic structure, and types of chemical bonds [27]. In addition, the application of analogy in learning makes learning more interesting, less boring, and contextual [33, 41].

The relevance of Basic Chemistry 1 material to *Sasak* local wisdom is also viewed from the representation approach which is a chemical characteristic consisting of microscopic, macroscopic, and symbolic components [38]. The complex and abstract chemical nature makes learning and teaching difficult for students and teachers [39]. This, conceptual understanding in chemistry includes the ability to represent and translate chemical problems using macroscopic (observable), microscopic (particulate), and symbolic representational forms [40]. Based on the results of research conducted by Gabel & Samuel [41], it is evident that chemical phenomena studied at the macroscopic level can also be studied at the sub-microscopic level, as well as the symbolic level to solve complex problems. Therefore, a good understanding of chemistry requires the ability to integrate these levels and is the biggest challenge in learning chemistry so that students often have difficulty connecting the different levels of representation and become a major obstacle to

learning [38, 39]. One alternative solution in overcoming these problems is through the use of visual tools in improving visualization skills and understanding representation by using images, concrete or real models, photos, graphics, diagrams, computational programs, integrating concepts with the culture of an area which has a positive impact on student learning outcomes [41, 42, 43, 44, 45, 46].

#### Ethnochemistry: Relevance of the Chemical Bonds to the Local Wisdom of the Sasak Tribe

The relevance of the chemical bond theory concept to *Sasak* local wisdom is scientifically viewed from the perspective of analogy between domains. The analogy is a way of expressing a comparative relationship between two or more concepts that are related to each other by referring to the relationship between concepts in explaining a relevant meaning [27]. In addition, the analogy is known as the meaning of relations (correspondence) which is owned between the structure of the two domains (analog domains). The analog domain (source or base domain) is the domain that is in memory, which represents the analogy which is then drawn and contains an analogous representation of the target [28]. An analogy involves the transfer of relational (structural) information from analog to the target, the transfer of which is carried out by the process of mapping or matching, which consists of finding the correspondence between two systems [29]. The two systems may belong to different domains, but have the same explanatory structure (inter-domain analogy or metaphorical). For example, the use of examples of solved problems to find ways of solving other similar problems, as well as using everyday life situations as analogs in chemical treatments or inter-domain analogies [35]. The familiarity and affinity of the analog domain support the mapping of elements from the two domains and allows students to construct and examine their own knowledge, by engaging them to view and examine their knowledge through the analogy process [31].

The application of the analogy approach is able to develop students' understanding of specific concepts used in analogies, identify and analyze relationships between concepts, develop critical thinking skills, and help students connect new information with existing knowledge [32]. Teaching with analogs enables students to be active in the learning process, helps students connect new information with previous knowledge, to integrate information for one subject to another, and to relate classroom information to everyday experiences. The results of previous research also emphasized that analogies support learning that approaches and help students to build topics easily, such as abstract concepts on nonclassical, forms of organic compounds, and types of organic bonds [27]. On the other hand, the application of analogy is very pleasing to students, which makes learning more interesting and less boring [33]. A fun learning process is a very important factor in supporting

the achievement of effective learning.

The relevance of the chemical bond theory concept to *Sasak's* local wisdom is scientifically viewed from the perspective of inter-domain analogy, which is based on the concept of electron stability / stable electronic configuration, the concept of positive ions and negative ions, and the theory of chemical bond formation. Based on the traditional wedding procession (*merarik*) which is the local wisdom of the *Sasak* tribe of Lombok which is most closely related to the theory of chemical bonds. The relationship between the tradition of pulling with chemical bonds in terms of analogy perspective, namely the existence of similarities in the theory or concept that underlies it, and the meanings and values contained therein [36]. At the *nenaroh* (applying) event, especially when there is an agreement between the girl and the young man to get married, whether it is asked by the young man himself or through his *subandar* or shout (male representative). The underlying concept is the concept of mutual need, mutual giving, and receiving to live together, with the bonding relationship, namely a marriage relationship through the marriage contract process [22]. In chemical bond theory, the concept that underlies the formation of chemical bonds is the concept of giving and receiving an atom to achieve a stable electron configuration [37]. Atoms can be bonded because the atoms that are bonded are more stable than atoms in separate states. The tendency of an atom to achieve this stability can occur by forming chemical bonds between one atom and another. Atoms that are close to the noble gas configuration will try to achieve the noble gas configuration either by accepting or giving away their outer shell electrons so that positive and negative ions are formed by transferring electrons from one atom to another [37], for example, an unstable sodium atom releases one electron to become a  $\text{Na}^+$  ion in an electronic configuration such as neon. The 11 Na atom  $_{11}\text{Na}$  (2. 8. 1)  $\rightarrow$  Ion  $_{11}\text{Na}^+$  (2. 8) (2. 8. 1), while the unstable Cl atom receives an additional electron, thus becoming a Cl ion with an electronic configuration such as argon. 17 Cl atom  $_{17}\text{Cl}$  (2. 8. 7)  $\rightarrow$  Ion  $_{17}\text{Cl}^-$  (2. 8. 8). These two ions with opposite charges attract each other electrostatically in the ion lattice. The handover of electrons that occurs from the joining of the two atoms above is called an ionic bond. The concept of ionic bonds is very closely related to the tradition of *merarik* (marriage) in the *Sasak* tribe because the concept of *merarik* (marriage) in the *Sasak* tribe is also based on the principle of mutual need and complementarity to achieve one goal that not only unites two individuals but essentially unites two families in a bond known as *besan* or the man's family relationship with the woman [36]. In addition, the interaction between two or more atoms is always accompanied by an expenditure of energy. The concept of energy expenditure in the chemical bonding theory is analogous to the existence of the *ajikraman* tradition (the amount of customary payments), where the submission of all

customary payments is carried out in a ceremony called *sorong serah* [22]. The force that holds the atoms in the molecule is called chemical bonding [37]. Chemical bonds are the forces or interactions that cause atoms to bond together as molecules or cause atoms, ions, and molecules to bond together as more complex collections.

*Merarik* in the *Sasak* dictionary means marriage [10] as shown in Figure 1. *Merarik* in the *Sasak* dictionary means marriage [10]. *Merarik* in the *Sasak* community is done in two ways, namely *menaling* (elopeing bride candidate) and *belako* (proposing). Part of the procession *Merarik* in the *Sasak* community which has strong relevance to the theory of chemical bonding is a tradition known as the *Sorong serah* (dowry submission) and *Nenaroh* (proposing) or *Bekeotan* (questioning). The connection between these two activities with the theory of chemical bonds is on the equation of the theory or concept underlying it, the meaning, and the values contained in it. In the procession *Nenaroh*, this connection can be found in building an agreement between a girl and a young man to get married [16]. The concept that underlies the agreement is a sense of mutual need, mutual giving, and mutual acceptance to live together. The bond to live together between a girl and a man is done through the marriage process [17]. The *Sorong serah* is carried out through traditional ritual ceremonies to hand over the bride to the groom's family, which marks the transfer of responsibility from the bride's family to the bridegroom as shown in Figure 2. The *Sorong serah* is carried out through traditional ritual ceremonies to hand over the bride to the groom's family, which marks the transfer of responsibility from the bride's family to the bridegroom. The philosophy that underlies the *Sorong serah* ritual is very analogous to the concept of ionic bonds, namely the handover of electrons between positive ions and negative ions to achieve stability, such as the formation of Sodium Chloride, NaCl.



Figure 1. *Merarik* tradition (wedding) of the Sasak tribe

In the theory of chemical bonds, the concept underlying the formation of chemical bonds is the concept of giving and receiving electrons between atoms to achieve a stable electronic configuration [18] because atoms that have bonded with other atoms will be more stable than the stand-alone atoms [19].

The tendency of an atom to achieve stability can occur

by forming chemical bonds between one atom and another [15]. The bond is carried out to achieve a noble gas configuration by accepting or releasing electrons from the outer shell that is owned so that positive and negative ions are formed by transferring electrons from one atom to another. For example an unstable Sodium atom releases one valence electron so that positive ions (Na<sup>+</sup>) are formed with electron configurations such as neon; Atom 11Na (2. 8. 1) → Ion 11Na<sup>+</sup> (2. 8) while unstable Cl atoms receive extra electrons so that negative ions (Cl<sup>-</sup>) are formed with electron configurations such as argon; Atom 17Cl (2. 8. 7) → Ion 17Cl<sup>-</sup> (2. 8. 8) as shown in Figure 3. The formation of chemical bonds through the handover of electron pairs between positive ions and negative ions to achieve electronic stability is called ionic bonds [20].



Figure 2. *Sorong sarah* ceremony (dowry submission) in the *Merarik* tradition

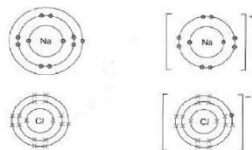


Figure 3. Handover of electrons in the formation of sodium chloride compound, NaCl

Not only is the concept of ion bonds related to the tradition of *Merarik* the Sasak tribe, but it is also related to the concept of forming metal bonds in the theory of chemical bonds formed by the attractive attraction that occurs between the positive charge of metal ions and the charge negative of free-moving electrons [21]. As for the relevance of the tradition of *Merarik*, especially in *Nenarih* activities, a girl is given the opportunity to give her own decisions without coercion from anyone. Submission of questions in *nenarih* activities can be done directly by the prospective husband or through a *Subandar* (delegation) or *Jerumanya* (youth body in the community) [22]. The aim is to clarify the status of the girl who is currently not promising another man to marry her. Furthermore, after obtaining certainty from the girl, it is determined when the girl will be taken to the prospective groom's house.

Usually, in the tradition of *Kavin lari* (elopeing bride candidate) in the Sasak tribe, which picks up the girl to be rushed (*te pating*) beside the groom, it is also accompanied by several men and women. Next, the girl who will be rushed is waiting outside the house. If the girl is successfully taken without interference, the girl is hidden in someone else's house, usually in the place of family members, not in the prospective husband's house. This is known as the '*Sebo*' tradition (hiding the bride candidate).

In addition, the interaction between two atoms or more is always accompanied by energy expenditure. The concept of energy expenditure on the theory of chemical bonding has a strong relationship with the existence of the *Afikrama* tradition (number of customary payments or related fee), in which the surrender of all customary prices is carried out in a ceremony called *Sorong sarah*. The force that holds atoms in a molecule is called a chemical bond. Chemical bonds are forces or interactions that cause atoms to be bonded together as molecules or cause atoms, ions, and molecules to be bonded together as more complex and stable bonds [23].

Table 1. Ethnochemistry in Sasak local wisdom

Sasak local wisdom	Chemistry subject matter
<i>Poteng reket</i> (sticky tape)	Chemical changes
<i>Sita</i> (salt)	Physics change (crystallization process) $NaCl_{aq} \rightarrow NaCl_{(s)}$
<i>Kopi hitam Sasak</i> (black coffee)	Physics change
<i>Gula beag</i> (brown sugar)	Caramelization process
<i>Nyelong</i> (virgin coconut oil)	Extraction process
<i>Tiak mant</i> (sap water)	Chemical changes <p>The reaction for the formation of the 5-hydroxymethyl-2-furaldehyde compound.</p>
<i>Kereng sesek</i> (woven fabric)	Chemical changes & Physics change

**Ethnochemistry: The relevance of the subject matter and its changes to local Sasak wisdom**

The concept of material and its changes integrated into local Sasak wisdom is reflected in the use of chemical elements from various types of metals such as gold, silver, bronze, copper, brass, and various other metals for the manufacture of traditional ceremonial tools and traditional Sasak arts. For example, the Sasak bride's jewelry is made of gold, silver, and bronze [22]. Compounds and mixtures are widely used in the life of the Sasak people, namely the manufacture of traditional art tools such as *gongs*, *terumpang*, *kenceng* and *kerts* which are made from a

combination of two or more metals [24]. Examples of physical changes found in local Sasak wisdom include the making of *sita* or salt, making *Sasak kopi hitam* (black coffee), and the tradition of *belulut* (coating the floors of traditional Sasak houses with cow dung). Examples of chemical changes are found in making *gula beag* (brown sugar), making *poteng reket* (sticky tape), *poteng ambon* (tape sweet potato), and *kereng sesek* (typical Sasak woven cloth). In the Sasak people, the technique of separating the mixture with crystallization techniques has been carried out from generation to generation and is still ongoing today, among others: in the process of making *sita* or salt by processing seawater, and for the manufacture of

beaq sugar or brown sugar from sap water. *Sasak* local wisdom that applies the principle of extraction is found in the manufacture of virgin coconut oil which is known in the *Sasak* tradition as "njeleng". The tradition of njeleng (making virgin coconut oil) is still ongoing today, especially when religious or traditional ceremonies are held such as *ngawitan* (wedding parties), *nyamatan* (circumcision), *begawe* (hajatan), and various other traditional ceremonies [22]. Local *Sasak* wisdom regarding the *njeleng* process, namely the manufacture of traditional *Sasak* medicinal oil known as "oat mandi" (a very potent medicine). This bath oat is made by certain people who are considered to have supernatural advantages and in the manufacturing process, it is preceded by a sacred ceremony (recitation of prayers). The ingredients of this medicinal concoction are only known by supernatural figures known as "belian *Sasak*" or shaman [25]. This *oat mandi* (a very potent medicine) is believed to be very effective in treating wounds. The results of ethnochemistry analysis in local *Sasak* wisdom are summarized in the following table 1.

In the Lombok *Sasak* tribe community, the use of various types of metal as an example of an element is reflected in the traditional ceremonial tools and traditional arts owned by the *Sasak* Lombok tribe, including:

(1) Tools for Traditional Ceremonies:

According to the traditions of the *Sasak* people, traditional ceremonial tools are objects that are considered sacred and have certain philosophical meanings. In the making of these ceremonial tools, many use metal elements such as gold, copper, iron, brass, and several other types of metal, as the following description. *Keris* is one of the objects that is considered sacred and is usually used during wedding ceremonies of the *Sasak* Lombok tribe, NTB.



Figure 4. Keris

The handle of the keris for the nobility is usually made of gold (Au) elements. Gold has an atomic number of 79. The arrangement of the outer electrons of gold is related to the yellow color property of gold. Metal colors are formed based on the transition of electrons between energy bands. The ability to absorb light at this wavelength to produce a distinctive gold color occurs due

to the d-bond transition which releases the position in the conduction band. Gold is considered a precious and precious metal. The chemical features of gold are shown by the stability of its chemical elements which can with stand rust and oxidation processes. Element Au (gold) crystallizes in the cubic face-centered (fcc) form as shown in Figure 5.

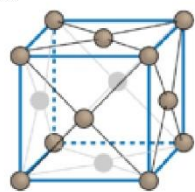


Figure 5. Cubic face centered (fcc) structure

(2) Traditional Art Tools: One of the traditional *Sasak* art tools that make use of zinc (Zn) as an ingredient and is known as "gula *gendeng*". This art tool is used by the *Sasak* people in selling *gula gendeng* (cotton sugar), where the sound emitted from this tool aims to attract the attention of buyers. The element zinc (Zn) has an atomic number of 30 and a mass number and a relative atomic mass of 65.39. Zinc is a metal that is bluish-white, lustrous and is diamagnetic. Zinc is capable of conducting electricity and compared to other metals it has relatively low melting points (420 °C) and boiling points (900 °C). Likewise, the melting point of zinc is the lowest of all the transition metals apart from mercury and cadmium. Zinc is slightly less dense than iron and has a hexagonal crystal structure as shown in Figure 6.

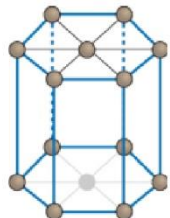


Figure 6. hexagonal crystal structure

Application of Ethnochemistry in Chemical Learning

Learning the concept of chemical bonds can be done by integrating the tradition of *Merarik* with the concept of chemical bonds (Ethnochemistry) in learning. First, students are asked to identify compounds found in daily life and discuss them in groups. Then each group was asked to choose salt or water compounds to analyze the types of bonds that make up that compound. The activity continued with presentations from each group to explain the concept of ionic bonds (surrender of electron pairs, the formation of positive and negative ions) in salt compounds, and the concept of covalent bonds (shared use of electron pairs) in water compounds to achieve a stable electronic configuration. Furthermore, through videos or pictures, traditional *Merarik* ceremonies (*Nenarih* and *Sorong serah*) from the *Sasak* tribe are displayed. Furthermore, students with teacher guidance analyze the relevance of tradition *Merarik* with ionic and covalent bonds based on the concept of analogy. The expected conclusion is that students know the basic principles of the *Merarik* tradition (*Nenarih* and *Sorong serah*) of the *Sasak* tribe is very analogous to the principle of ionic and covalent bonding based on the principle of mutual need, the concept of giving and receiving, and the cooperation to achieve stability. In this case, Ethnochemistry is used as a source of learning in studying chemistry, meaning understanding chemical concepts through everyday life experiences (contextual learning) so that learning will be more interesting and challenging for students. The activity continued with students conducting individual or paired investigations related to chemical ideas in Ethnochemistry. Ideas must be established through class discussions with teacher guidance so that can give students the opportunity to develop chemical knowledge independently (student-centered learning).

4. Conclusions

1. The chemical bond theory has relevance to the tradition of *Merarik* the *Sasak* tribe, Lombok, West Nusa Tenggara, Indonesia namely the tradition of *Nenarih* and *Sorong serah*.
2. The values of the local wisdom of the *Sasak* Lombok tribe are strongly related to the concept of chemical bonds reviewed in terms of philosophical values and analogies namely the concept of positive and negative ions, stable electron configuration, the theory of chemical bond formation, ionic and covalent bonds, metal bonds, hydrogen bonds and Van der Waals bonds.
3. The moral, social and spiritual values contained in the local wisdom of the tradition of *Merarik* are closely related to the basic principles of the theory of chemical bonds, namely the concept of mutual need, mutual giving and receiving in order to achieve

stability, tolerance, social solidarity, and the value of cooperation to achieve stability, peace, tranquility and shared prosperity.

4. Compounds and mixtures are widely used in the life of the *Sasak* people, namely the manufacture of traditional art tools such as gongs, terramping, and keneng which are made from a combination of two or more metals.
5. Examples of physical changes found in local *Sasak* wisdom include dyeing *Sesek* cloth, making *sia* or salt, and the tradition of *belulu* (coating the floors of traditional *Sasak* houses with cow dung). Examples of chemical changes are found in making *beaq sugar*, making *poteng reket* (sticky tape), and coloring *Sesek fabrics*.
6. The application of Ethnochemistry in chemistry learning can be used as a learning resource and instructional Media so learning will be more interesting and challenging for students (Contextual learning).

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## 09 Pengembangan Modul Kimia Berbasis Kearifan Lokal Kota Semarang pada Materi Larutan Asam Basa



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### Pengembangan modul kimia berbasis kearifan lokal Kota Semarang pada materi larutan asam dan basa

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#### ABSTRAK

Modul merupakan salah satu faktor penunjang keberhasilan proses pembelajaran. Penelitian ini bertujuan untuk mengembangkan modul kimia berbasis kearifan lokal Kota Semarang (kampung jamu dan kampung batik) pada materi larutan asam dan basa. Penelitian dan pengembangan ini dilakukan melalui tiga tahap, yaitu (1) tahap analisis kebutuhan (*define*), (2) perancangan prototype modul kimia (*design*), (3) validasi kepada ahli serta uji coba produk (*develop*). Uji coba dilakukan terhadap 9 peserta didik MA Uswatun Hasanah untuk mengetahui motivasi dan hasil belajar menggunakan modul kimia berbasis kearifan lokal. Hasil penelitian menunjukkan modul kimia yang telah dikembangkan dinyatakan valid oleh ahli materi (rerata 85,30%) dan ahli media (rerata 87,32%), serta memperoleh respon positif dari peserta didik yang dapat dilihat dari ketercapaian hasil belajar dan motivasinya. Dengan demikian dapat disimpulkan bahwa modul kimia berbasis kearifan lokal materi larutan asam dan basa layak digunakan dalam pembelajaran.

#### ABSTRACT

*Development of chemistry module based on local wisdom of Semarang City in acid and base solution topic. Modules are one of the factors supporting the success of learning process. The purpose of this research was to develop a chemistry module based on local wisdom of Semarang City (jamu and batik villages) in acid and base solution topic. This research and development was carried out through three stages, namely (1) needs analysis (define), (2) the design of chemistry module prototype (design), (3) experts validation and product trial (develop). Product trial were conducted on 9 students of MA Uswatun Hasanah to determine motivation and learning outcomes using chemistry module based on local wisdom. The results showed that the chemistry module that had been developed was declared valid by material experts (mean 85.30%) and media experts (mean 87.32%), as well as obtaining positive responses from students which could be seen from the achievement of learning outcomes and motivation. Thus, it can be concluded that the chemistry module based on local wisdom of the acid and base solution topic is feasible to be used in learning.*

#### Keywords:

Chemistry module

Local wisdom

Acid and base solution topic



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#### PENDAHULUAN

Kebudayaan dan pendidikan merupakan dua hal yang tidak dapat dipisahkan (Rahmawati, Yolida, & Marpaung, 2018). Pembelajaran dapat dikembangkan guru dengan mengacu kearifan lokal suatu daerah sebagai upaya untuk mengenalkan keunikan, budaya, tradisi suatu daerah (Damayanti, Dewi, & Akhlis, 2013), serta kegiatan masyarakat dalam menangani masalah lingkungan (Ajayi, Achor, & Agogo, 2017). Oleh karena itu, guru dapat memanfaatkan alam dan fenomena yang terjadi di lingkungan sekitar sebagai sumber belajar IPA (Karyadi, Ruyani, Susanta, & Dasir, 2016), salah satunya pada pembelajaran kimia.

Kimia merupakan kajian mengenai komposisi, struktur, properti, dan reaksi materi (Kotsalas, Antoniou, & Scoullou, 2017). Penyampaian materi kimia dengan topik yang asing bagi peserta didik menyebabkan peserta didik mengalami kesulitan dalam memahami materi kimia (Singh & Chibuiye, 2016). Sebaliknya, jika konsep yang dipelajari berhubungan dengan kehidupan sehari-hari peserta didik maka akan menghasilkan pembelajaran yang bermakna (Asmaningrum, Koirudin, & Kamariah, 2018; Sari & Sugiyarto, 2015).

Kota Semarang merupakan salah satu kota industri di Provinsi Jawa Tengah. Industri rumah tangga dapat menjadi salah satu sumber pembelajaran kimia, misalnya pada industri jamu dan batik. Guru dapat mendesain proses pembelajaran menggunakan bahan-bahan pembuatan jamu, misalnya asam jawa dan brotowali untuk materi identifikasi sifat larutan. Sedangkan pada industri batik biasanya digunakan bahan pewarna alami seperti kunyit dan bunga Bougainville yang dapat dijadikan indikator alami asam dan basa.

Proses pembelajaran seharusnya juga menerapkan penguasaan *minds-on* (kognitif), *hearts-on* (afektif), serta aspek *hands-on* (psikomotor) (H. Hartini, Narulita, & Iqbal, 2019). Untuk menunjang hal tersebut diperlukan sarana dan prasarana pendukung, misalnya media pembelajaran (Wahyuni & Kurniawan, 2019; Widiyati & Nurwahidah, 2018). Penggunaan media menjadikan komunikasi antara guru dan siswa berjalan lancar sehingga materi dapat tersampaikan dengan baik (Hidayati & Rizal, 2019; Taufiq, Dewi, & Widiyatmoko, 2014).

Modul merupakan salah satu media penunjang keberhasilan proses pembelajaran (Hasanah & Wahyuni, 2016; Tampubolon, 2015). Guru dapat menggunakan modul untuk memaksimalkan pemahaman peserta didik (DeWit, Siraj, & Alias, 2014; Wulandari, Widiyati, & Sari, 2019). Oleh karena itu, modul harus dikemas secara menarik, efisien, inovatif, disesuaikan dengan kebutuhan dan karakteristik peserta didik (Arimadona & Silvina, 2019), serta mengenalkan kebudayaan di daerah peserta didik (Fitri, Izzatin, & Ferryansyah, 2019). Modul pembelajaran dapat dikembangkan dengan memperhatikan kearifan lokal daerah sehingga membuat peserta didik dapat diarahkan sesuai tujuan pembelajaran, serta meningkatkan kesadaran peserta didik untuk menjaga, melestarikan dan mengembangkan lingkungannya (Saputra & Wahyuni, 2017).

Hasil observasi awal pada pembelajaran kimia di MA Uswatun Hasanah menunjukkan bahwa pembelajaran yang dilakukan guru belum mengkaitkan kearifan lokal. Materi yang disampaikan terbatas sesuai kurikulum. Pemanfaatan lingkungan sekitar sebagai sumber pembelajaran kurang optimal dan belum mengintegrasikan antara nilai-nilai budaya yang terkandung dengan materi yang sedang diajarkan. Fakta menunjukkan hanya 41,17% peserta didik kelas XI MA Uswatun Hasanah Semarang yang mencapai nilai KKM (Kriteria

Ketuntasan Minimal) pada mata pelajaran kimia yaitu 73. Selain itu, guru juga masih menggunakan metode pembelajaran konvensional seperti ceramah, demonstrasi dan diskusi sehingga peserta didik menjadi kurang termotivasi dan cenderung pasif dalam proses pembelajaran. Kajian materi pada buku pegangan yang digunakan peserta didik juga belum mengintegrasikan budaya, latar belakang, maupun pengalaman peserta didik dalam proses pembelajaran. Hal ini menjadikan peserta didik kurang memahami penerapan konsep kimia pada kehidupan sehari-hari.

Penelitian terdahulu telah menguji keefektifan pembelajaran berbasis kearifan lokal, di antaranya mampu meningkatkan prestasi belajar (Shidiq, 2016), kecintaan terhadap budaya lokal di lingkungan sekitar (Damayanti et al., 2013), menumbuhkan nilai karakter konservasi (Khusniati, 2014; Rahayu, W. E., & Sudarmin, 2015). Penelitian lain juga telah mengembangkan dan menguji keefektifan modul berbasis kearifan lokal, yaitu dapat meningkatkan minat (Munawaroh, Prihandono, & Waluyuni, 2017), kemampuan berpikir kreatif (Almuharomah, Mayasari, & Kurniadi, 2019), serta literasi sains (Sudarmim & Samini, 2015). Namun, kajian secara khusus yang membahas pengembangan modul berbasis kearifan lokal pada materi kimia masih jarang dilakukan, misalnya pada larutan asam dan basa. Materi ini sangat mendukung pengembangan aspek kognitif, afektif dan psikomotor serta kepedulian peserta didik terhadap lingkungan. Oleh karena itu, penting dilakukan penelitian mengenai pengembangan modul kimia berbasis kearifan lokal Kota Semarang pada materi larutan asam dan basa untuk meningkatkan motivasi dan hasil belajar peserta didik.

## METODE

### Jenis Penelitian

Penelitian dan pengembangan ini menggunakan desain 4-D model (Thiagarajan, S., Semmel, D. S., & Semmel, 1974). Model ini terdiri dari 4 tahap yakni (1) *define*, (2) *design*, (3) *develop* dan (4) *disseminate*. Namun, penelitian ini hanya dilakukan sampai tahap ke-3 saja. Tahap *disseminate* (penyebar luasan produk) tidak dilakukan oleh peneliti.

### Waktu dan Tempat Penelitian

Penelitian dilaksanakan dari bulan April sampai bulan September 2018. Bertempat di kampus UIN Walisongo Semarang dan di MA Uswatun Hasanah.

### Populasi dan Sampel

Populasi dalam penelitian ini adalah seluruh peserta didik kelas XII MA Uswatun Hasanah dan teknik sampling dalam penelitian ini yaitu *random sampling*. Sampel yang digunakan yakni 9 orang peserta didik kelas XII IPA yang mewakili peserta didik berkemampuan tinggi, sedang dan rendah dengan jumlah masing-masing 3 orang.

### Prosedur Penelitian

Model pengembangan yang digunakan pada penelitian ini adalah model 4-D (Thiagarajan, S., Semmel, D. S., & Semmel, 1974), yaitu (1) tahap analisis kebutuhan (*define*), (2) perancangan prototype modul kimia (*design*), (3) validasi kepada ahli serta uji coba produk (*develop*) dan (4) penyebarluasan produk (*disseminate*). Namun, penelitian hanya dilakukan sampai tahap ketiga saja, yaitu *develop*. Skema pengembangan modul kimia berorientasi kearifan lokal disajikan pada Gambar 1.



Gambar 1. Skema pengembangan modul kimia berorientasi kearifan lokal Kota Semarang

Tahap *define* terdiri dari lima langkah, yakni (1) identifikasi masalah, (2) analisis karakteristik peserta didik, (3) analisis tugas, (4) analisis konsep materi, dan (5) merumuskan tujuan pembelajaran. Identifikasi masalah dilakukan dengan wawancara guru kimia, peserta didik MA Uswatun Hasanah terkait kegiatan belajar di kelas, metode pembelajaran yang digunakan guru, serta pencapaian hasil belajar peserta didik kelas XI pada materi pelajaran kimia. Langkah analisis karakteristik peserta didik dilakukan dengan penyebaran angket kebutuhan peserta didik. Selanjutnya, menganalisis tugas-tugas peserta didik yang diberikan oleh guru dalam proses pembelajaran untuk mengetahui tingkat penguasaan peserta didik pada materi larutan asam dan basa sesuai standar kompetensi minimal. Langkah keempat yaitu menganalisis konsep pokok materi larutan asam dan basa, kompetensi inti, kompetensi dasar dan indikator pembelajaran. Selanjutnya, merumuskan tujuan pembelajaran berdasarkan indikator pencapaian pembelajaran pada langkah analisis konsep dan analisis kurikulum. Hal ini dilakukan modul kimia berbasis kearifan lokal yang dikembangkan sesuai silabus pada kurikulum 2013.

Tahap kedua yakni *design* atau merancang *prototype* produk dilakukan dengan mengumpulkan referensi mengenai konsep materi larutan asam dan basa berbasis kearifan lokal kota Semarang. Selanjutnya memilih format modul sesuai dengan standar BSNP 2014, dan membuat rancangan awal modul sesuai dengan indikator pencapaian. Tahap terakhir yaitu *develop* dengan tujuan memvalidasi produk modul yang dikembangkan dan diujikan pada skala terbatas.

### Data, Instrumen dan Teknik Pengumpulan Data

Data yang diperoleh pada penelitian ini dapat dibedakan menjadi data kualitatif dan data kuantitatif. Data kuantitatif berupa hasil penilaian ahli materi, ahli media, dan peserta didik sedangkan data kualitatif diperoleh dari adanya saran dan kritik yang diberikan oleh responden.

Instrumen yang digunakan dalam penelitian ini adalah angket, lembar observasi dan pedoman wawancara. Angket yang disusun berupa angket kebutuhan peserta didik, validasi media dan respon peserta didik terhadap modul kimia berorientasi kearifan lokal.

### Teknik Analisis Data

Analisis data yang digunakan pada penelitian ini adalah analisis deskriptif dan analisis inferensial meliputi data hasil angket validasi produk modul yang dikembangkan, serta data angket tanggapan peserta didik.

## HASIL DAN PEMBAHASAN

Modul kimia berbasis kearifan lokal Kota Semarang (kampung jamu dan kampung batik) pada materi larutan asam dan basa telah selesai dikembangkan. Modul ini bertujuan untuk mempermudah peserta didik dalam memahami materi larutan asam dan basa. Modul ini

dikembangkan dengan paradigma konstruktivisme. Hal ini dapat membuat peserta didik mampu membangun konsep materi secara mandiri (Sari & Wulanda, 2019). Materi yang disajikan pada modul juga dikaitkan dengan kehidupan sehari-hari dan kearifan lokal Kota Semarang mengenai pembuatan batik dan jamu dengan tujuan peserta didik memahami materi larutan asam dan basa secara menyeluruh. Karyadi et al. (2016) menyatakan bahwa proses pembelajaran berbasis kearifan lokal mampu membuat peserta didik menggunakan kemampuan sainsnya untuk memahami lingkungan hidup.

Pengembangan modul kimia berbasis kearifan lokal Kota Semarang (kampung batik dan kampung jamu) mengacu pada model pengembangan Thiagarajan yaitu *define, design, develop*. Berdasarkan hasil observasi pada tahap *define*, diperoleh fakta bahwa metode pembelajaran yang sering digunakan oleh guru yaitu ceramah, demonstrasi dan diskusi. Proses pembelajaran juga masih berpusat pada guru (*teacher centered learning*) sehingga peserta didik cenderung menjadi pasif saat proses pembelajaran dan minat terhadap pembelajaran kimia rendah. Hal ini senada dengan pernyataan Iwakumi (2017) serta Yulina, Permanasari, Hernani, & Setiawan (2019) bahwa penggunaan model dan media pembelajaran yang tepat dapat mempengaruhi motivasi dan pencapaian hasil belajar peserta didik. Materi pelajaran yang disajikan hanya sesuai kurikulum, belum mengintegrasikan antara nilai-nilai budaya yang terkandung dengan materi yang sedang diajarkan. Guru juga jarang memanfaatkan lingkungan sekitar sebagai sumber pembelajaran. Berdasarkan hasil wawancara guru, peserta didik kelas XI MA Uswatun Hasanah yang tuntas pada mata pelajaran kimia hanya 41,17% dengan nilai KKM (Kriteria Ketuntasan Minimal) yaitu 73. Respon peserta didik MA Uswatun Hasanah kelas XII IPA terhadap pembelajaran kimia juga dikategorikan cukup dengan rata-rata 59,25%.

Angket ATCL (*Attitude Toward Chemistry Lessons*) juga diberikan pada peserta didik MA Uswatun Hasanah kelas XI untuk mengetahui tingkat motivasi peserta didik pada pembelajaran kimia. Hasil analisis menunjukkan bahwa peserta didik memiliki motivasi cukup rendah dalam pembelajaran kimia, yang ditunjukkan pada Tabel 1. Oleh karena itu, peneliti mengembangkan modul kimia berorientasi kearifan lokal sebagai alternatif media pembelajaran dengan tujuan meningkatkan minat dan motivasi peserta didik dalam pembelajaran kimia.

Tabel 1. Hasil analisis angket ATCL

Aspek	Presentase	Kategori
Menyukai teori kimia	57,3%	Cukup
Menyukai praktikum kimia	68,88%	Baik
Keyakinan siswa tentang kimia	59,25%	Cukup
Kecenderungan belajar kimia	51,11%	Kurang

Langkah selanjutnya yaitu melakukan analisis terhadap tugas-tugas yang diberikan guru kepada peserta didik. Berdasarkan hasil analisis, diperoleh fakta bahwa tugas yang diberikan guru berupa soal-soal dari LKS dan buku paket yang ditugaskan pada pertengahan proses pembelajaran. Namun, soal-soal tersebut hanya berupa pertanyaan terkait materi dan belum mengintegrasikan kearifan lokal Kota Semarang.

Analisa konsep dilakukan untuk mengidentifikasi konsep dasar dalam penyusunan materi pada modul berorientasi kearifan lokal. Hal ini untuk memudahkan peserta didik dalam mencapai kompetensi yang diharapkan (Fuadi, Sumaryanto, & Lestari, 2014). Konsep utama materi larutan asam dan basa yang harus diajarkan dan diharapkan dapat dikuasai peserta didik dianalisis berdasarkan silabus kimia kelas XI kurikulum 2013. Kompetensi dasar dan indikator pembelajaran yang diharapkan dapat dicapai peserta didik melalui pembelajaran menggunakan modul berbasis kearifan lokal pada materi larutan asam dan basa disajikan pada Tabel 2.

Tabel 2. Kompetensi dasar dan indikator pembelajaran materi larutan asam dan basa

Kompetensi Dasar	Indikator Pembelajaran
3.10 Memahami konsep asam dan basa serta kekuatannya dan keseimbangan pengionannya dalam larutan.	(1) Siswa mampu memahami kandungan sifat asam dan basa yang ada dalam asam jawa, dan brotowali. (2) Siswa mampu menjelaskan konsep asam basa Arrhenius, Brownsted Lowry dan Lewis. (3) Siswa mampu menentukan sifat larutan asam basa menggunakan berbagai indikator asam basa. (4) Siswa mampu menentukan jenis larutan asam basa berdasarkan pengukuran pH. (5) Siswa mampu menganalisis kekuatan asam basa berdasarkan proses ionisasinya. (6) Siswa mampu menghitung konsentrasi larutan asam-basa. (7) Siswa mampu menghitung pH larutan asam basa.
4.10 Menentukan trayek perubahan pH beberapa indikator yang diekstrak dari bahan alam	(1) Siswa mampu merancang percobaan membuat indikator asam basa dari bahan alam bunga Bougenville. (2) Siswa mampu melakukan percobaan membuat indikator alam dengan menggunakan bunga bougenville. (3) Siswa mampu mengamati perubahan warna yang dihasilkan dari indikator alami bunga bougenville. (4) Siswa mampu menganalisis perubahan warna yang dihasilkan dari indikator alami bunga bougenville.

Pada tahap *design* (perancangan), modul dikembangkan sesuai hasil analisis kebutuhan peserta didik. Langkah pertama yang harus dilakukan pada tahap *design* adalah menyusun indikator, sebagai acuan dalam pembahasan materi yang ingin dicapai. Selanjutnya, menentukan sumber belajar terkait kearifan lokal Kota Semarang. Modul yang dikembangkan juga berisi pertanyaan-pertanyaan dan apersepsi untuk mengajak peserta didik termotivasi mempelajari materi pada modul. Materi pada modul dikembangkan dengan mengkaitkannya pada aplikasi kehidupan sehari-hari dan kearifan lokal Kota Semarang yaitu proses pembuatan batik dan bahan-bahan pembuatan jamu. Desain modul yang dikembangkan adalah sebagai berikut : (a) cover depan, (b) halaman sampul, (c) kata pengantar, (d) daftar isi dan karakteristik modul, (e) pendahuluan meliputi KI, KD dan indikator, petunjuk penggunaan modul, peta konsep larutan asam basa, pesona kearifan lokal, f) konten atau penjabaran materi pembelajaran, g) wawasan kearifan lokal, h) informasi pendukung, i) latihan soal, j) rangkuman materi, k) glosarium, l) evaluasi dan kunci jawaban dan, m) daftar pustaka. Contoh materi yang disajikan pada modul kimia berbasis kearifan lokal. Contoh isi dalam modul disajikan pada Gambar 2.



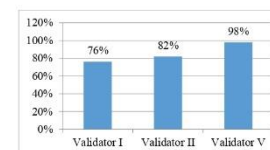
Gambar 2. Tampilan isi pada modul berbasis kearifan lokal Kota Semarang

Pada bagian pendahuluan disajikan pesona kearifan lokal Kota Semarang, yaitu kampung jamu dan kampung batik. Hal ini bertujuan untuk membangkitkan minat peserta didik untuk mempelajari materi larutan asam dan basa dan keterkaitannya dengan kearifan lokal yang ada di lingkungan peserta didik. Oleh karena itu, diharapkan seluruh peserta didik yang berada di suatu wilayah tertentu dapat memahami dan mengaplikasikan konsep sains yang dipelajari dalam kehidupan sehari-hari. Hal ini senada dengan pernyataan Saputra & Wahyuni (2017) bahwa pembelajaran berbasis kearifan lokal meningkatkan kemampuan peserta didik dalam mengkaji dan menelaah secara ilmiah fenomena alam di lingkungan sekitar. Peserta didik juga akan merasa senang melalui pembelajaran berbasis kearifan lokal (Hasanah & Wahyuni, 2016). Tampilan pesona kearifan lokal Kota Semarang terkait materi larutan asam dan basa disajikan pada Gambar 3.



Gambar 3. Tampilan halaman pesona kearifan lokal Kota Semarang

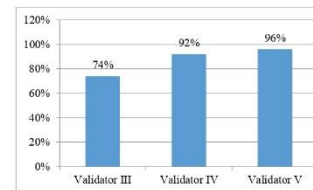
Pada tahap *develop* (pengembangan) dilakukan validasi kepada ahli. Validasi ini dilakukan melalui dua tahap, yaitu validasi ahli media dan validasi ahli di bidang materi kimia. Validasi ditujukan kepada empat orang dosen kimia dan satu orang guru kimia. Penilaian kualitas produk media yang telah dikembangkan didasarkan beberapa aspek dan indikator yang telah ditentukan. Hasil penilaian modul oleh ahli materi dapat dilihat pada Gambar 4.



Gambar 4. Hasil validasi modul kepada ahli materi

Berdasarkan grafik pada Gambar 4, terlihat bahwa persentase keidealan media berdasarkan penilaian dari ahli materi untuk validator I sebesar 76%, validator II yaitu 82% dan validator V yaitu 98%. Rata-rata persentasenya adalah 85,30%. Hal ini menunjukkan bahwa modul yang dikembangkan sudah memenuhi aspek kelayakan isi, aspek kebahasaan, aspek teknik penyajian maupun aspek kearifan lokal.

Hasil validasi produk modul yang ditujukan kepada ahli media disajikan pada Gambar 5.



Gambar 5. Grafik Validasi Ahli Media

Berdasarkan grafik pada Gambar 5, persentase keidealan media berdasarkan validasi kepada ahli media sebesar 74% oleh validator III, 92% oleh validator IV dan 96% oleh validator V. Rata-rata persentasenya adalah 87,32%. Hal ini menunjukkan bahwa modul yang dikembangkan sudah memenuhi aspek penyajian modul, aspek kelayakan kegrafikan maupun aspek kualitas tampilan. Perbandingan persentase keidealan media berdasarkan validasi dari ahli materi maupun ahli media disajikan pada Gambar 6.

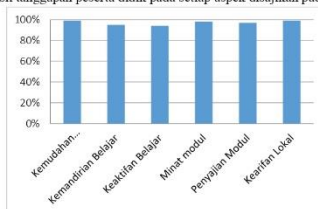


Gambar 6. Perbandingan rata-rata skor keidealannya media berdasarkan validasi

Berdasarkan Gambar 6, persentase keidealannya media berdasarkan hasil penilaian dari ahli materi maupun ahli media secara keseluruhan termasuk dalam kategori baik, sehingga dapat disimpulkan bahwa modul pembelajaran kimia berbasis kearifan lokal layak digunakan dalam uji coba terbatas.

Kegiatan praktikum yang ada pada modul memungkinkan peserta didik untuk terlibat aktif dalam proses pembelajaran. Senada dengan pernyataan Sari & Wulanda (2019), kegiatan praktikum dapat mengakomodasi peserta didik untuk mengembangkan kemampuan *hands-on* maupun *minds-on* nya dengan baik. Aktivitas peserta didik juga meningkat melalui penggunaan modul berbasis kearifan lokal pada pembelajaran (Safitri, Subiki, & Wahyuni, 2018). Hasil penelitian ini sejalan dengan penelitian yang dilakukan Hartini, Misbah, & Resy (2017) dan Saputra & Wahyuni (2017) yang menunjukkan bahwa penggunaan modul berbasis kearifan lokal meningkatkan hasil belajar peserta didik.

Tahap selanjutnya yaitu melakukan uji coba terbatas produk modul kimia yang telah dikembangkan kepada 9 orang peserta didik kelas XII MA Uswatun Hasanah yang mewakili peserta didik berkemampuan tinggi, sedang dan rendah dengan jumlah masing-masing 3 orang. Peserta didik diminta untuk memberikan tanggapan mengenai produk modul kimia berbasis potensi lokal yang dikembangkan. Angket respon yang diberikan kepada peserta didik meliputi 6 komponen, yaitu (1) kemudahan memahami materi, (2) kemandirian belajar, (3) keaktifan belajar, (4) minat modul, (5) penyajian modul, dan (6) kearifan lokal. Perbandingan hasil tanggapan peserta didik pada setiap aspek disajikan pada Gambar 7.



Gambar 7. Perbandingan hasil tanggapan peserta didik terhadap modul kimia berbasis potensi lokal untuk setiap komponen

Berdasarkan Gambar 7, terlihat bahwa tanggapan peserta didik pada komponen **kemudahan dalam memahami materi** modul memperoleh persentase skor tinggi yaitu 99%. Hal ini menunjukkan bahwa penyajian materi yang terdapat dalam modul mudah dipahami dan peserta didik merasa senang belajar menggunakan modul berorientasi kearifan lokal. Adanya uraian, contoh dan latihan soal yang disajikan dalam modul menarik dan disertai dengan gambar-gambar, sehingga memudahkan peserta didik dalam mengkaitkan ilmu kimia dengan kearifan lokal. Uraian materi dan keseluruhan isi modul diawali dengan pertanyaan-pertanyaan yang lebih menekankan pada proses dan menuntun peserta didik dalam menemukan konsep.

Hasil angket tanggapan peserta didik pada aspek **kemandirian belajar** memperoleh skor 95%. Hal ini menunjukkan bahwa pembelajaran dengan modul kimia berbasis potensi lokal menjadikan peserta didik menjadi lebih mandiri dalam belajar, misalnya melalui konten ayo kenali lingkungan, contoh soal dan pembahasannya, serta latihan soal. Kouten ayo kenali lingkungan mengajak peserta didik untuk mengamati, mengidentifikasi fenomena yang ada di lingkungan terkait materi yang sedang dipelajari, sehingga dapat menumbuhkan sifat percaya diri dan inisiatif. Hal ini sejalan dengan pernyataan Prama & Dewi (2014) bahwa peserta didik memiliki kemandirian belajar apabila mempunyai sifat percaya diri, motivasi, inisiatif, disiplin dan tanggung jawab.

Hasil angket tanggapan peserta didik pada aspek **keaktifan belajar** memperoleh skor 94%. Pada modul berorientasi kearifan lokal terdapat contoh soal yang mudah dipahami sehingga membuat peserta didik semangat dalam mengerjakan latihan soal yang terdapat di modul. Keaktifan dalam kegiatan belajar dapat meningkatkan kemampuan peserta didik dalam mengkonstruksikan pengetahuannya sendiri seperti memproses segala informasi yang diperoleh dari lingkungan (Nurwahidah, Sarwi, & Handayani, 2012).

Hasil angket peserta didik pada aspek **minat** terhadap modul mendapatkan persentase keidealannya sebesar 98%. Peserta didik memberikan tanggapan bahwa modul berorientasi kearifan lokal menggunakan bahasa yang mudah dipahami dan dilengkapi gambar yang *full color*, sehingga menarik minat mereka untuk mempelajari modul. Minat dan motivasi berkaitan erat dengan sikap belajar yang positif. Peserta didik yang memiliki sikap belajar positif akan belajar lebih aktif dan akan memperoleh hasil yang lebih baik dibandingkan peserta didik yang memiliki sikap belajarnya negatif (Hartati, 2015).

Hasil angket tanggapan peserta didik pada komponen **penyajian modul** memperoleh skor 97%. Hal ini menunjukkan bahasa yang digunakan dalam modul yang dikembangkan mudah dimengerti dan dipahami oleh peserta didik. Selain itu, gambar yang disajikan dalam modul jelas dan mempermudah peserta didik dalam memahami materi. Modul yang menarik dan didukung dengan bahasa yang komunikatif akan memudahkan peserta didik dalam memahami materi serta meningkatkan rasa ingin tahu peserta didik. Pernyataan tersebut sejalan dengan Prastowo (2012) yang menjelaskan bahwa bahasa yang digunakan pada modul harus komunikatif, mudah diterima peserta didik sesuai dengan tingkat pemahamannya, serta cakupan bahasan yang terfokus dan terukur.

Pada aspek **kearifan lokal**, persentase keidealannya yang diperoleh sebesar 99%. Hal ini menunjukkan pembelajaran kimia berbasis kearifan lokal dapat meningkatkan minat peserta didik dalam belajar sehingga akan berdampak positif terhadap hasil belajarnya. Hal ini sejalan

dengan Ajayi et al. (2017) yang menyatakan bahwa penggunaan pendekatan pembelajaran etnokimia meningkatkan prestasi dan restensi peserta didik.

#### SIMPULAN DAN SARAN

##### Simpulan

Kualitas modul kimia berorientasi kearifan lokal dibuktikan dengan validasi ahli dan angket tanggapan peserta didik. Validasi ahli materi dan ahli media kategori "Sangat Baik" dengan persentase sebesar 85,3% dan 87,3%.

##### Saran

Rekomendasi atau saran dari penelitian ini yaitu (1) modul kimia berbasis kearifan lokal Kota Semarang materi asam dan basa perlu diterapkan dalam kelas kecil, (2) modul kimia berbasis kearifan lokal perlu dikembangkan lebih lanjut dengan materi dan tingkat kelas yang berbeda agar dihasilkan produk baru.

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# 10 On the Development of Learning Designs for the Inclusion of Indigenous Science in the Context of Chemistry Education to Foster Education for Sustainable Development



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## On the Development of Learning Designs for the Inclusion of Indigenous Science in the Context of Chemistry Education to Foster Education for Sustainable Development

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### ABSTRACT

This paper reports a three year research and development project on the design of a lesson plan based on an educational research framework for the inclusion of a local indigenous cultural context into chemistry education. The research was intended to foster education for sustainable development (ESD) and to enhance the relevance in chemistry learning by integrating intercultural and multi-perspective scientific worldviews. The development of the learning designs involved different research phases, namely (a) exploring the content and context of indigenous science related to sustainability issues for their use in chemistry education, (b) implementing teaching interventions to identify students' views towards the topic and the lesson plan, and (c) investigating the students' ideas and arguments related to the issues in question. In search of effective implementation of learning designs, two lesson plans and corresponding teaching and learning materials were developed. Selected aspects from the implementation are described.

**Keywords:** Chemistry education, Curriculum development, Indigenous knowledge, Education for sustainable development.

### 1. INTRODUCTION

Based on the Agenda 21, the UNESCO has launched the world Decade for Education for Sustainable Development (DESD) from 2005-2014 [1]. This program was proposed to integrate education for sustainable development (ESD) into education in all subjects and on all educational levels, among them secondary and tertiary chemistry education. This program was suggested necessary to equip the future generation with important skills to participate in sustainable development and to live sustainably in the future.

In parallel to the DESD, ESD has started to become implemented in secondary chemistry education slowly and basically starting from Western countries, e.g. [2] [3] [4]. Indications from the implementation of ESD suggest that ESD in chemistry education can promote the relevance of science learning in terms of relevance for students' individual daily lives, their life in society,

and with relationships to potential careers [5]. The implementation of ESD in Asian countries, especially in Indonesia, so far stepped behind. Its implementation was limited to short programs only and mainly restricted to higher education [6] [7]. Therefore, the development and implementation of curricula that support ESD in chemistry education in Indonesia are required.

Content and contexts for ESD should take the living context of the learners into consideration, e.g. in terms of Indonesia, referring to the geographical, cultural, and socio-economic conditions of Indonesian students [8] [9]. Indonesia is a multi-ethnic and multi-cultural society. There is a lot of traditional knowledge, known as indigenous knowledge, that instills local wisdom and values about nature and sustainable use of natural resources to meet the needs of local societies [7] [10]. This knowledge includes the application of scientific concepts and practices (indigenous science) in combination with culture and



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philosophical values that are respected in the corresponding society to protect nature and achieve sustainability [11]. This indigenous knowledge context is suggested to have potential to be integrated into science and chemistry learning to contribute to ESD [7] [11].

Research and development on the inclusion of indigenous knowledge in the context of chemistry learning to foster ESD has been increased during the last years [7] [8] [10] [11] [12] [13]. First studies attempted to reconstruct and integrate indigenous knowledge into the science curriculum in Indonesia on the upper secondary school and university levels. This paper reports the process of curriculum development on the inclusion of the indigenous knowledge of the Baduy community into chemistry education and reflecting on its implementation.

### 2. THEORETICAL FRAMEWORK

The educational design framework for this project intended to integrate indigenous science and indigenous perspectives on sustainability into chemistry education in Indonesia. The design process was guided by an educational research framework (Figure 1) [11] adapted from the Model of Educational Reconstruction (MER) [14]. This educational research framework integrates views from indigenous knowledge and Western modern science to analyse content structures and related contextual knowledge for evidence-based curriculum development and research on teaching and learning based in altered or newly developed learning designs.

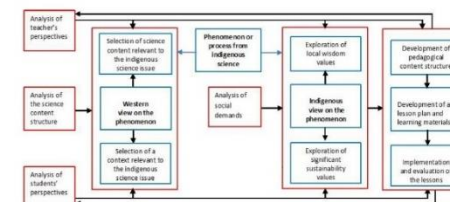


Figure 1 Educational design framework to reconstruct and integrate indigenous science and Western modern science for curriculum development in science education [11].

### 3. RESEARCH PROCESS and FINDINGS

The research and development process has been conducted over three years. The focus was the inclusion of indigenous knowledge into the context of chemistry education. The study was conducted with student teachers and upper secondary school students to evaluate potential effects of learning designs. According to the educational research framework in Figure 1, the curriculum development process included three phases, namely (1) exploring indigenous science related to relevant sustainability issues, (2) developing the teaching interventions and identifying students' perspectives toward the topic,

and (3) mapping students' views and arguments on the application of indigenous science.

#### 3.1 Exploration of indigenous science related to sustainability issues for its use in chemistry education

The initial study was an ethnographic research to explore indigenous science relevant to chemistry education in Indonesia [10]. This research was related to a general clarification of the concept and analysis of the state-of-the-art of using indigenous science in science education [11]. The ethnographic study involved observations, interviews and focus group discussions with the indigenous people of the Baduy on Java, Indonesia. A triangulation of data was utilized



to ensure validity by comparing the field data with other existing literature related to indigenous science of the Baduy community. Based on the data, the inventory of indigenous science was further analysed to see any relationship to the content in the Indonesian chemistry education curriculum. The analysis encompassed thematic analyses focusing exemplary topics to be used as contexts for chemistry learning. The content and contexts identified in the indigenous

science of the Baduy were reflected based on five criteria for selecting socio-critical and problem-oriented issues for science teaching [15] with relation to a context-based socio-constructivist pedagogical approach as described by Juntunen and Aksela [16]. This analysis identified potential topics from indigenous science related to sustainability to be used for socio-scientific issues-based chemistry learning [7] (Figure 1).

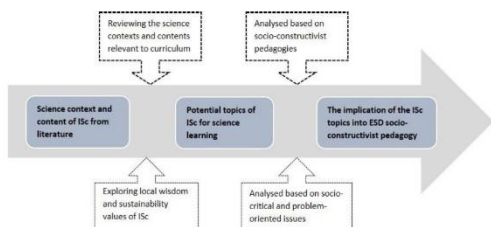


Figure 2 Analysis of integrating indigenous science (ISc) into socio-critical and problem-oriented chemistry education [7].

From the analysis, the topic of pesticides use was chosen for updating chemistry learning related to sustainability and inspired by indigenous knowledge. The topic was called "Bio-rational control of pest insects using indigenous materials vs synthetic pesticides". It was inspired by the local wisdom, philosophy and sustainability values of the Baduy community, who utilize botanical pesticides from indigenous plant extracts to repel pest insects. The related chemistry content of the topic encompasses organic compounds, pesticides, phytochemistry, and analytical chemistry. The sustainability aspects to be learned from this topic are to learn about risk-benefit analysis between synthetic and green pesticides as well as green chemistry approaches to isolate and explore eco-benign pesticides [7]. For implementing the topic into chemistry education, green chemistry principles can become an issue for the practice of science education practical work, sustainability strategies can become content in the chemistry curriculum, and socio-scientific issues-based learning can be operated [17].

### 3.2 Developing the teaching interventions

In the research and development process, two learning designs were produced. The first learning design focuses the controversial sustainability issues of pesticides use from the perspectives of indigenous knowledge and Western modern science. The second learning design attempts to introduce indigenous knowledge as a starting point to learn about green and sustainable chemistry and corresponding practical work.

#### 3.2.1 Learning design 1: Chemistry learning about pesticides use based on different perspectives taken from indigenous and Western modern science

The first learning design focuses on the controversial sustainability issue of pesticides use. The lesson plan was developed with two groups on different educational levels, encompassing upper secondary school students and university chemistry student teachers in Indonesia. The main activities start from the controversial issues of pesticides use to encourage learners to think critically, express their

arguments, and solve chemistry problems behind the issue. The description of the lesson plan is given in Table 1.

Table 1. The first learning design on pesticides use in chemistry education

Learning Steps	Description
Step 1: Exploring prior personal knowledge	<ul style="list-style-type: none"> <li>- Brainstorming what students know about pesticides use</li> <li>- Discussing any knowledge about the context or topic</li> <li>- Identifying students' initial ideas and opinions connected to the chemistry context of the lesson plan</li> </ul>
Step 2: Introducing the context and controversial issue	<ul style="list-style-type: none"> <li>- Exploring the context of pesticides use from various sources of media</li> <li>- Analyzing the global perspective of pesticides use</li> <li>- Provoking controversial questions about pesticides use</li> </ul>
Step 3: Initiating multi-perspective thinking from indigenous and Western modern science	<ul style="list-style-type: none"> <li>- Analyzing multi-perspectives from indigenous and Western modern science on pesticides use</li> <li>- Identifying the science, values, philosophy and local wisdom of indigenous knowledge from the Baduy to complement Western modern science (chemistry) views</li> <li>- Analysing potential alternative solutions from the perspectives of indigenous knowledge and Western modern science.</li> </ul>
Step 4: Connecting the context with chemistry concepts	<ul style="list-style-type: none"> <li>- Providing the connection between relevant chemistry concepts related to pesticides use</li> <li>- Providing problem-solving questions that engage students to apply chemical concepts behind the topic</li> </ul>
Step 5: Meta-reflection	<ul style="list-style-type: none"> <li>- Considering the consequences of the two different perspectives</li> <li>- Considering the potential of collaboration and shared visions between different perspective</li> <li>- Reflecting the process of decision making toward the issue</li> <li>- Reflecting students' individual or group actions</li> <li>- Reflecting future deliberations</li> </ul>

The implementation of this first learning design indicated that this lesson plan is appropriate for university-level chemistry education [8]. The topic of pesticides use seems to be suitable for university chemistry teacher education because it deals with a complex issue to promote higher critical thinking skills and a stronger foundation of chemistry content knowledge [12]. The learning design engaged students with both basic chemistry content knowledge, indigenous knowledge and how this knowledge and the application of science in a societal debate can be evaluated and reflected. The learning design has potential to support the development of important skills. These skills include decision making,

argumentation, choosing appropriate information, and collaboration. For upper secondary school chemistry, the teaching intervention might need improvement in terms of better connecting the chemistry knowledge related to issues to the context. For applying this learning design in secondary school chemistry, the basic chemistry content knowledge behind the issue needs to be strengthened before so that the students would be able to engage the chemistry concepts better with the socio-scientific issue [12].

### 3.2.2 Learning design 2: Using indigenous knowledge as a starting point to learn about green and sustainable chemistry along pesticides use

The second learning design attempted to facilitate students learning about green and sustainable chemistry inspired by indigenous knowledge. The lesson was implemented in an elective environmental chemistry course for university chemistry student

teachers. The learning activities started from the context of indigenous chemistry (ethnochemistry). From this information, students conducted investigations on green and sustainable chemistry and green laboratory work inspired by ethnochemistry. Table 2 describes the lesson plan of the second learning design.

**Table 2.** The teaching sequences of the second learning design

Learning Steps	Description
Step 1: Exploring ethnochemistry and related information from green chemistry	<ul style="list-style-type: none"> <li>- Exploring information about ethnochemistry related to the topic of pesticides use from various media</li> <li>- Exploring the general context of pesticides use by internet search (what are pesticides, their functions and types, green pesticides and their characteristics, etc.)</li> <li>- Exploring the concept of green chemistry and its application</li> </ul>
Step 2: Exploring the chemistry concepts behind ethnochemistry	<ul style="list-style-type: none"> <li>- Using online chemical information databases and research papers to understand the phytochemical concepts behind ethnochemical use of bio-pesticides</li> <li>- Discussing the finding with the teacher to get feedback</li> </ul>
Step 3: Exploring the chemistry concepts behind ethnochemistry by various chemical experiments	<ul style="list-style-type: none"> <li>- Conducting or observing the investigation of chemicals or phytochemicals from ethnochemistry using various laboratory techniques</li> <li>- Predicting and identifying the chemicals compounds that can be used as alternative green and sustainable pesticides</li> <li>- Discussing the result of the experiments in student groups</li> </ul>
Step 4: Discussion of experimental results	<ul style="list-style-type: none"> <li>- Getting feedback from the teacher</li> </ul>
Step 5: Evaluating laboratory methods based on green chemistry	<ul style="list-style-type: none"> <li>- Comparing and evaluating different extraction methods using green chemistry criteria</li> <li>- Deciding the best method that mostly represents green chemistry</li> </ul>

The implication of the second learning design showed positive feedback from the students [13]. The learning activities facilitated the students to learn chemistry across cultures inspired by ethnochemistry. This lesson plan also motivated students to learn chemistry from local culture. In addition, the learning sequences also provided the students with content and hands-on and minds-on activities related to green chemistry, especially in practical works. This lesson plan, however, tended to provide less engagement with the reflection on chemistry applications in society, which is a major focus of ESD learning. As a consequence, general skills that are important for students to participate in social debate on socio-

scientific issues are hard to achieve. On the other hand, learning about green and sustainable chemistry as the contribution toward sustainable development can be accommodated by this learning design and also focus a part of ESD.

### 3.3 Identifying students' views and arguments on the application of indigenous science

During the teaching interventions of the first learning design, students were involved in group discussions to share their arguments about the sustainability issue of pesticides use based on the different perspectives from indigenous and Western

modern science. At the end of the lesson plan, the students had to answer chemistry problem-solving questions connecting the concepts of chemistry learning with the indigenous context of the lesson plan. Findings from the analysis indicate that both upper secondary school students and university student teachers broadened their spectrum of arguments related to the sustainability-relevant chemistry issue of pesticides use under inclusion of the category of ethical arguments. In terms of the application of chemical content, the university students showed a much better understanding of the chemical concepts compared to upper secondary school students [12].

## 4. CONCLUSION

Curriculum development in this project on the inclusion of indigenous knowledge in chemistry learning has produced two learning designs that can be implemented in both upper secondary school and university level chemistry education. Teaching interventions were carried out involving upper secondary school students and chemistry student teachers in Indonesia. The finding indicates that the topic was considered relevant and interesting by the students. The lesson plans were perceived to encourage students' learning of chemistry enriched by reflecting different interconnected worldviews to find solutions to sustainability issues. The choice of the learning design, however, should consider the level of education and students' thinking abilities. Each learning design has the advantage in accordance with the skills, knowledge and attitudes that teachers want to instill in students. It depends on the needs of the curriculum and learning purposes that are suggested to be achieved. Further research should aim at identifying further topics from indigenous science to be implemented in secondary and higher chemistry education to benefit from indigenous knowledge and its motivating potential for chemistry education, in Indonesia and beyond. It also needs further research to find out how generally positive the inclusion of indigenous knowledge is for chemistry education whilst comparing cases from different societies and cultures.

## AUTHORS' CONTRIBUTION

Robby Zidny: conceptualization, method, data curation, visualization, editing, drafting manuscript. Ingo Eilks: Review, conceptualization, and editing of manuscript.

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# 11 Need Analysis for Basic Chemistry Practice Modules Based on Local Wisdom

## Need Analysis for Basic Chemistry Practice Modules Based on Local Wisdom

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**Abstract**—One of the most important components needed in the implementation of the practicum is the practicum module so that a proper practicum module is needed to direct the practicum becomes effectively and efficiently. This study aims to analyze the student's needs on local wisdom-based chemistry practicum modules as the initial stage of the module development process. The research is a quantitative descriptive study referring to the stage of analysis in ADDIE development model. The research subjects were 48 students who had taken basic chemistry courses in the Chemistry Education Study Program, Universitas Samudra. The data were obtained through filling out the initial observation sheet and questionnaire on the student's needs for the expected practicum module. The results of initial observations indicate that the existing practicum module has not met the needs of 20.8% of students in understanding the practicum material, because the material explanation is incomplete according to 56.3% of students. The results of the needs analysis showed 77.4% of students need additional practicum modules to support learning in the practicum. Meanwhile, 93.8% of students stated that a practicum module based on local wisdom are needed in basic chemistry practicum.

**Keywords**—local wisdom, practicum, etho-chemistry

### I. INTRODUCTION

Teaching materials are systematically arranged learning resources that contain concepts, facts, both written and unwritten, to assist students in understanding and in applying learning the content [1]. Learning could be done effectively if the teaching materials support the learning activities. For example, the teaching materials in the form of learning module could help students comprehensively master the subject [2]. On the other side, modules are printed handouts in the form of packages relating to learning materials. By using the module,

students can individually complete their study materials as well as control and recognize their learning identity. In practicum implementation, the practicum module is one of the most important components needed in practicum. A proper practicum module can effectively and efficiently direct the practicum to achieve the objectives of implementing the practicum.

Teaching material module development is a process by which a teacher organizes the developed teaching material to ease the delivery and to build students' understanding of the material. ADDIE model is one of the general learning design models, emerged in the 1990s developed by Reiser and Mollenka. ADDIE model functions as a guide in building effective, dynamic training program tools and infrastructure that support the training performance itself. ADDIE development model has systematic stages so that it fits the characteristics of media development, especially the practicum module [3]. It has 5 stages of development, namely: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation [4]. The stage begins with a needs analysis in order to gather information related to products needed by potential users. Needs analysis is used as a foundation in developing teaching materials [5].

Science learning in Indonesia could not ignore culture contribution nor local wisdom [6]. Indonesia has around 300 ethnic groups with differences in values, beliefs, and practices which are explored in a limited way in the context of chemistry education [7]. Modules can be used as teaching materials that can connect knowledge of science with the local wisdom [8]. This study aims to analyze the student needs on local-wisdom-based-chemistry practicum modules that will be developed.

### II. METHODS

The research is a quantitative descriptive study referring to the stage of *analysis* in ADDIE development model. The research was conducted in August 2020, with research subjects that were students having taken basic chemistry courses in the Chemistry Education Study Program of the Faculty of Teacher Training and Education, Universitas Samudra. Samples were taken using purposive sampling technique with a total sample of 48 students.

The data were obtained through filling out the initial observation sheet and questionnaire on the student's needs for the expected practicum module. Initial observation aimed to determine the weaknesses of the practicum module being used by students in basic chemistry lab work. Meanwhile, the needs questionnaire aimed to determine the expected follow-up efforts in the module to be developed. The data obtained in this study were qualitative and quantitative data. Data were analyzed descriptively by systematically compiling data, categorizing data, reducing data, presenting, and drawing conclusions.

### III. RESULTS AND DISCUSSION

The student needs of the local-wisdom-based-chemistry practicum module were analyzed from the data obtained from the observation sheets and need questionnaires. The observation was initially filled by research subjects before filling out the need's questionnaire.

#### A. Initial Observation

The observation obtained data regarding the condition of the module being used by students for basic chemistry practice. The practicum module used contains several topics or materials being practiced, namely: acidimetry-alkalimetry, oxidation reduction reactions, acid-base indicators, titration and crystallization, diffusion and chromatography, chemical reactions, electrolysis, electroplating, periodic table, reactions of alkali metals and alkaline earth metals, and qualitative analysis of organic compounds. Figure 1 presents the results of observations about the materials in the practicum module perceived to be difficult by the students. Referring to Figure 1, the "qualitative analysis of organic compounds" is the most difficult material to understand by 39.6% of students. Another material that is also difficult to understand is acidimetry-alkalimetry (31.3% of students). Based on these findings, the development of the practicum module will be directed at the preparation of content that makes it easier for students to understand the material for qualitative analysis of organic compounds and acidimetry-alkalimetry. Students find it easier to understand the material if the contents of the material are related directly to the student's daily life [9].

The observation results show that the practicum module has not met the needs of 20.8% of students in understanding the practicum material due to various factors as shown in Figure 2. What causes 56.3% of students to have difficulty in understanding practicum material is the incomplete material in

the practicum module. Other factors with a significant percentage were the lack of images (37.5%), abstractness of material (18.8%) and less attractive modules (12.5%).

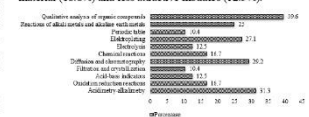


Fig. 1. The difficulty level of the material in the practicum module.

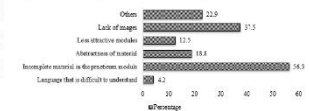


Fig. 2. The factors causing student difficulties in understanding the material in the practicum module.

The criteria of the module expected by students can be seen in Figure 3. It shows that 81.3% of students expect the practicum module which provides detailed explanation of the material. In addition, the practicum module is expected to use a more understandable language (62.5% of students), more applicable and related to everyday life (58.3%), provide visualization for abstract content (16.7%), and local-wisdom-based (12.5%). Language comprehension ability correlates strongly with student achievement on chemistry courses [10]. Students' appropriation of chemistry language was deeply related to how they incorporated scientific culture into their everyday culture [11].

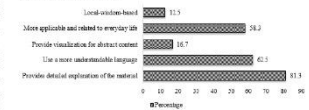


Fig. 3. Criteria for the expected practicum module.

#### B. Needs Analysis

Figure 4 shows the results of the questionnaire survey. Referring to the figure, 79.2% of students stated that basic chemistry practicum is a practicum with material that is difficult to understand. Meanwhile, 35.4% of students stated that the practicum modules used were not sufficient to understand practicum. As many as 77.1% of students need

additional practicum modules to support learning in the practicum.

As a follow-up to the results of initial observations, a practicum module was developed based on local wisdom or ethnochemistry. Several studies have shown that the use of science modules based on local wisdom were effective to improve students' scientific literacy, science process skill and scientific attitude [7-8]. In addition, the integrated ethnochemistry module is effectively used to improve learning outcomes [12]. As many as 87.5% of students stated that they had never used a practicum module based on local wisdom. However, 93.8% of students agree that practicum modules based on local wisdom are needed in basic chemistry practicum.

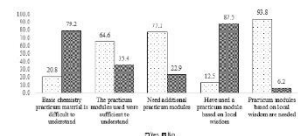


Fig. 4. The results of need analysis questionnaire

The results of the questionnaire analysis show some additional content expected in the module in is shown Figure 5. The material that is applicable in daily life is the most expected module additional content (72.9% of students). Students have difficulties in relating the chemistry phenomena they learned and the life around them [13]. In addition, the module is also expected to contain additional content in the form of images (68.8%), visualization of abstract material (18.8%), and others (31.3%).



Fig. 5. Additional content that is expected to be contained in the module.

Figure 6 presents the level of student interest in using the basic chemistry practicum module based on local wisdom that 47.9% of the students filled "very interested", 16.7% "interested", 27.1% "quite interested", 2.1% "not interested", and 6.3% "uninterested". Meanwhile, the majority of subjects stated that qualitative analysis material for organic compounds was suitable for developing practicum modules based on local wisdom. This finding is in line with other research which shows that students are interested and motivated using chemistry teaching aids based local wisdom as a media for

learning chemistry [13]. Ethnoscience raises local wisdom as an object of meaningful science learning. Incorporating ethnochemistry practices in teaching chemistry was found to have positive effect on enhancing students' motivation and attitude towards chemistry [14-15].

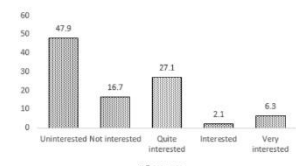


Fig. 6. Student interest in practicum modules based on local wisdom.

#### IV. CONCLUSION

Initial observation shows that the existing practicum modules did not meet the needs of all students in understanding practicum material. The main criteria for the practicum module that students want is that the content in the module is able to provide detailed material explanations. The results of the needs questionnaire analysis showed that most students needed additional practicum modules to support learning in practicum. Students stated that a local wisdom-based practicum module is needed in basic chemistry practicum. The explanation regarding the application of the material in daily life is the additional content that is expected to be included in the module. In general, students need and are very interested in using practicum modules based on local wisdom.

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# 12 Identifikasi Potensi Budaya Lokal Berbasis Etnokimia di Kabupaten Bantul

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## IDENTIFIKASI POTENSI BUDAYA LOKAL BERBASIS ETNOKIMIA DI KABUPATEN BANTUL

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### ABSTRAK

Kebudayaan dapat dimanfaatkan sebagai sumber pembelajaran, misalnya etnokimia sehingga keberadaannya tetap terjaga. Etnokimia merupakan pembelajaran kimia yang dikaitkan dengan budaya. Penelitian ini bertujuan untuk mengkaji potensi budaya lokal Kabupaten Bantul bidang industri kerajinan berbasis etnokimia dan mengkaji keterkaitan antara potensi budaya lokal Kabupaten Bantul bidang industri kerajinan dengan pembelajaran kimia. Penelitian yang dilakukan adalah penelitian deskriptif kualitatif. Teknik pengumpulan data pada penelitian ini adalah observasi, wawancara, dan studi pustaka. Keabsahan data yang digunakan adalah uji kredibilitas dengan triangulasi data, uji dependabilitas, dan uji konfirmabilitas. Adapun teknik analisa data menggunakan metode Miles Huberman berupa reduksi data, penyajian data, dan penarikan kesimpulan. Data yang terkumpul dikategorisasikan dan disusun secara sistematis kemudian dibuat kesimpulan. Hasil penelitian menunjukkan bahwa potensi budaya lokal Kabupaten dapat dijadikan sebagai sumber pembelajaran berbasis kimia. Potensi budaya lokal berbasis etnokimia di Kabupaten Bantul adalah kerajinan batik, keris, gamelan, dan wayang kulit. Batik dapat dikaitkan dengan materi larutan asam basa, ikatan kimia, konsep mol, dan tata nama kimia. Keris dapat dikaitkan dengan materi sel volta dan korosi serta kimia unsur (periode 4). Gamelan dapat dikaitkan dengan materi reaksi oksidasi dan reduksi serta kimia unsur (periode 4). Wayang kulit dapat dikaitkan dengan materi polimer dan koloid.

Kata kunci: Kabupaten Bantul, potensi budaya lokal, kimia

N. Azizah & S. Premono

Identifikasi Potensi Budaya Lokal Berbasis  
Etnokimia di Kabupaten Bantul

### 1. PENDAHULUAN

Indonesia terdiri dari sekitar 250 suku/etnis yang tersebar di seluruh wilayahnya (Dokhi, 2016). Kebudayaan yang muncul akibat beragamanya suku/etnis tersebut dapat luntur dengan adanya arus globalisasi (Mubah, 2011). Hal tersebut menjadi tantangan dalam pendidikan Indonesia karena arus globalisasi dapat mengubah pola hidup masyarakat. Sejalan dengan itu, kurikulum 2013 dibentuk berdasarkan landasan filosofi bahwa pendidikan didasarkan pada budaya bangsa Indonesia. Melalui proses pendidikan, peserta didik memperoleh kesempatan untuk mengembangkan potensi dirinya terhadap apa yang dilihat, didengar, dibaca, dan dipelajari dari warisan budaya yang dimiliki (Permendikbud Nomor 36 tahun 2018). Rahmawati (2018) menyebutkan bahwa penekanan budaya ke dalam pembelajaran akan menimbulkan kesadaran kepada peserta didik terhadap budayanya. Hal ini sesuai dengan penelitian yang dilakukan oleh Arfanawati, Sudarmin, dan Woro (2016) bahwa penggunaan pengetahuan lokal diperlukan dalam pembelajaran karena berkaitan dengan kehidupan sehari-hari. Namun, pembelajaran di sekolah belum dikaitkan dengan kehidupan sehari-hari, seperti halnya kebudayaan yang berada di lingkungan masyarakat (Shidiq, 2016).

Pembelajaran berbasis budaya dapat digunakan dalam berbagai bidang, tidak terkecuali dalam sains. Lebih lanjut, Shidiq (2016) mengungkapkan bahwa pendekatan pembelajaran yang menjadikan budaya sebagai objek dalam sains disebut dengan etnosains. Menurut Arfanawati, Sudarmin, dan Woro (2016), melalui pembelajaran etnosains, peserta didik mengalami peningkatan hasil belajar kognitif dan berpikir kritis. Hal tersebut disebabkan oleh rasa ketertarikan dan antusias yang lebih tinggi dari peserta didik terhadap pembelajaran karena terlibat secara langsung dalam proses pembelajaran yang berkaitan dengan kehidupan. Akan tetapi, pada kenyataannya guru atau pendidik belum menerapkan pembelajaran berbasis budaya.

Etnosains mencakup beberapa disiplin ilmu, diantaranya etnobiologi, etnokimia, etnofisika, etnomatematika, etnomedis, dan berbagai praktik pertanian adat dan teknologi pengolahan makanan (Abonyi, dkk, 2014). Pembelajaran berbasis etnokimia dapat mempengaruhi pandangan masyarakat terhadap kimia, bahwa kimia bukan hanya sesuatu yang berbahaya saja karena banyak terdapat dalam kehidupan sehari-hari, misalnya penggunaan *baking soda* dalam pembuatan roti (Rahmawati, 2017). Contoh kajian etnokimia dalam pembelajaran yaitu pemanfaatan air kelapa hijau dalam budaya Jawa. Air kelapa hijau yang diminum oleh ibu hamil dipercaya dapat membuat kulit bayi menjadi putih bersih, mempercepat persalinan, menyuburkan rambut, dan membuat air ketuban bersih. Air kelapa hijau sebagai isotonic alami bermanfaat untuk rehidrasi bagi ibu hamil. Budaya tersebut dapat dikaitkan dengan materi kimia larutan elektrolit dan non elektrolit (Rahmawati, 2017). Namun demikian, penerapan pembelajaran kimia berbasis budaya memiliki permasalahan dalam hal integrasi antara budaya dengan materi kimia (Rahmawati, dkk, 2020).

Kesesuaian antara potensi budaya lokal dengan materi pembelajaran tidak terlepas dari lokasi tempat budaya tersebut berasal. Kabupaten Bantul memiliki potensi budaya lokal dalam berbagai bidang, diantaranya pariwisata, industri, dan pertanian (*banjurkab.go.id*). Delapan puluh persen (80%) hasil kerajinan di Di Yogyakarta berasal dari Kabupaten Bantul (*clmpt.bantulkab.go.id*). Hasil industri kerajinan tersebut antara lain kerajinan gerabah kasongan, kerajinan tatah sungging untuk wayang kulit, topeng, batik, kerajinan kulit (tas, sepatu, jaket, dll), serta kerajinan dari kayu, bambu, dan batu (BPPD Kabupaten Bantul, 2018). Akan tetapi tidak semua potensi budaya lokal dapat diintegrasikan ke dalam pembelajaran etnokimia.

Integrasi antara budaya dengan kimia tidak hanya menciptakan pembelajaran kimia yang lebih bermakna kepada peserta didik, akan tetapi juga turut melestarikan budaya bangsa. Melihat

belum banyaknya penelitian yang mengkaji etnosains, khususnya etnokimia dalam pendidikan di Indonesia, serta adanya potensi budaya lokal di Kabupaten Bantul yang dapat dijadikan sumber pembelajaran kimia, maka diperlukan penelitian yang mengkaji potensi budaya lokal di Kabupaten Bantul berbasis etnokimia.

## 2. METODE PENELITIAN

Penelitian ini merupakan penelitian deskriptif kualitatif. Penelitian kualitatif bertujuan untuk mendeskripsikan dan menganalisis fenomena peristiwa, aktivitas sosial, sikap, kepercayaan, persepsi, dan pemikiran orang baik secara individual maupun kelompok (Sukmadinata, 2013). Penelitian kualitatif menggunakan analisis data secara induktif (Moleong, 2018). Analisis data secara induktif tersebut digunakan untuk mengungkapkan data secara khusus dan detail, sehingga ditemukan kategori, dimensi, dan hubungan yang penting dan asli dengan pertanyaan terbuka (Sukmadinata, 2013). Fokus penelitian ini berada pada identifikasi potensi budaya lokal yang dimiliki oleh suatu daerah atau wilayah untuk dijadikan pendekatan dalam pembelajaran kimia di sekolah menengah atas. Hal-hal yang akan diteliti diantaranya potensi budaya lokal yang berada di suatu daerah yang mungkin diterapkan dalam pembelajaran berbasis etnokimia serta keterkaitan antara potensi dan budaya tersebut dengan materi pembelajaran kimia.

Penelitian dilakukan di beberapa Sekolah Menengah Atas (SMA) dan industri kerajinan di Kabupaten Bantul, pengambilan sampel menggunakan teknik *purposive* sampling. Subjek penelitian adalah guru mata pelajaran kimia. Adapun objek yang diteliti adalah potensi budaya lokal wilayah setempat yang dapat diterapkan dalam pembelajaran berbasis etnokimia yaitu beberapa industri kerajinan di Kabupaten Bantul. Teknik pengumpulan data pada penelitian ini adalah observasi, wawancara, dan studi Pustaka. Instrumen pengumpulan data berupa lembar observasi, pedoman wawancara, teknik analisis data menggunakan model Miles dan Huberman, untuk keabsahan data dilakukan uji kredibilitas, uji dependabilitas, dan uji konfiabilitas.

## 3. HASIL DAN PEMBAHASAN

Hasil penelitian akan menguraikan potensi budaya lokal berbasis etnokimia di Kabupaten Bantul dan keterkaitan potensi budaya lokal tersebut dengan materi pembelajaran kimia. Pembahasan ini sesuai dengan data penelitian yang diperoleh melalui observasi, wawancara, dan studi pustaka. Observasi dilakukan di industri kerajinan Kabupaten Bantul untuk mengetahui proses pembuatan produk potensi budaya lokal dan konten kimia terkait. Wawancara dilakukan kepada guru mata pelajaran kimia untuk mengetahui integrasi antara potensi budaya lokal dengan materi pembelajaran kimia. Studi pustaka dilakukan untuk mendukung hasil penelitian observasi dan wawancara yang berupa teori dari berbagai sumber, seperti buku dan jurnal.

### Potensi Budaya Lokal Berbasis Etnokimia di Kabupaten Bantul

Penerapan pembelajaran berbasis etnokimia memerlukan identifikasi potensi budaya lokal yang sesuai dengan materi pembelajaran kimia. Hal tersebut diperlukan integrasi antara potensi budaya lokal dengan materi pembelajaran kimia, sehingga proses pembelajaran dapat berjalan sesuai dengan tujuan pembelajaran yang hendak dicapai. Pembelajaran berbasis etnokimia dapat dilakukan terhadap beberapa materi kimia yang terintegrasi dengan potensi budaya lokal setempat. Kabupaten Bantul memiliki berbagai macam potensi budaya lokal, dari potensi budaya

lokal tersebut, hasil kerajinan menjadi produk unggulan dan ciri khas. Potensi budaya lokal Kabupaten Bantul yang dapat dijadikan sumber pembelajaran berbasis etnokimia dalam bidang industri kerajinan diantaranya kerajinan batik, keris, gamelan, dan wayang kulit. Hal ini didukung dari hasil wawancara terhadap guru mata pelajaran kimia. "Dari segi materi, yang dapat dijadikan sumber pembelajaran adalah kerajinan batik, wayang, gamelan, kaca tiup. Menurut saya yang cocok dijadikan sumber pembelajaran kimia adalah batik, kerajinan kulit, keris."

Hasil kerajinan batik, keris, gamelan, dan wayang kulit tersebut merupakan potensi budaya lokal di Kabupaten Bantul yang dapat berpeluang untuk dijadikan sebagai sumber pembelajaran berbasis etnokimia. Penerapan pembelajaran etnokimia yang mengintegrasikan antara potensi budaya lokal dengan materi kimia di sekolah ini bermanfaat sebagai berikut.

### Melestarikan budaya daerah

Melalui pembelajaran etnokimia, peserta didik mempelajari lebih jauh mengenai potensi budaya lokal yang terdapat di lingkungan sehingga pemahaman peserta didik terhadap kebudayaan meningkat. Lebih lanjut, meningkatkan cinta tanah air peserta didik dan perkembangan jaman tidak melunturkan kebudayaan yang telah ada. Hal tersebut sesuai dengan penelitian Nuralita (2020) bahwa implementasi budaya lokal ke dalam pembelajaran etnokimia mampu meningkatkan kecintaan peserta didik terhadap daerah dan bangsa Indonesia.

### Pembelajaran lebih menarik

Pembelajaran etnokimia merupakan pembelajaran yang melibatkan budaya ke dalam proses pembelajaran, sehingga peserta didik melaksanakan pembelajaran secara nyata sesuai apa yang ada di dalam lingkungan mereka. Memasukkan potensi budaya lokal ke dalam pembelajaran kimia menjadikan pembelajaran menjadi lebih menarik karena relevan dengan kehidupan sehari-hari. "Pembelajaran etnokimia cocok diterapkan dalam pembelajaran karena lebih kontekstual sehingga akan memotivasi siswa untuk mempelajari kimia, lebih lanjut akan meningkatkan prestasi belajar peserta didik."

### Meningkatkan pemahaman

Pembelajaran etnokimia dapat meningkatkan pemahaman peserta didik terhadap kimia bahwa kimia mempunyai korelasi dengan budaya yang terdapat di lingkungan. Peserta didik dapat membandingkan antara apa yang mereka temui secara nyata di lingkungan dengan teori melalui pembelajaran di kelas. Hal ini sesuai dengan pendapat dari Ibu Esthi Wikan Nastro bahwa melalui pembelajaran kimia yang dikaitkan dengan budaya menjadikan peserta didik lebih memahami materi karena terdapat aplikasi dalam kehidupan. Oleh karena itu, integrasi antara potensi budaya lokal dengan materi pembelajaran kimia di sekolah perlu dilakukan.

### Keterkaitan Potensi Budaya Lokal dengan Materi Pembelajaran Kimia

Pembelajaran etnokimia merupakan pembelajaran yang mengintegrasikan antara budaya dengan materi kimia. Integrasi yang dimaksud yaitu hubungan timbal balik antara budaya dengan kimia yang menjadikan pembelajaran lebih kontekstual. Proses pembelajaran etnokimia dapat dilakukan dengan cara sebagai berikut.

1. Guru memberikan pernyataan terkait konten lokal pada bagian pendahuluan untuk menarik peserta didik. Hal itu sesuai dengan pernyataan Ibu Esthi Wikan Nastro bahwa pembelajaran etnokimia lebih cocok dimunculkan dalam bagian aperepsi untuk menarik peserta didik bahwa kimia terdapat dalam kehidupan sehari-hari.

2. Guru dan peserta didik melakukan kegiatan inti pembelajaran yaitu mempelajari materi kimia yang terintegrasi dengan potensi budaya lokal melalui diskusi atau praktikum. Hal ini sesuai dengan penelitian yang dilakukan oleh Sepmiarni, I Made, dan I Wayan (2015) bahwa pada kegiatan inti, guru melakukan tindakan dengan peserta didik, seperti diskusi atau praktikum sesuai dengan konten lokal dan materi kimia yang dipelajari. Pembelajaran pada kegiatan inti dapat digunakan media terkait konten budaya, seperti artikel atau video kebudayaan yang berhubungan dengan kimia untuk meningkatkan keingintahuan dan motivasi belajar peserta didik. Melalui artikel, peserta didik dapat menghubungkan secara langsung materi pembelajaran kimia yang dipelajari di sekolah dengan kebudayaan yang ada (Rahmawati, 2018).

3. Pemberian tugas untuk pemahaman lebih lanjut dengan mengamati proses produksi produk potensi budaya lokal melakukan analisis konten materi kimianya. "Siswa dapat diberi tugas di luar pembelajaran di kelas, seperti melihat proses pembuatan batik, lalu dicek konten kimianya melalui studi literatur".

Integrasi antara potensi budaya lokal dengan materi pembelajaran kimia pada penelitian ini memerlukan analisis melalui observasi, wawancara, dan studi pustaka. Potensi budaya lokal yang dimaksud adalah potensi budaya lokal Kabupaten Bantul berupa batik, keris, gamelan, dan wayang kulit. Potensi budaya lokal dan integrasinya dengan materi pembelajaran kimia tersebut akan dijelaskan sebagai berikut.

#### Batik

Pembuatan batik tulis melalui serangkaian proses yang secara keseluruhannya memerlukan waktu yang lebih lama tergantung dengan motif yang dikehendaki, yaitu kurang lebih 2 bulan untuk batik tulis klasik dengan motifnya memenuhi seluruh kain. Melalui observasi, proses pembuatan batik tulis antara lain pembuatan pola, pembatikan, pewarnaan, pelorodan, dan finishing.

##### a. Pembuatan Pola

Sebelum pembuatan batik, perlu disiapkan kain terlebih dahulu. Terdapat beberapa macam kain mori untuk membatik, diantaranya primisima dan koreta. Perbedaan jenis kain ini terletak pada tekstur dan serat kainnya. Kain mori yang diperdagangkan mengandung kanji yang berlebihan, sehingga perlu dicuci untuk menghilangkan sedikit kanji tersebut dengan menggunakan air karena kanji dapat menghalangi penyerapan warna. Kain batik dicuci dengan menggunakan air kemudian dikeringkan lalu dipola. Pembuatan pola batik dilakukan dengan menggunakan pensil sesuai motif yang diinginkan ke kain batik atau dengan mal kertas. Pembatik biasanya lebih menggunakan mal kertas agar kain batik tetap bersih dan terhindar dari coretan atau goresan.

##### b. Pembatikan

Proses pembatikan diawali dengan pencairan malam atau lilin batik yang dilakukan dengan cara dipanaskan di atas kompor atau pemanas lain. Lilin batik berfungsi untuk menahan warna agar tidak masuk ke dalam serat kain pada bagian yang tidak dikehendaki. Pencairan lilin batik ini merupakan proses perubahan wujud dari zat padat menjadi cair. Terdapat beberapa jenis lilin batik, yaitu lilin klowong, lilin tembok, dan lilin parafin. Perbedaan lilin ini terletak pada penggunaan, tekstur, dan warna lilin batik.



Gambar 1. (a) Pencairan lilin (b) Hasil Pembatikan

Proses pembatikan atau penorehan lilin ke kain batik dilakukan menggunakan perantara canting. Perekatan lilin ke kain batik hingga menutup motif merupakan proses perubahan wujud lilin dari cair menjadi padat kembali. Pembatikan ini melalui empat tahap diantaranya pembuatan pola, pembatikan pola kedua, pemberian isen-isen, dan pengeblokan. Pembuatan pola merupakan tahap pembatikan pertama, yaitu dengan pembatikan sesuai pola dengan menggunakan lilin klowong. Pembatikan kedua merupakan pembatikan pola pada sisi sebaliknya. Pemberian isen-isen merupakan pemberian isian, hiasan, dan ornamen pada bagian pola batik. Pengeblokan merupakan pemberian lilin secara menyeluruh pada bagian kain yang diinginkan berwarna putih dengan menggunakan lilin tembok. Selama proses pembatikan ini, kestabilan api dalam pencairan lilin dijaga agar lilin meleleh dengan sempurna. Haerudin dan Vivin (2018) menyatakan bahwa tinggi rendahnya titik leleh lilin batik berkaitan dengan kecepatan daya cair dan daya tembus lilin pada kain ketika dibatikan serta kemudahan lilin terlepas pada saat penglorodan.

##### c. Pewarnaan

Pewarna yang digunakan dalam pewarnaan kain batik terdapat dua macam, yaitu warna alami dan warna sintesis. Pewarna alami merupakan pewarna yang berasal dari tumbuh-tumbuhan, sedangkan pewarna sintesis merupakan pewarna dari bahan kimia. Pewarna sintesis terdapat beberapa macam, diantaranya naphthol, remazol, dan indigosol. Setiap pewarna, baik pewarna alami maupun sintesis mempunyai pengunci atau pembangkit warna masing-masing yang bermanfaat untuk mencegah pemudaran warna. Hal ini sesuai dengan penelitian yang dilakukan oleh Purwanto (2018) bahwa penguncian warna batik ini dilakukan agar warna tidak mudah pudar. Pewarna alami untuk batik berasal dari bagian tumbuh-tumbuhan, baik itu daun, batang, maupun akar yang memiliki kandungan zat warna yang kuat. Pewarna alami yang dapat digunakan sebagai pewarna batik antara lain: warna biru berasal dari tom/ indigo; warna merah dari akar mengkudu, kayu mahoni, dan secang; warna kuning dari buah jelawe dan kuntir, kayu nangka, dan daun mangga kwent; serta warna coklat dari kulit dan kayu tingi (Natanegara dan Dir, 2019). Bahan tersebut dimasak dalam air panas sehingga memunculkan warna. Setelah dilakukan pewarnaan, kain batik dikunci warnanya menggunakan tawas (alum/ aluminium sulfat/  $Al_2(SO_4)_3 \cdot 18H_2O$ ) atau kapur ( $CaCO_3$ ) yang dilarutkan dalam air.

Bahan yang digunakan dalam pewarna alami batik merupakan bahan yang menghasilkan warna yang pekat dan khas, sehingga bahan tersebut dapat dijadikan sebagai indikator alami asam basa. Indikator alami asam basa adalah indikator asam basa yang berasal dari alam untuk mengetahui suatu larutan apakah bersifat asam atau basa. Indikator alami asam basa ini dipelajari dalam materi larutan asam basa pada mata pelajaran kimia kelas XI, sehingga penggunaan bahan alami untuk pewarnaan batik dapat diintegrasikan dengan materi kimia larutan asam basa. Hal tersebut sesuai dengan Bapak Yudhi Supriatno bahwa penggunaan bahan alam untuk



pewarnaan batik dapat diintegrasikan dengan materi larutan asam basa sebagai indikator alami. Kompetensi yang dipelajari pada materi larutan asam basa adalah sebagai berikut.

KD 3.10 Menjelaskan konsep asam dan basa serta kekuatannya dan kesetimbangan pengionnya dalam larutan.

KD 4.10 Menganalisis trayek perubahan pH beberapa indikator yang diekstrak dari bahan alam melalui percobaan.

Pewarna sintesis merupakan bahan pewarna kimia, yaitu pewarna naphthol, indigosol, dan remazol. Zat warna naphthol merupakan campuran antara naphthol (1-naphthol/ $C_{10}H_7OH$ ), kostik (NaOH), dan TRO (*Turqies Red Oil*), yang dilarutkan dalam air hangat. Naphthol tidak dapat larut dalam air, sehingga untuk melarutkannya diperlukan kostik dan didispersi dengan TRO (koloid pelindung). Pewarna naphthol garam diazo yang dilarutkan dalam air sebagai pengunci atau pembangkit warna. Zat warna indigosol merupakan zat warna batik campuran anantara indigo dan natrium nitrit ( $NaNO_2$ ) yang menggunakan pengunci berupa HCl. Zat warna remazol merupakan zat warna yang proses penggunaannya menggunakan teknik colet (seperti lukis, menggunakan kuas) dengan pengunci warna berupa *waterglass* ( $Na_2SiO_2$ / sodium silikat).



Gambar 2. Tabel Warna naphthol

Proses pelarutan pewarna batik merupakan aplikasi dari materi pembelajaran kimia berupa kovalen polar dan non polar, seperti naphthol yang bersifat non polar tidak larut dalam air yang bersifat polar. Pembahasan mengenai kovalen polar dan non polar dipelajari pada pembelajaran dalam materi pokok ikatan kimia kelas X. Hal ini sesuai pernyataan dari Lutfinor (2011) bahwa pada pewarnaan batik terdapat konsep ikatan kimia. Kompetensi yang dipelajari dalam ikatan kimia adalah sebagai berikut.

KD 3.5 Membandingkan ikatan ion, ikatan kovalen, ikatan kovalen koordinasi, dan ikatan logam, serta kaitannya dengan sifat zat.

KD 4.5 Merancang dan melakukan percobaan untuk menunjukkan karakteristik senyawa ion atau senyawa kovalen berdasarkan beberapa sifat kimia.

Selain itu, penggunaan larutan kimia dalam proses pewarnaan batik merupakan aplikasi dari materi kimia berupa molaritas larutan. Hal ini sesuai dengan pendapat dari Ibu Esthi Wikan Nastri bahwa proses pewarnaan batik memerlukan larutan kimia dengan konsentrasi tertentu. Dengan demikian, penggunaan larutan kimia berhubungan dengan molaritas larutan yang dipelajari pada materi pokok konsep mol kelas X. Kompetensi yang dipelajari adalah sebagai berikut.

KD 3.10 Menerapkan dasar-dasar hukum kimia, konsep massa molekul relatif, persamaan kimia, konsep mol, dan kadar zat untuk menyelesaikan perhitungan kimia.

KD 4.10 Menganalisis data hasil percobaan menggunakan hukum-hukum dasar kimia kuantitatif.

#### d. Pelorodan

Pelorodan merupakan pembersihan lilin yang melekat pada kain batik, sehingga motif dan warna pada kain batik dapat terlihat. Proses ini dilakukan dengan merebus kain batik pada air dengan campuran soda abu. Penggunaan soda abu bertujuan untuk mempercepat dan memudahkan proses pelorodan, sejalan dengan pendapat Ibu Nur Laili Latifah bahwa soda abu digunakan untuk mempermudah pelorodan malam pada kain batik. Penggunaan soda abu atau natrium karbonat ( $Na_2CO_3$ ) pada proses pelorodan terjadi akibat soda abu membantu pelarutan dan pembersihan lilin batik yang menempel pada kain. Hal tersebut dikarenakan soda abu bersifat alkali sehingga kekuatan tarik kain menurun. Oleh karena itu, lilin batik mudah terlepas dari kain (Suheryanto, 2015).



Gambar 3. Pelorodan

#### e. Finishing

Setelah proses pewarnaan selesai, kain batik dikeringkan di bawah sinar matahari. Kain batik dipacking dan siap untuk digunakan. Pencucian kain batik hendaknya menggunakan lerak. Lerak bersifat saponin yang dapat berfungsi sebagai pencuci kain batik yang ramah lingkungan karena berasal dari alam. Penggunaan lerak juga dilakukan untuk menjaga warna kain agar tidak mudah luntur. Hal ini sesuai dengan penelitian yang dilakukan oleh Laela, dkk (2018) bahwa penggunaan lerak sebagai sabun pencuci batik selain menjadi detergen yang ramah lingkungan sehingga menjaga keseimbangan ekosistem lingkungan juga menjadi pencuci batik yang efektif untuk meningkatkan masa pakai batik dengan menjaga kelunturan warna.

Proses pembuatan batik dari pembatikan hingga finishing menggunakan beberapa bahan kimia. Setiap bahan kimia mempunyai nama dan rumus kimia tertentu. Penamaan kimia dan rumus kimia ini dapat diintegrasikan ke dalam pembelajaran kimia, yaitu dalam materi redoks dan tata nama kelas X. Materi reaksi reduksi dan oksidasi serta tata nama senyawa memiliki kompetensi sebagai berikut.

KD 3.9 Mengidentifikasi reaksi reduksi dan oksidasi menggunakan konsep bilangan oksidasi unsur dan penamaan senyawa.

KD 4.9 Menganalisis beberapa reaksi berdasarkan perubahan bilangan oksidasi yang diperoleh dari data hasil percobaan dan/atau melalui percobaan.

Integrasi antara potensi budaya lokal (batik, keris, gamelan, dan wayang kulit) dengan materi pembelajaran kimia dapat dirangkum dalam tabel berikut.

Tabel 1. Integrasi Potensi Budaya Lokal dengan Materi Kimia

No	Materi Kimia	Potensi Budaya	Keterangan
1	Ikatan kimia	Batik	Pelarutan pewarna batik merupakan aplikasi dari kovalen polar dan non polar.
2	Redoks dan Tata Nama Senyawa	Batik	Macam-macam bahan atau senyawa yang digunakan dalam proses pembuatan batik memiliki nama dan rumus kimia.
3	Konsep mol	Batik	Proses pewarnaan batik merupakan aplikasi dari molalitas larutan, yaitu setiap larutan kimia yang digunakan memiliki konsentrasi tertentu.
4	Larutan asam basa	Batik	Pewarna alami batik dapat dijadikan sebagai indikator alami asam basa karena memiliki warna yang pekat dan khas.
5	Koloid	Wayang kulit	Cat dalam pewarnaan wayang kulit merupakan salah satu contoh koloid jenis sol.
6	Sel volta dan korosi	Keris	Korosi pada bilah keris dan penggunaan jeruk nipis untuk menghilangkan karat pada bilah keris.
7	Unsur periode 3 dan 4	Keris	Bahan baku pembuat bilah keris dan sarung merupakan unsur kimia, seperti besi (Fe), nikel (Ni), kuningan (campuran antara tembaga (Cu) dan seng (Zn)), perak (Ag) dan emas (Au).
		Gamelan	Bahan baku pembuat gamelan merupakan unsur kimia, seperti besi (Fe), kuningan (campuran antara tembaga (Cu) dan seng (Zn)), dan perunggu (peleburan antara tembaga (Cu) dan timah (Sn)).
8	Polimer	Wayang kulit	Kulit hewan, seperti kulit sapi dan kerbau sebagai bahan baku pembuatan wayang kulit merupakan sumber polimer alami.

Selain terdapat peluang diterapkannya pembelajaran etnokimia, akan tetapi dalam penerapannya juga terdapat hambatan-hambatan, diantaranya:

1. Tidak semua materi dapat menggunakan pembelajaran etnokimia

Pembelajaran etnokimia tidak dapat dilakukan pada semua materi pembelajaran kimia karena tidak semua potensi budaya memuat konten kimia secara luas. "Penerapannya hanya disisipkan pada materi-materi tertentu". "Etnokimia dapat diterapkan dalam pembelajaran pada materi-materi tertentu, tetapi tidak dapat semuanya karena harus disesuaikan dengan KI dan KD". Oleh karena itu, pendidik perlu melakukan identifikasi terhadap potensi budaya lokal yang terdapat di lingkungan masyarakat sesuai dengan materi yang dipelajari dalam pembelajaran kimia di sekolah.

## 2. Kemampuan guru

Proses integrasi antara potensi budaya lokal dengan materi pembelajaran kimia memerlukan kemampuan atau pengetahuan guru yang tinggi dalam menganalisis, sehingga pembelajaran yang dilakukan tepat sasaran dan sesuai dengan tujuan yang hendak dicapai. Hal ini sesuai dengan pernyataan dari Bapak Yudhi Supriatno melalui wawancara bahwa penerapan pembelajaran etnokimia tergantung kepada pemahaman guru mengenai budaya lokal serta hubungannya dengan materi yang terkait dengan budaya tersebut. Peningkatan kemampuan guru dapat dilakukan melalui diskusi dengan teman sejawat maupun pelatihan-pelatihan untuk menunjang kemampuan guru.

## 3. Alokasi waktu

Pembelajaran etnokimia memerlukan waktu yang relatif lebih lama dibandingkan dengan pembelajaran pada umumnya. Hal ini diakibatkan karena dalam pembelajaran etnokimia diperlukan analisis terhadap potensi budaya kaitannya dengan kimia. "Permasalahan dalam pembelajaran etnokimia adalah alokasi waktu, dimana kita harus mempelajari budaya dan materi pokok kimia".

## 4. KESIMPULAN

Kesimpulan yang dapat diambil dari penelitian ini adalah sebagai berikut:

1. Kebudayaan sebagai warisan leluhur dapat dilestarikan melalui pendidikan. Pembelajaran yang mengintegrasikan antara potensi budaya lokal dengan materi pembelajaran kimia disebut dengan etnokimia. Potensi budaya lokal Kabupaten Bantul yang dapat dijadikan sebagai sumber pembelajaran kimia adalah kerajinan batik, keris, gamelan, dan wayang kulit. Melalui pembelajaran etnokimia dapat melestarikan budaya daerah, menjadikan pembelajaran yang lebih menarik, dan meningkatkan pemahaman peserta didik.
2. Pembelajaran etnokimia dapat dilakukan pada bagian pendahuluan, integrasi pada bagian inti pembelajaran, maupun pemberian tugas di luar kelas. Integrasi antara potensi budaya lokal Kabupaten Bantul dengan materi pembelajaran kimia tersebut antara lain sebagai berikut.
  - a. Batik mempunyai keterkaitan dengan materi kimia berupa larutan asam basa, ikatan kimia, konsep mol, dan tata nama kimia.
  - b. Keris mempunyai keterkaitan dengan materi kimia berupa korosi dan elektrokimia serta kimia unsur.
  - c. Gamelan mempunyai keterkaitan dengan materi kimia berupa reaksi oksidasi dan reduksi serta kimia unsur.
  - d. Wayang kulit mempunyai keterkaitan dengan materi kimia berupa polimer dan koloid.
3. Pembelajaran etnokimia dalam penerapannya mempunyai hambatan, yaitu tidak semua materi dapat menggunakan pembelajaran etnokimia, kemampuan guru, dan alokasi waktu.

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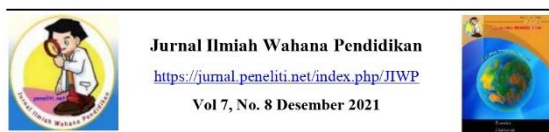
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## 13 Analisis Keterampilan Abad 21 Siswa dengan Pendekatan *Culturally Responsive Teaching* Terintegrasi Etnokimia



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Penerapan Pendekatan *Culturally Responsive Teaching* Terintegrasi Etnokimia untuk Mengembangkan Keterampilan Abad 21 Siswa

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### Abstract:

*This study aims to develop 21st century skills of students in hydrolysis material using a culturally responsive teaching approach which is integrated with ethnochemistry. This research was conducted in the even semester of the 2018/2019 academic year involving 19 students of class XI IPA Aliyah Alkhairaat Guraping. This study uses a qualitative method that focuses on the development of 21st century students' skills in salt hydrolysis material. The collected data is taken through reflective student journals, student interviews and observers' classroom observations. The standard quality in this study is trustworthiness by using pre-engagement, persistent observation, progressive subjectivity, and member checking. Based on the results of the study of salt hydrolysis learning using a culturally responsive teaching approach it can be seen that 21st century students' skills, namely information skills, automation skills and communication skills are seen by the use of this approach. In addition, students' motivation and curiosity also develop. Culturally responsive teaching can be used as an alternative to develop 21st century skills for students in learning hydrolysis of salt.*

**Keywords:** *Culturally responsive teaching, ethnochemistry, 21st century skills*

### PENDAHULUAN

Ilmu kimia merupakan salah satu bidang ilmu yang tidak terpisahkan dalam dunia pendidikan terutama di tingkatan SMA. Ilmu kimia membahas tentang materi, meliputi susunan, sifat-sifat dan perubahannya, serta perubahan energy yang menyertai perubahan materi tersebut

(Chang, 2003). Pembelajaran kimia diarahkan untuk terbentuknya proses interaksi antara peserta didik dengan pendidik dan sumber belajar untuk memperoleh ilmu terkait materi melalui fenomena.

Ilmu kimia saat ini masih dirasa sulit oleh sebagian besar siswa. Hal tersebut disebabkan muatannya yang bersifat abstrak

selain itu, faktor yang menjadi penyebab adalah kurangnya guru mengaitkan konsep kimi dengan kehidupan sehari-hari padahal kimia sangat erat kaitannya dengan fenomena sekitar bahkan yang dialami dan dikerjakan siswa sehari-hari. Oleh karena itu, pembelajaran kimia harus dikaitkan dengan latar belakang budaya siswa atau fenomena yang sering dijumpai, agar menghasilkan pembelajaran bermakna (Aikenhead, 2003). Sebagaimana amanat kurikulum 2013 yang menganut pola pembelajaran dalam bentuk pengalaman langsung siswa (*learned-curriculum*) sesuai dengan latar belakang, karakteristik dan kemampuan awal mereka.

Kurikulum 2013 merupakan gerbang awal untuk memasuki pendidikan di abad 21. Abad 21 menuntut setiap siswa untuk memiliki kecakapan atau keterampilan sehingga dalam proses pembelajaran yang dilakukan dapat memunculkan ciri dari keterampilan abad 21 diantaranya mencari tahu, merumuskan masalah, berfikir analitis, dan melakukan kerjasama atau kolaborasi. Nilai tersebut dapat muncul pada siswa jika guru memiliki kemampuan untuk mengeksplorasi siswa dengan mengajak siswa terlibat secara aktif dalam pembelajaran yang kreatif, menarik, menyenangkan, inovatif, dan kekinian, sehingga siswa ingin berpartisipasi dan berperan aktif sesuai dengan latar belakang budaya.

Sesuai hasil observasi yang dilakukan di Madrasah Aliyah Alkhairaat Guraping, menunjukkan bahwa proses pembelajaran kimia di masih berorientasi nilai tanpa memperhatikan keterampilan yang lain termasuk keterampilan abad 21. Sehingga proses pembelajaran terkesan monoton dan tradisional/konvensional seperti ceramah, latihan dan penguasaan sehingga keterampilan siswa dalam berkomunikasi atau menyampaikan ide belum terlihat. Hal

tersebut menjadi salah satu pemicu rendahnya rasa penasaran dan ingin tahu siswa dalam menjalani proses pembelajaran kimia di kelas. Kurangnya ketertarikan siswa untuk mengikuti proses pembelajaran menjadi masalah yang tidak dapat kita hindari

Salah satu pendekatan yang menuntut siswa untuk mengembangkan keterampilan abad 21 dan menciptakan pembelajaran kimia yang bermakna serta terkait dengan budaya siswa yaitu pendekatan *Culturally Responsive Teaching (CRT)*. *Culturally Responsive Teaching* adalah suatu pendekatan pembelajaran yang menghendaki adanya persamaan hak setiap siswa untuk mendapatkan pengajaran tanpa membedakan latar belakang budaya siswa (Gay, 2000). Pembelajaran CRT juga dapat diintegrasikan dengan etnokimia untuk mengembangkan kemampuan dalam keterampilan kolaborasi, komunikasi empati, dan berpikir tingkat tinggi (Rahmawati & Ridwan, 2017)

### METODOLOGI PENELITIAN

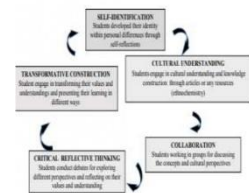
Penelitian ini dilaksanakan di Madrasah Aliyah Alkhairaat Guraping pada materi hidrolisis. Subjek penelitian ini adalah siswa kelas XI di MA Alkhairaat Guraping yang berjumlah 19 orang. Pengambilan sampel pada penelitian ini adalah dengan menggunakan *purposive sampling* yaitu teknik pengambilan sampel sebagai sumber data dengan pertimbangan tertentu. (Sugiyono, 2010:392)

Penelitian ini menggunakan metode kualitatif dengan pendekatan interpretif yakni suatu pendekatan khusus untuk desain penelitian, pembentukan konsep, analisis data dan standar. Pendekatan interpretif menyediakan informasi mendalam mengenai kompleksitas pengalaman kehidupan berdasarkan sudut pandang subjek yang menjalani penelitian kehidupan tersebut. Teknik pengumpulan data pada penelitian ini

menggunakan wawancara, observasi kelas, reflektif jurnal, dan dokumentasi. Tahap analisis data meliputi (1) Mentranskrip data hasil wawancara dengan siswa, data hasil observasi, dan data hasil reflektif jurnal, (2) Mengeksplorasi dan memberi kode pada penelitian, Mereduksi dan melakukan seleksi data, (3) analisis data dan (4) penarikan kesimpulan (Creswell, 2012).

#### HASIL DAN PEMBAHASAN

Pembelajaran menggunakan pendekatan *culturally responsive teaching* terintegrasi etnokimia pada materi hidrolisis dilakukan selama semester ganjil tahun 2018 pada kelas XI IPA diawali dengan adanya karakteristik pendidikan atau kebutuhan siswa yang harus diatasi dengan menggunakan pendekatan pembelajaran tersebut. Tahapan pembelajaran menggunakan pendekatan ini lebih memperhatikan aspek informasi, komputasi, otomasi dan komunikasi yang dimana merupakan ciri dari keterampilan abad 21 siswa. Gambaran umum pelaksanaan Pembelajaran dengan mengintegrasikan CRT dengan etnokimia dapat dilihat pada bagan berikut.



Gambar 1. Model CRT Terintegrasi Etnokimia (Rahmawati et.al, 2017)

Tahapan pembelajarannya sebagai berikut:

- 1) Menjelaskan tentang pendekatan pembelajaran *culturally responsive teaching* yang terintegrasi etnokimia
- 2) Melakukan apersepsi untuk mengetahui sejauh mana pengetahuan siswa tentang materi yang akan diajarkan
- 3) Menyampaikan materi pembelajaran yang dikaitkan dengan budaya siswa
- 4) Melakukan tanya jawab untuk mengkonstruksi pengetahuan siswa berdasarkan pengetahuan yang dimiliki sebelumnya
- 5) Membagi kelompok dengan latar budaya siswa yang berbeda
- 6) Siswa membahas tugas tentang asal mula roti coe dan menjawab pertanyaan di dalam artikel yang diberikan guru
- 7) Melakukan praktikum kelompok berbasis etnokimia yang berasal dari artikel yang diberikan guru

Pembelajaran yang mengintegrasikan etnokimia dengan pendekatan *culturally responsive teaching* ini menggunakan metode *Project based learning* yang merupakan salah satu metode pembelajaran kolaboratif beraliran konstruktivisme, dimana menggunakan proyek/kegiatan sebagai media belajar, (Sukirman, 2008: 60-61). *Project based learning* atau biasa disebut dengan pembelajaran berbasis proyek merupakan pembelajaran kooperatif yang menggunakan system pengelompokan kecil (Sanjaya, 2006: 240), dimana tiap anggota kelompok terdiri dari anggota kelompok heterogen yang memiliki latar belakang kemampuan akademik, suku, jenis kelamin yang berbeda dengan menghasilkan sebuah produk dari hasil kerja kelompok. Pembelajaran dengan menggunakan metode ini membuat siswa untuk mengeksplorasi, menginterpretasi, mensintesis, dan mengkomunikasikan hasil belajar yang membuat siswa termotivasi dalam belajar. Praktikum yang dibuat siswa pada penelitian ini yaitu tentang bagaimana membuat kue khas Maluku Utara *roti coe* yang melibatkan

proses kimia dalam hal ini pada materi hidrolisis.

Pembelajaran CRT terintegrasi etnokimia membuat siswa antusias mengikuti pembelajaran.

"Siswa tampak antusias ketika guru memperlihatkan gambar kue roti coe dan memberikan tugas untuk mencari tahu asal usul roti coe masuk ke daerah mereka" (Lembar Observasi, Observer D.A. 08 Desember 2018)

"belajar dengan menggunakan pendekatan ini (*culturally responsive teaching*) begitu menyenangkan, karena kami dapat berbagi pengalaman tentang budaya kami masing-masing" (Wawancara siswa, 05 Januari 2019)

Berdasarkan wawancara siswa di atas, dapat diketahui bahwa siswa melalui pembelajaran dengan menggunakan pendekatan *culturally responsive teaching* pada tahapan pembahasan artikel etnokimia tentang *roti coe* membuat siswa lebih aktif dan dapat berbagi cerita dan pengalamannya masing-masing. Siswa yang berasal dari budaya yang berbeda ini tidak merasa tereliminasi dan terdiskriminasi untuk menampilkan status budayanya sehingga rasa saling menghargai antara budaya yang satu dengan yang lainnya secara langsung terpujuk dalam diri masing-masing siswa. Hal inilah yang menjadi ciri khas pendekatan *culturally responsive teaching*. Hal tersebut sejalan dengan hasil penelitian yang menyatakan bahwa belajar dengan memanfaatkan budaya lokal dapat meningkatkan aktivitas belajar siswa (Taher, 2019)

Keterampilan yang muncul pada pembelajaran dengan metode ini diantaranya;

#### 1) Keterampilan Informasi

Dalam menghadapi arus globalisasi, keterampilan dalam menguasai teknologi untuk mencari informasi sangatlah diperlukan. Adapun kemampuan informasi merupakan kemampuan siswa yang meliputi kemampuan untuk mampu menggunakan seluruh informasi yang diperoleh dari berbagai sumber untuk membuat kesimpulan dan keputusan, serta menggunakan informasi tersebut dengan bijak dan benar sesuai dengan norma dan etika yang berlaku. Kemampuan keterampilan informasi siswa dapat dilihat dari reflektif jurnal siswa, observasi kelas yang dilakukan oleh observer, dan hasil wawancara siswa

"Penggunaan media dan teknologi kami semakin mahir, dalam hal ini mencari informasi yang dianggap paling valid dari Hp dan internet"

(Wawancara siswa S.A, 05 Januari 2019)

Selain media dan teknologi yang digunakan untuk mengakses informasi, orang tua dan masyarakat juga berperan penting untuk mendapatkan informasi terkait tugas mencari asal-usul kue khas *roti coe*. Adanya komunikasi yang dibangun antara siswa dengan masyarakat luar terkait dengan tugas yang diberikan dapat menambah pengetahuan budaya serta pengalaman belajar siswa

#### 2) Keterampilan Otomasi

Keterampilan abad 21 siswa yang dapat mengatasi problematika ini yaitu keterampilan abad 21 unsur otomasi yang mana keterampilan ini mengajarkan siswa untuk berfikir kritis dan dapat memecahkan masalah yang ada sehingga dapat mengambil sebuah keputusan. Kemampuan berpikir kritis siswa dan memecahkan masalah yaitu dimana siswa mampu untuk memberi alasan yang tepat jika diberikan pertanyaan dan persoalan, dapat menghubungkan informasi yang rumit dan menarik kesimpulan, menanyakan pertanyaan penting untuk

memperoleh jawaban dan memberikan penilaian berdasarkan sudut pandang yang baik.

*"pembelajaran ini membuat saya berpikir kritis tentang bagaimana cara memunculkan ide kreatif dalam praktikum membuat kue roti coe ini"*  
(wawancara siswa W.B, 05 Januari 2019)

*"kami sama – sama berpikir dan membuat keputusan untuk menggunakan kacang hijau sebagai isian (inti) dari kue roti coe kelompok kami"*  
(wawancara siswa W.W 05 Januari 2019)

Berdasarkan wawancara di atas, siswa menjadi terbiasa untuk berpikir kritis dalam menjawab hal sulit. Sehingga dapat disimpulkan bahwa pembelajaran dengan menggunakan pendekatan *culturally responsive teaching* terintegrasi etnokimia dapat membuat siswa untuk berpikir kritis dalam menyelesaikan suatu masalah yang dihadapi

### 3) Keterampilan Komunikasi

Pada pembelajaran dengan menggunakan pendekatan *culturally responsive teaching* terintegrasi etnokimia, salah satu unsur keterampilan abad 21 siswa yang muncul selama proses pembelajaran berlangsung ialah keterampilan komunikasi siswa. Keterampilan komunikasi merupakan salah satu keterampilan yang menekankan pentingnya kerjasama atau kolaborasi dalam menyelesaikan masalah. Keterampilan komunikasi juga merupakan salah satu keterampilan yang sudah pasti sering kita lakukan. Namun dalam proses pembelajaran, kemampuan komunikasi dan kolaborasi ini berbeda dari arti biasanya, kemampuan komunikasi dan kolaborasi dalam pembelajaran yaitu mampu menyampaikan ide – ide baik secara lisan maupun tulisan, menghargai orang lain saat sedang diskusi

dan mampu mendengarkan ide dari orang lain.

*"Dengan bekerja kelompok, saya dapat berkomunikasi untuk bertukar pendapat dan berkolaborasi dalam menyelesaikan tugas praktikum yang dibuat"*  
(Reflektif Jurnal Siswa, J.A, 29 Desember 2018)

*"Di dalam kelompok, semua anggotanya mau untuk mengemukakan pendapat mereka"*  
(Reflektif jurnal siswa H.D, 29 Desember 2018)

Keterampilan komunikasi dan kolaborasi siswa dimulai dari siswa mempresentasikan hasil temuan mereka tentang asal – usul kue khas *roti coe* menurut budaya mereka masing – masing sampai semua siswa bekerja sama dalam membuat praktikum, serta saling mendengarkan pendapat dari teman. Berdasarkan reflektif jurnal, kemampuan komunikasi siswa juga berkembang.



Gambar 2. Kegiatan Kelompok Siswa

Dari gambar terlihat bahwa siswa saling bekerjasama dalam penyelesaian praktikum yang dikerjakan. Siswa tampak berkolaborasi dengan baik antara sesama anggota kelompok untuk menghasilkan sebuah karya yang menarik dan unik. Gambar sebelah kiri memperlihatkan komunikasi siswa yang satu dengan yang lain dalam hal pembagian tugas dalam anggota kelompok sehingga masing –

masing siswa tidak ada yang tidak bekerja. Dengan menerapkan pendekatan *culturally responsive teaching* terintegrasi etnokimia pada pembelajaran ini, kemampuan komunikasi dan kolaborasi siswa semakin baik dalam hal pengerjaan tugas kelompok

### 4) Motivasi

Pembelajaran dengan menggunakan pendekatan *culturally responsive teaching* terintegrasi etnokimia membuat rasa ingin tahu siswa semakin berkembang, dikarenakan pendekatan *culturally responsive teaching* merupakan sebuah pendekatan baru yang belum tersentuh oleh siswa dan pembelajaran kimia di sekolah belum mengaitkan dengan latar belakang budaya siswa sehingga memunculkan rasa ketertarikan dan penasaran tentang bagaimana proses pembelajaran dengan menggunakan pendekatan ini begitu besar. Berikut merupakan pernyataan siswa

*"saya merasa senang dan tertarik dengan pembelajaran saat kami mempresentasikan hasil artikel tentang roti coe, wawasan saya mengenai budaya kita semakin bertambah"*  
(Wawancara siswa F.K, 05 Januari 2019)

*"suasana kelas tampak sedikit gaduh saat guru memperlihatkan gambar kue roti kepada siswa, antusias dan semangat belajar siswa sangat terlihat"*  
(Lembar observasi Observer D.A, 08 Desember 2018)

Berdasarkan hasil pengamatan observer, siswa terlihat motivasinya saat guru memperlihatkan gambar kue *roti coe* yang belum pernah mereka jumpai saat proses pembelajaran kimia. *Culturally responsive teaching* juga mengembangkan motivasi siswa untuk membuat kreativitas tersendiri dalam pembelajaran terutama ketika membuat praktikum, seperti pada pernyataan siswa berikut.

*"praktikum yang dikerjakan sangat memunculkan kreativitas tersendiri karena kelompok kami harus membuat sesuatu yang menarik dalam pembuatan kue roti coe, selain itu kami menjadi termotivasi dan merasa terpacu untuk membuat karya sebaik mungkin saat kami melihat hasil karya kelompok lain"*  
(Wawancara Siswa F.K, 05 Januari 2019)

Berdasarkan wawancara siswa di atas, siswa merasa termotivasi dalam pengerjaan praktikum kelompok untuk membuat hasil karya yang lebih baik, karena tidak ingin kalah dengan kelompok lain. Pembelajaran dengan pendekatan ini mampu memunculkan rasa motivasi siswa, selain itu siswa juga sangat antusias dan bersemangat dalam mengikuti proses pembelajaran. Hal ini sesuai teori bahwa motivasi dan tujuan menjadi factor utama keberhasilan siswa dalam kemampuan akademiknya.

### 5) Rasa Ingin Tahu

Rasa ingin tahu merupakan keinginan untuk menyelidiki dan menalami suatu fenomena atau pernyataan (Samani dan Hariyanto, 2012). Pembelajaran kimia menggunakan pendekatan *culturally responsive teaching* merupakan pembelajaran yang baru bagi siswa, sehingga mendorong keingintahuan siswa. Berikut merupakan pernyataan siswa:  
*"Perasaan saya dengan menggunakan pendekatan ini cukup tertarik, karena pembelajaran seperti ini merupakan pembelajaran yang baru sehingga rasa ingin tahu terhadap apa yang akan dipelajari cukup besar"*  
(Reflektif Jurnal siswa, 08 Desember 2018)

Berdasarkan reflektif jurnal siswa di atas, siswa merasa tertarik dengan pembelajaran menggunakan pendekatan *culturally responsive teaching* karena merupakan sebuah pembelajaran yang baru

bagi siswa. Ketertarikan siswa akan pembelajaran ini membuat rasa ingin tahu siswa semakin besar sehingga siswa lebih bersemangat melakukan proses pembelajaran. Hal ini juga sesuai dengan pernyataan observer:

*Pembahasan artikel membuat siswa semakin penasaran tentang apa yang akan dibuat pada pertemuan berikutnya saat praktikum nanti”*

*(Lembar Observasi, Observer D.A, 15 Desember 2018)*

Pembelajaran dengan melibatkan budaya membuat siswa semakin antusias. Rasa ingin tahu siswa semakin terlihat ketika pembahasan artikel tentang kue khas *roti coe* semakin berkembang. Rasa penasaran seperti apa yang akan dibuat saat praktikum nanti, bagaimana cara membuatnya merupakan rasa ingin tahu siswa yang perlu dibimbing sehingga menghasilkan hasil yang terarah

#### KESIMPULAN

Berdasarkan hasil penelitian penerapan pendekatan *culturally responsive teaching* terintegrasi etnokimia pada materi hidrolisis dapat mengembangkan keterampilan abad 21 siswa. Keterampilan yang muncul diantaranya: 1) keterampilan informasi, di mana siswa dapat menguasai berbagai teknologi untuk memperoleh informasi terkait materi yang di sampaikan; 2) keterampilan otomasi, yaitu siswa dapat berpikir kritis untuk menyelesaikan dan memecahkan masalah yang ada dan timbul saat proses pembelajaran berlangsung; 3) keterampilan komunikasi, yaitu keterampilan siswa dalam bekerjasama dan berkolaborasi dengan sesama anggota kelompok untuk menyelesaikan segala tugas yang diberikan, serta rasa ingin tahu dan meningkatkan motivasi belajar mereka.

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# 14 Penerapan Pendekatan *Culturally Responsive Teaching* Terintegrasi Etnokimia dalam Mengembangkan Keterampilan Siswa Abad 21 pada Materi Hidrolisis di MAN 1 TIKEP



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Penerapan Pendekatan *Culturally Responsive Teaching* Terintegrasi Etnokimia dalam Mengembangkan Keterampilan Siswa Abad 21 pada Materi Hidrolisis di MAN 1 TIKEP

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#### Abstract:

The purpose of this study is to integrate ethnochemistry through the *Culturally Responsive Teaching* approach and develop 21st-century students' skills through a *Culturally Responsive approach*. Teaching Integrated Ethnochemistry on Hydrolysis material. The goal of the *Culturally Responsive Teaching* approaches that all students can involve themselves to participate actively in the learning process. The method used in qualitative descriptive approach research can produce descriptive data in the form of written or spoken words from people on observed behavior, this approach is directed at the background and the individual holistically with this qualitative approach the researcher will find it easier to apply, analyze 21st-century skills with an integrated ethnochemical culturally responsive teaching approach on hydrolysis material in MAN 1 Tikep, sampling in this study using purposive sampling data collection techniques using interviews, classroom observation, reflective journals, and documentation. Data analysis is qualitative data analysis, which is presenting data starting from examining all collected data, compiling it, then proceeding to the next stage, checking its validity and interpreting it by analyzing the ability of reason to make decisions. The results showed that with the ethnochemical integrated culturally responsive teaching approach on hydrolysis material in developing 21st-century skills, students indicated that students' learning development was increasing in understanding the concept of hydrolysis material because learning that took place besides conveying theory, there was also practicum without experiment that directly involved students' culture. The culturally responsive ethnochemical integrated teaching approach in learning is an approach that is integrated with student culture and linked to chemistry so that students understand what the teacher says and learning looks more meaningful.

**Keyword:** CRT Approach, Ethnochemistry, Hydrolysis

#### PENDAHULUAN

Pendidikan adalah usaha sadar dan terencana untuk mewujudkan suasana belajar dan proses agar peserta didik secara aktif mengembangkan potensi dirinya untuk memiliki kekuatan spiritual, keagamaan, pengendalian diri, kepribadian, kecerdasan, akhlak mulia, serta keterampilan yang diperlukan dirinya, masyarakat, bangsa, dan negara. Sehingga dalam melaksanakan prinsip penyelenggaraan pendidikan harus sesuai dengan tujuan pendidikan nasional yaitu; mengembangkan kemampuan dan membentuk watak serta peradaban bangsa yang bermartabat dalam rangka mencerdaskan kehidupan bangsa.

Pendidikan adalah salah satu bentuk perwujudan kebudayaan manusia yang dinamis dan syaria perkembangan. Secara harfiah, (Triyanto, 2012) menurut *Kamus Besar Bahasa Indonesia*, pendidikan dan kebudayaan memiliki makna yang sebenarnya memiliki keterkaitan didalamnya. Pendidikan merupakan hal atau perbuatan suatu cara mendidik. Kebudayaan adalah hasil kegiatan dan penciptaan batin (akal budi) manusia (seperti kepercayaan, kesenian, dan adat istiadat).

Ilmu kimia merupakan salah satu bidang ilmu yang tidak terpisahkan dalam dunia pendidikan terutama di tingkatan SMA. Ilmu kimia membahas tentang materi, meliputi susunan, sifat-sifat dan perubahannya, serta perubahan energy yang menyertai perubahan materi tersebut (Clang, 2005). Jadi pembelajaran kimia adalah proses interaksi antara peserta didik dengan pendidik dan sumber belajar untuk memperoleh ilmu terkait materi melalui fenomena. Sehingga pembelajaran kimia harus dikaitkan dengan latar belakang budaya siswa atau fenomena yang sering dijumpai, agar menghasilkan pembelajaran bermakna (Gabel, 2019).

Pemerintah telah mengembangkan kurikulum 2013 yang dengan menggunakan

filosofi pendidikan yang berakar pada budaya bangsa untuk membangun kehidupan masa kini dan masa mendatang. Kurikulum 2013 mengadopsi pola pembelajaran dalam bentuk pengalaman belajar langsung siswa (*learned-curriculum*) sesuai dengan latar belakang, karakteristik, dan kemampuan awal siswa, tuntutan pada tiap kompetensi kurikulum 2013 ada 3 ranah, yaitu ranah pengetahuan, ranah sikap dan ranah keterampilan. Abad 21 ini menuntut setiap siswa harus memiliki kecakapan atau keterampilan sehingga dalam proses pembelajaran yang dilakukan dapat memunculkan ciri dari keterampilan abad 21 diantaranya adalah mencari tahu, merumuskan masalah, berfikir analitis, dan melakukan kerjasama atau kolaborasi.

Menjadi permasalahan saat ini adalah pihak sekolah, guru atau siswa itu sendiri belum mengembangkan keterampilan etno kimia yang berbasis budaya pada proses pembelajaran dikelas, hasil observasi yang dilakukan di MAN 1 Tikep telah menunjukkan bahwa proses pembelajaran kimia di sekolah masih berorientasi pada nilai tanpa memperhatikan keterampilan yang lain termasuk keterampilan abad 21, inilah yang menjadi penyebab rendahnya rasa penasaran dan ingin tahu siswa dalam menjalani proses pembelajaran kimia di kelas.

Pendekatan *Culturally Responsive Teaching* adalah suatu metode pembelajaran yang menghendaki adanya persamaan hak setiap siswa untuk mendapatkan penguasaan tanpa membedakan latar belakang budaya siswa. Dengan adanya pendekatan pembelajaran ini dapat memungkinkan siswa terlibat aktif baik berkomunikasi dan berkolaborasi dengan teman-temannya, sehingga keterampilan-keterampilan tersebut dapat dilatih dengan cara mengintegrasikan dan mengembangkan keterampilan abad 21 dengan pendekatan *Culturally Responsive Teaching* terintegrasi etnokimia pada materi hidrolisis di harapkan dapat



mengembangkan keterampilan siswa terintegrasi etno kimia pada materi hidrolisis.

#### METODOLOGI PENELITIAN

Penelitian yang dilakukan merupakan bagian dari penelitian deskripsi kualitatif. Pendekatan kualitatif adalah prosedur pendekatan yang menghasilkan data dekriptif berupa kata-kata tertulis atau lisan dari orang-orang atau perilaku yang diamati. Pendekatan ini diarahkan pada latar dan individu tersebut secara holistic (utuh) (Moleong, 2005:4). Penelitian ini menggunakan metode *interpretive research*. Bevi dan Kedar (2008) mengemukakan bahwa *interpretive research* adalah suatu pendekatan khusus untuk desain penelitian, penentuan konsep, analisis data dan standar penelitian. *Interpretive research* adalah metode penelitian yang mencakup orientasi pengalaman yang menunjukkan bahwa setiap tindakan manusia memiliki makna yang bergantung pada sejarah atau pengalaman sebelumnya. *Interpretive research* menyediakan informasi mendalam mengenai kompleksitas pengalaman kehidupan berdasarkan sudut pandang subjek yang menjalani penelitian kehidupan tersebut (Schwandt, 2000).

Dengan pendekatan kualitatif dalam penelitian ini, maka peneliti akan menerapkan dan menganalisis kemampuan keterampilan abad 21 dengan menerapkan pendekatan *Culturally Responsive Teaching* terintegrasi Etokimia pada materi Hidrolisis di MAN 1 Tikop, yang Fokus penelitian ini adalah untuk mengembangkan keterampilan abad 21 siswa melalui pendekatan *Culturally Responsive Teaching* pada materi Hidrolisis. Pengambilan data dalam penelitian ini dilakukan dengan wawancara, observasi kelas, reflektif jurnal dan dokumentasi.

#### Teknik Pengambilan Sampel

Pengambilan sampel pada penelitian ini adalah dengan menggunakan *purposive*

*sampling* yaitu teknik pengambilan sampel sebagai sumber data dengan pertimbangan tertentu. Pertimbangan tertentu ini misalnya orang tersebut tahu tentang apa yang akan diteliti, atau mungkin sebagai penguasa sehingga dapat memudahkan peneliti menjelajahi pengambilan sampel sebagai sumber data, awalnya berjumlah sedikit lama kelamaan menjadi besar (Sugiyono, 2010).

#### Teknik Pengumpulan Data

Teknik pengumpulan data dengan cara wawancara, observasi kelas, reflektif jurnal, dan dokumentasi.

- Wawancara adalah proses tanya jawab lisan antara dua orang atau lebih secara langsung. terberg dalam Sugiyono (2013) mengemukakan bahwa wawancara merupakan pertemuan dua orang untuk bertukar informasi dan ide melalui tanya jawab, sehingga dapat dikonstruksikan makna dalam suatu topik tertentu.
- Observasi kelas adalah upaya merekam segala peristiwa dan kegiatan yang terjadi selama tindakan itu berlangsung, dengan atau tanpa alat bantu. Artinya data yang diperoleh melalui observasi berasal dari subjek pada saat terjadinya tingkah laku (Chairiri, 2009).
- Reflektif jurnal adalah catatan harian siswa yang dapat menjelaskan proses integrasi etokimia pada pendekatan *culturally responsive teaching* dalam mengembangkan keterampilan abad 21 siswa pada proses pembelajaran.
- Dokumentasi merupakan catatan peristiwa yang sudah berlalu. Dokumen bisa berbentuk tulisan, gambar, atau karya-karya monumental, dokumen yang berbentuk tulisan seperti catatan

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harian, sejarah kehidupan, biografi, yang berbentuk gambar misalnya foto, gambar hidup, sketasa dan lain-lain. Studi dokumen tersebut merupakan pelengkap dari penggunaan metode observasi dan wawancara dalam penelitian kualitatif. (Sugiyono, 2013)

#### Teknik Analisis Data

Teknik analisis data pada penelitian ini adalah analisis data kualitatif. Yang dilakukan dengan cara menyajikan mulai dari menelaah seluruh data yang terkumpul, menyusunnya dalam satu kesatuan kemudian dikategorikan pada tahap berikutnya, memeriksa keabsahan kemampuan nalar peneliti untuk membuat suatu keputusan. Ada lima langkah yang saling terkait dalam analisis dan interpretasi data penelitian kualitatif (Creswell, 2012). Tahapan-tahapan yang dilakukan peneliti dalam analisis data sebagai berikut :

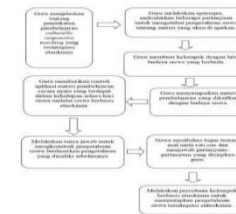
- Mempersiapkan dan mengorganisir data penelitian untuk dianalisis.
- Mengeksplorasi dan memberi kode pada penelitian.
- Menelompokkan kode yang telah dibuat untuk membangun deskripsi dan tema.
- Mempresentasikan dan melapokan data penelitian (kualitatif).
- Melakukan validasi terhadap data hasil penelitian.

#### HASIL DAN PEMBAHASAN

##### Integrasi pendekatan *culturally responsive teaching* dengan Etokimia pada materi Hidrolisis

Integrasi pendekatan *culturally responsive teaching* dengan etokimia bertujuan untuk mengembangkan keterampilan abad 21 siswa diperoleh dari beberapa data yaitu melalui

wawancara siswa, reflektif jurnal, data observasi oleh observer serta pemberian tugas melalui artikel yang diberikan peneliti. Melalui data tersebut, peneliti mengkodring dan menganalisis (Miles dan Huberman, 2007) implikasi yang muncul selama menerapkan keterampilan *culturally responsive teaching* pada proses pembelajaran. Pendekatan *culturally responsive teaching* dalam pembelajaran merupakan pembelajaran terintegrasi yang terdiri dari informasi, komputasi, otomasi dan komunikasi dimana pembelajaran ini lebih diarahkan untuk mendorong peserta didik mencari tahu dari berbagai sumber informasi, menggunakan teknologi dan media untuk merumuskan masalah (bertanya) dan bukan hanya menyelesaikan masalah (menjawab), berfikir analitis (pengambilan keputusan) serta peserta didik lebih menyadari pentingnya melakukan kerjasama kolaborasi dalam menyelesaikan masalah. Berikut disajikan bagan alir mengenai penerapan pendekatan *culturally*



Gambar 1. Bagan alir penerapan *culturally responsive teaching*

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Pembelajaran dengan menggunakan metode ini membuat siswa untuk mengeksplorasi, menginterpretasi, mensintesis, dan mengkomunikasikan hasil belajar yang membuat siswa termotivasi pada materi hidrolisis. Berikut deksripsi percobaan pada proses pembelajaran :

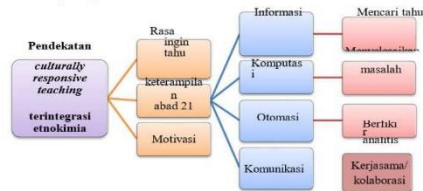
dalam belajar. Percobaan yang dibuat siswa pada penelitian ini yaitu pembuatan kue khas Maluku Utara salah satunya adalah *roti coe* yang melibatkan proses kimia dalam hal ini

Tabel 1. Deskripsi Praktikum Siswa

Materi	Nama Percobaan	Deskripsi
Hidrolisis Garam <i>coe</i>	Membuat kue khas <i>roti coe</i>	Percobaan membuat <i>roti coe</i> ini dibuat oleh kelompok dengan variasi yang berbeda. Percobaan ini dibuat siswa secara berkelompok dengan membuat adonan <i>roti coe</i> terlebih dahulu yang terdiri dari tepung terigu, telur, mentega, air bersih, santan dan pengembang kue (soda kue), sedangkan isian dari <i>roti coe</i> itu sendiri dibuat dengan empat varian rasa yang berbeda.

Dari tabel ini dapat dijelaskan bahwa deskripsi percobaan siswa secara berkelompok dalam melakukan percobaan/praktikum tercipta suasana diskusi yang menyenangkan, saling menghargai ide-ide dan pendapat dari

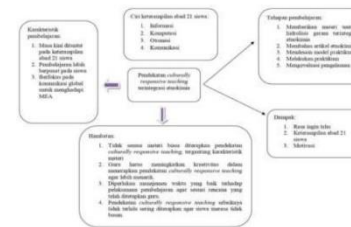
sesama anggota kelompok. Terdapat beberapa keterampilan abad 21 yang muncul dari pengerjaan percobaan/praktikum tersebut telah diuraikan di sub bab selanjutnya.



Gambar 2. Implikasi Pendekatan Culturally Responsive Teaching Terintegrasi Etnokimia

Gambar diatas adalah skema ringkasan perkembangan pendidikan abad 21 siswa yang muncul selama proses pembelajaran dengan menggunakan pendekatan *culturally responsive teaching* terintegrasi etnokimia pada materi hidrolisis. Implikasi yang muncul lebih berfokus pada pendidikan abad 21 siswa dan implikasi lain seperti rasa ingin tahu

dan motivasi siswa seperti yang digambarkan pada skema diatas. Hasil penelitian terkait perkembangan abad 21 siswa yang dikaji, diperoleh dari reflektif jurnal siswa, lembar observasi, dan hasil wawancara siswa yang dianalisis dengan tahapan analisis data, Miles dan Huberman (2007).



Gambar 3. Pendekatan *culturally responsive teaching* terintegrasi etnokimia

**PEMBAHASAN**

Hasil penelitian yang telah dijelaskan pada sub bab sebelumnya menunjukkan bahwa dari penerapan pendekatan *culturally responsive teaching* terintegrasi etnokimia pada materi hidrolisis terlihat semakin berkembangnya keterampilan abad 21 siswa melalui tahapan-tahapan pembelajaran yang terdiri dari memberikan materi tentang hidrolisis, membahas artikel etnokimia, mendesain model praktikum, melakukan praktikum, dan mengevaluasi pengalaman. Implikasi yang muncul lebih berfokus pada keterampilan abad 21 siswa dan implikasi lain seperti rasa ingin tahu dan motivasi siswa yang diperoleh dari analisis data

hasil wawancara, reflektif jurnal siswa, dan lembar observasi siswa yang dilakukan oleh observer.

**Integrasi pendekatan *culturally responsive teaching* dengan Etnokimia pada materi Hidrolisis**

Pemilihan pendekatan dalam pembelajaran ini adalah hal yang sangat penting, karena dengan pemilihan pendekatan yang tepat juga menjadi tolak ukur tercapainya tujuan pembelajaran. Pemilihan pendekatan yang tepat dapat dilakukan dengan melihat karakteristik materi serta karakteristik siswa. Dalam mengintegrasikan pendekatan *culturally responsive teaching* dengan etnokimia lebih

mengedepankan pada proses pembelajaran yang dikaitkan dengan kehidupan sehari-hari siswa, sehingga metode yang dipakai dalam pembelajaran ini menggunakan metode *PjBL* yang mengedepankan pembelajaran berbasis proyek. Dipilihnya *PjBL* sebagai metode dalam pembelajaran ini dikarenakan metode ini mampu mengembangkan keterampilan abad 21 siswa. Pendekatan *culturally responsive teaching* dalam pembelajaran ini diharapkan dapat mengembangkan keterampilan abad 21 siswa, khususnya keterampilan berpikir kritis, memiliki rasa ingin tahunya yang tinggi serta mendorong kreativitas dan inovasi siswa dalam berfikir analitis serta mampu bekerjasama dan berkolaborasi.

Dibawah ini diuraikan ada lima langkah tahapan pembelajaran yang telah diterapkan selama proses penelitian atau pembelajaran berlangsung.

- Memberikan materi tentang hidrolisis garam terintegrasi etnokimia  
Pada tahapan ini peneliti telah menjelaskan secara teoritis kepada siswa pokok bahasan hidrolisis dengan pendekatan *culturally responsive teaching* yang terintegrasi etnokimia.
- Membahas artikel etnokimia  
Pada tahapan ini, siswa tampak antusias sehingga suasana kelas tampak ramai ketika masing-masing kelompok mempresentasikan hasil temuannya, suasana kelas yang biasanya hening dan terlihat membosankan ketika proses pembelajaran kimia berlangsung kini tampak hidup karena para siswa sangat berperan aktif dalam proses pembelajaran dengan mengunakan pendekatan *culturally responsive teaching*. Hal ini dapat diketahui dari kutipan wawancara siswa berikut :  
"belajar dengan menggunakan pendekatan ini (*culturally responsive teaching*) begitu menyenangkan, karena kami dapat berbagi pengalaman

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*tentang budaya kami masing-masing"*

- Mendesain model percobaan  
Pada tahapan ini peneliti telah membagi siswa dalam beberapa kelompok secara heterogen kemudian membahas hal-hal yang berhubungan dengan percobaan yang akan dilakukan yaitu model roti coe yang dibuat, waktu dan tempat pelaksanaannya. Dari tahapan mendesain model percobaan, dapat memunculkan rasa tanggung jawab, kerjasama, komunikasi dan kolaborasi. Selain itu juga siswa dapat mengembangkan kreativitas dan inovasinya serta dapat menganalisis keputusan berdasarkan inisiatif sendiri. Hal ini dapat dilihat dari reflektif jurnal siswa berikut :  
"Kita saling bekerjasama dan membantu, karena semua anggota sudah mendapatkan tugasnya masing-masing untuk menyiapkan alat dan bahan pembuatan praktikum, sehingga pekerjaan terasa ringan"
- Melakukan Percobaan  
Tahapan melakukan percobaan adalah inti dari tahapan pembelajaran dalam penelitian dikarenakan siswa dapat secara langsung merasakan proses pembelajaran dengan mengintegrasikan pendekatan *culturally responsive teaching*. Keladiran benda-benda nyata yang sering ditemukan siswa secara langsung dalam kehidupan sehari-hari yang diintegrasikan dalam pembelajaran sangat membantu dan memudahkan siswa dalam mengkonstruksi pengetahuannya. Sehingga tingkat penialaman siswa tentang materi yang disampaikan secara konseptual dan faktual cenderung berbeda. Hal ini dapat dilihat dari reflektif jurnal siswa berikut :  
"ternyata pembelajaran seperti ini sangat mudah untuk dipahami, dibandingkan dengan pembelajaran yang biasa diterapkan oleh guru sehari-hari-hari sebelumnya"



Gambar 4. Suasana pada saat melakukan percobaan/praktikum

- Mengevaluasi Pengalaman  
Mengevaluasi pengalaman adalah tahapan terakhir dalam proses pembelajaran selama melakukan penelitian, dalam tahapan ini setiap kelompok dapat melihat kelebihan dan kekurangan kelompok masing-masing.
- Dalam evaluasi pengalaman ini peneliti mengajukan pertanyaan kepada setiap kelompok sesuai dengan kinerja masing-masing kelompok dengan cara peneliti mewawancarai setiap anggota kelompok kemudian di tuliskan di reflektif jurnal siswa.



Gambar 5. Evaluasi pembelajaran dengan wawancara

**Integrasi pendekatan *culturally responsive teaching* untuk mengembangkan keterampilan abad 21 siswa**

Integrasi pendekatan *culturally responsive teaching* untuk mengembangkan keterampilan abad 21 siswa dapat diperoleh dari hasil reflektif jurnal, observasi kelas oleh observer dan wawancara siswa. Data yang diperoleh kemudian dianalisis data yang dikoding menjadi sebuah kesimpulan data yang bermakna (Miles dan Huberman, 2009). Keterampilan abad 21 siswa yang muncul selama proses pembelajaran

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menggunakan pendekatan *culturally responsive teaching* yaitu keterampilan informasi, komputasi, otomasi dan komunikasi yang akan dijadikan satu persatu. Dari hasil penelitian, kemampuan yang paling menonjol selama proses pembelajaran adalah ketika siswa diberi tugas untuk mencari informasi seputar materi yang diberikan. Siswa terlihat sangat antusias dan telaten dalam penggunaan media elektronik untuk mencari informasi. Berikut merupakan hasil wawancara siswa :  
"keterampilan teknologi kami semakin berkembang dalam hal mencari informasi tentang materi yang belum di mengerti"

Dibawah ini diraikan keterampilan abad 21 siswa dan implikasi lain yang muncul yang diamati peneliti selama proses pembelajaran yang mengintegrasikan etnokimia pada pendekatan *culturally responsive teaching* sebagai berikut :

- Keterampilan informasi
 

Kemampuan informasi merupakan kemampuan siswa yang meliputi kemampuan untuk mampu menggunakan seluruh informasi yang diperoleh dari berbagai sumber untuk membuat kesimpulan dan keputusan, serta menggunakan informasi tersebut dengan bijak dan benar sesuai dengan norma dan etika yang berlaku. Pendekatan *culturally responsive teaching* yang diintegrasikan dengan etnokimia sangat membantu keterampilan literasi informasi dan penguasaan teknologi siswa meningkat. Dapat dilihat dari hasil wawancara siswa sebagai berikut:

*"teknologi dalam pembelajaran dengan mengintegrasikan pendekatan ini (culturally responsive teaching) yaitu dengan menggunakan internet untuk mencari informasi dan handphone sebagai mediana"*

*"media yang digunakan dalam mencari informasi seputar tugas – tugas yang diberikan adalah handphone dengan menggunakan teknologi internet"*
- Keterampilan otomasi
 

Keterampilan otomasi ini siswa harus mampu berfikir kritis dalam menyelesaikan masalah, siswa memiliki kemampuan untuk mengatasi segala permasalahan yang muncul selama proses pembelajaran serta mampu mengembangkan potensi yang dimiliki oleh siswa. Dapat dilihat beberapa hasil wawancara siswa yang dapat menunjukkan siswa mampu berpikir kritis ketika diperhadapkan oleh sebuah permasalahan.

*"pembelajaran ini membuat saya berpikir kritis tentang bagaimana*

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*cara memunculkan ide kreatif dalam praktikum membuat kue roti coe ini"*

*"ide untuk membuat kue roti coe dengan isian (tuni) sayur muncul saat kami diminta untuk membuat keunikan tersendiri dalam praktikum membuat roti coe"*

- Keterampilan komunikasi
 

Keterampilan komunikasi merupakan salah satu keterampilan yang menekankan pentingnya kerjasama atau kolaborasi dalam menyelesaikan masalah, dalam proses pembelajaran, kemampuan komunikasi dan kolaborasi dalam pembelajaran yaitu mampu menyampaikan ide-ide baik secara lisan maupun tulisan, menghargai orang lain saat sedang diskusi dan mampu mendengarkan ide dari orang lain. Berdasarkan catatan observasi dari observer, kemampuan komunikasi dan kolaborasi siswa dalam pembelajaran sangat baik karena keterampilan komunikasi dan kolaborasi siswa dimulai dari siswa mempresentasikan hasil temuan mereka tentang asal-usul kue khas *roti coe* menurut budaya mereka sendiri, semua siswa berpartisipasi penuh dalam bekeja sama membuat percobaan, serta saling mendengarkan pendapat dari teman-teman yang lain, dalam hal ini kemampuan komunikasi siswa sangat berkembang.

*"Dengan bekerja kelompok, saya dapat berkomunikasi untuk bertukar pendapat dan berkolaborasi dalam menyelesaikan tugas praktikum yang dibuat"*

*"Di dalam kelompok, semua anggotanya mau untuk mengemukakan pendapat mereka"*



Gambar 6. Kerja sama siswa dalam melakukan percobaan/praktikum

- Motivasi
 

Proses pembelajaran dengan pendekatan *culturally responsive teaching* terintegrasi etnokimia dapat membuat rasa ingin tahu siswa semakin bertambah karena , dengan pendekatan *culturally responsive teaching* adalah suatu pendekatan pembelajaran yang baru bagi siswa dalam pelajaran kimia. Dalam kesempatan ini peneliti mengaitkan dengan latar belakang budaya siswa sehingga dapat memicu rasa ketertarikan siswa dalam proses pembelajaran. (Rahmawaty, dkk 2017) dapat dilihat pernyataan siswa sebagai berikut *saya merasa senang dan tertarik dengan pembelajaran saat kami mempresentasikan hasil artikel tentang roti coe, wawasan saya mengenai budaya kita semakin bertambah"*
- Rasa ingin tahu
 

Rasa ingin tahu adalah suatu keinginan untuk menyelidiki dan memahami suatu fenomena atau pernyataan (Samani dan Hariyanto, 2012) dengan menggunakan pendekatan *culturally responsive teaching* dapat mendorong rasa keingintahuan siswa semakin meningkat, bisa dilihat pernyataan siswa sebagai berikut :

*"Perasaan saya dengan menggunakan pendekatan ini cukup tertarik, karena pembelajaran seperti*

*ini merupakan pembelajaran yang baru sehingga rasa ingin tahu terhadap apa yang akan dipelajari cukup besar"*

#### KESIMPULAN

Berdasarkan hasil penelitian tentang penerapan pendekatan *culturally responsive teaching* terintegrasi etnokimia pada materi hidrolisis untuk mengembangkan keterampilan abad 21 dapat membantu siswa dengan mudah diintegrasikan dengan budaya siswa dan dikaitkan dengan materi kimia sehingga siswa lebih mudah memahami apa yang disampaikan peneliti dan pembelajaran tampak lebih bermakna.

Karakter keterampilan abad 21 siswa dan implikasi lain yang muncul selama proses pembelajaran mengintegrasikan etnokimia pada pendekatan *culturally responsive teaching*, terdiri dari 5 karakter diantaranya: 1) keterampilan informasi, 2) keterampilan otomasi, 3) keterampilan komunikasi, 4) motivasi 5) rasa ingin tahu.

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# 15 Etnokimia: Eksplorasi Potensi Kearifan Lokal Sasak Sebagai Sumber Belajar Kimia

## ETNOKIMIA: EKSPLORASI POTENSI KEARIFAN LOKAL SASAK SEBAGAI SUMBER BELAJAR KIMIA

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### ABSTRACT

Most educators have difficulty integrating the chemistry triangle in learning so that students have difficulty understanding chemical concepts, namely in the microscopic and symbolic domains. The existence of these difficulties has an impact on the low cognitive, affective, and psychomotor learning outcomes of students. Moreover, the currently available learning resources are still focused on abstract concepts without being integrated with students' daily experiences so that chemistry material becomes difficult to understand. The purpose of this study was to analyze the form of relevance of Sasak local wisdom with chemical materials and explore the potential of Sasak local wisdom as a learning resource in Basic Chemistry courses. This type of research is an ethnographic research. Data collection techniques used are observation, interview, and documentation techniques. The data obtained were analyzed using a qualitative analysis technique which is a combination of the Miles & Huberman and Spradley models. Based on the results of the study, it was concluded that the form of relevance of Sasak local wisdom with chemistry can be reviewed based on the perspective or approach of analogy, representation, apperception, visualization and interpretation and the potential of local Sasak Lombok wisdom as a learning resource in Basic Chemistry courses, namely on 5 topics between other materials and changes in the separation and manufacture of mixtures, the atomic structure of the periodic system of elements, and chemical bonds are integrated with local Sasak wisdom.

### 1. PENDAHULUAN

Karakteristik ilmu kimia mencakup tiga domain yang distilahkan dengan *chemist's triangle* atau segitiga kimia meliputi domain makro atau nyata, domain sub-mikro yang bersifat abstrak berupa atom, ion, molekul, serta struktur dan domain simbolik berupa persamaan, rumus, persamaan matematika, dan

grafik (Sutrisno et al., 2020). Ketiga domain tersebut menunjukkan tingkat kompleksitas ilmu kimia yang harus dikuasai oleh peserta didik sehingga dalam pembelajaran pendidik khususnya harus selalu memperhatikan urgensi segitiga kimia sehingga dapat disampaikan secara runtut dan sistematis (Sutrisno et al., 2020; Yilafaw & Lewis, 2016). Selain itu, tujuan pembelajaran kimia di tingkat perguruan tinggi harus dapat melahirkan lulusan dengan pengetahuan yang komprehensif (mikroskopik, makroskopik, dan simbolik), serta mampu mengembangkan aspek sikap dan psikomotorik sehingga mampu untuk bersaing dalam menghadapi era globalisasi (De Jong, 2018). Akan tetapi, berbagai hasil penelitian terdahulu membuktikan bahwa sebagian besar pendidik mengalami kesulitan mengintegrasikan segitiga kimia dalam pembelajaran sehingga mahasiswa mengalami kesulitan dalam memahami konsep kimia yaitu pada domain mikroskopik dan simbolik. Adanya kesulitan tersebut berdampak pada rendahnya hasil belajar kognitif, afektif, dan psikomotorik mahasiswa (Calik et al., 2015; De Jong, 2018). Merujuk pada permasalahan tersebut, dosen diharapkan mampu mengaplikasikan pembelajaran kimia yang didukung dengan sumber belajar kimia yang terintegrasi dengan kehidupan dan pengalaman sehari-hari mahasiswa sehingga tujuan pembelajaran kimia dapat tercapai secara optimal melalui praktek pembelajaran yang berbasis konstruktivisme.

Pembelajaran yang berbasis konstruktivisme yang dilengkapi dengan sumber belajar yang relevan dengan kehidupan sehari-hari peserta didik akan menjadikan pembelajaran menjadi lebih bermakna. Selain itu, esensi teori belajar konstruktivisme yaitu pengetahuan dan pengalaman yang diperoleh peserta didik merupakan hasil konstruksi yang sudah dilakukan melalui keterlibatan aktif peserta didik, baik secara fisik maupun mental untuk memperoleh pengetahuan dan pengalaman baru (Huit & Dawson, 2011; Sumardi et al., 2020; Wahyudiati, 2016; Wahyudiati et al., 2020). Pengetahuan dan pengalaman tersebut diperoleh melalui pengalaman inderawi, baik mendengar, mengamati, melakukan aktivitas motorik, proses berpikir ilmiah, dan akhirnya merumuskan dalam pikiran sebagai suatu pengetahuan (Coll et al., 2002; Wahyudiati et al., 2019; Wivit, Ginting, & Hirdaus, 2013). Prinsip pembelajaran yang berbasis konstruktivisme sangat relevan dengan teori perkembangan kognitif Vygotsky yang menekankan pengorganisasian situasi kelas, penerapan strategi, dan interaksi antara pendidik dengan peserta didik, dan juga pentingnya pengaruh lingkungan sosial terhadap perkembangan pemikiran peserta didik (Fadi, 2019; Sumardi et al., 2020). Lingkungan sosial yang dimaksudkan dapat berupa objek dan simbol budaya, lembaga sosial, maupun bahasa. Simbol yang dihasilkan oleh budaya membantu peserta didik untuk berpikir, berkomunikasi, dan memecahkan masalah untuk menyesuaikan proses-proses berpikir diri sendiri (Hasanah et al., 2018; Sumardi et al., 2020; Wahyudiati, 2016). Oleh karena itu, melalui penerapan pembelajaran berbasis konstruktivisme (model-model pembelajaran aktif dan inovatif) yang dilengkapi dengan sumber belajar yang terintegrasi dengan kearifan lokal diharapkan dapat mengaktifkan peserta didik dalam mengkonstruksi pengetahuan baru melalui proses berpikir ilmiah dan melibatkan keterampilan pemecahan masalah sehingga mampu mengembangkan aspek kognitif, afektif, dan psikomotorik mahasiswa. Akan tetapi, pengembangan sumber belajar kimia yang terintegrasi kearifan lokal masih sangat jarang dilakukan terlebih lagi sumber belajar yang tersedia saat ini masih terfokus pada konsep-konsep yang bersifat abstrak tanpa diintegrasikan dengan pengalaman keseharian peserta didik sehingga materi kimia masih menjadi materi yang paling sulit dipahami peserta didik pada setiap tingkat pendidikan (Ador, 2017). Dengan demikian, salah satu upaya yang dapat dilakukan untuk dapat memudahkan peserta didik dalam memahami materi kimia yaitu melalui ketersediaan sumber belajar yang relevan dengan kehidupan sehari-hari peserta didik salah satunya melalui pengintegrasian materi kimia dengan kearifan lokal suatu daerah yang merupakan aplikasi dari etnokimia.

Etnokimia adalah berbagai praktik budaya yang terdapat pada masyarakat dan memiliki keterkaitan secara kimiawi yang menggambarkan praktik kimia dari kelompok budaya yang dapat diidentifikasi sebagai studi tentang gagasan kimia yang dapat ditemukan dalam budaya apapun (Abramova & Greer, 2013; Ador, 2017; Rahmawati et al., 2017). Dengan kata lain, etno mengacu pada anggota kelompok masyarakat dalam lingkungan budaya apapun yang dapat diidentifikasi melalui tradisi budaya, kode, simbol, mitos, dan cara-cara tertentu yang digunakan untuk mempertahankan dan menyimpulkannya. Berbagai penelitian terdahulu yang menerapkan etnokimia dalam pembelajaran melalui pemanfaatan produk budaya menunjukkan hasil yang positif seperti hasil penelitian yang dilakukan oleh melalui pemanfaatan produk budaya sebagai sumber belajar berdampak pada peningkatan hasil belajar kognitif siswa, berpengaruh terhadap sikap ilmiah mahasiswa, dan hak asasi manusia (Abramova & Greer, 2013; Ador, 2017; Rahmawati et al., 2017; Rosa & Clark, 2011). Akan tetapi, berdasarkan hasil penelitian menunjukkan bahwa integrasi budaya dalam pembelajaran dan praktikum kimia masih sangat jarang dilakukan (Ador, 2017; Abramova & Greer, 2013; Rosa & Clark, 2011).

Permasalahan pembelajaran kimia lainnya juga diperkuat dengan adanya era globalisasi yang sangat mempengaruhi keberbadaan peserta didik yang ditandai dengan mulai terikisnya nilai budaya dan kearifan lokal daerah yang menjadi pertanda ancaman terhadap huntutnya identitas nasional Indonesia.

Selain itu, dampak era globalisasi juga menyebabkan munculnya penyimpangan perilaku, serta sangat kurang penguasaan pembelajaran yang berbasis budaya (Abramova & Greer, 2013; Attas & Ashraf, 1979; Fadli, 2018; Fadli & Irwanto, 2020; Rosa & Clark, 2011). Oleh karena itu, sangat urgen untuk diterapkannya etnokimia dalam pembelajaran melalui pemanfaatan produk budaya dan lingkungan sekitar sebagai sumber belajar dan laboratorium alam. Akan tetapi, kondisi faktual saat ini menunjukkan bahwa integrasi etnokimia dengan kurikulum, perangkat pembelajaran dan dalam penyusunan bahan ajar masih sangat jarang dilakukan (Sitrisno et al., 2020; Abramova & Greer, 2013; Rosa & Clark, 2011), serta hasil penelitian menunjukkan trend penelitian di bidang kimia dari tahun 2004-2013 yang mengangkat budaya lokal menjadi kajian hanya sebesar 1,7 % (Wahyudiati, 2016; Wahyudiati et al., 2020). Terlebih lagi, permasalahan faktual yang terjadi yaitu ketersediaan bahan ajar kimia yang terintegrasi dengan kearifan lokal pada mata kuliah Kimia Dasar belum pernah dilakukan. Kelebihan dari bahan ajar kimia yang berbasis etnokimia dapat memudahkan peserta didik dalam memahami konsep-konsep kimia karena berhubungan langsung dengan pengalaman keseharian peserta didik yang merupakan implementasi dari teori belajar konstruktivisme. Teori belajar konstruktivisme memiliki esensi yaitu konstruk pengetahuan dan pengalaman yang diperoleh merupakan gabungan dari hasil konstruksi pengetahuan dan pengalaman lama yang diperoleh dengan pengetahuan baru yang sedang dialaminya sehingga mampu mengembangkan kemampuan kognitif dan psikomotorik peserta didik (Huitf & Dawson, 2011; Samardi et al., 2020; Wahyudiati, 2016; Wahyudiati et al., 2020). Demikian juga hasil penelitian relevan juga membuktikan bahwa proses pembelajaran yang mengacu pada konteks kehidupan peserta didik dengan warisan budaya (nilai-nilai kearifan lokal) sebagai substansi dalam memahami materi kimia, acuan dalam mengembangkan aspek sikap dan keterampilan, serta acuan dalam melakukan penyelidikan ilmiah berbasis laboratorium alam dapat meningkatkan hasil belajar kognitif, afektif, dan psikomotorik peserta didik (Ador, 2017; Singh, 2016). Dengan demikian penelitian sangat urgen untuk dilakukan untuk menjadi solusi permasalahan belum tercapainya tujuan pembelajaran kimia secara maksimal karena belum memadainya sumber belajar kimia yang relevan dengan konteks kehidupan peserta didik.

Mengacu pada kajian teori dan empiris di atas, urgensi penelitian ini adalah untuk memberikan salah satu solusi terbaik dari permasalahan pembelajaran kimia melalui pengintegrasian etnokimia dalam kurikulum sehingga proses pembelajaran ditempatkan berdasarkan konteks kehidupan peserta didik dengan warisan budaya sebagai substansi pemahaman konsep dan penyelidikan ilmiah berbasis laboratorium alam yang bersumber pada nilai-nilai kearifan lokal suatu daerah (Ador, 2017; Singh, 2016), seperti halnya kearifan lokal yang dimiliki suku Sasak Lombok NTB. Nilai-nilai kearifan lokal yang dimiliki suku Sasak Lombok memiliki relevansi dengan pembelajaran kimia yang tercermin dalam tradisi masyarakat Sasak yang bersumber dari sistem sosial, sistem nilai, dan produk budaya setempat. Oleh karena itu, melalui eksplorasi potensi kearifan lokal Sasak sebagai sumber belajar kimia dan laboratorium alam yang akan dilakukan pada penelitian ini, diharapkan tidak hanya mampu mengembangkan aspek kognitif mahasiswa, tetapi juga dapat mengembangkan aspek afektif dan psikomotorik yang sangat relevan dengan tuntutan pembelajaran abad 21. Adapun tujuan dari penelitian ini adalah untuk mengeksplorasi potensi kearifan lokal Sasak yang dapat dijadikan sebagai sumber belajar dan laboratorium alam pada mata kuliah Kimia Dasar sebagai bentuk pengintegrasian etnokimia dalam kurikulum di perguruan tinggi.

## 2. METODE

Pendekatan yang digunakan dalam penelitian ini adalah pendekatan naturalistik/kualitatif dengan jenis penelitian etnografi. Penggunaan pendekatan naturalistik didasarkan atas pertimbangan sumber dan jenis data yang akan di ambil yang bersifat holistik atau menyeluruh. Selain itu, penelitian naturalistik didasarkan atas keseluruhan situasi sosial dan lingkungan yang diteliti. Tahapan penelitian dari etnografi terdiri dari tahap deskripsi, tahap analisis, dan tahap interpretasi. Tahap deskripsi dilakukan untuk menggali latar belakang permasalahan melalui kegiatan observasi awal terkait dengan objek penelitian. Tahap analisis dilakukan untuk memperoleh data yang akurat berdasarkan rumusan masalah dan tujuan penelitian untuk menjawab pertanyaan penelitian. Adapun tahap interpretasi dilakukan untuk memperoleh kesimpulan yang akurat berdasarkan analisis data yang telah dilakukan.

Teknik pengumpulan data yang digunakan dalam penelitian ini adalah teknik observasi, wawancara, dan dokumentasi. Penggunaan teknik-teknik tersebut didasarkan pada jenis data yang diambil. Dalam menganalisis data, peneliti menggunakan teknik analisis data kualitatif gabungan model Miles & Huberman dan Spradley. Penggunaan teknik tersebut didasarkan atas kesesuaiannya dengan jenis data yang akan dianalisis, yaitu data yang dikumpulkan dengan teknik observasi, wawancara, dan dokumentasi. Teknik analisis data model Miles dan Huberman mencakup tiga tahapan, yaitu: reduksi data, penyajian data, dan kesimpulan atau verifikasi (Creswell, 2009). Analisis data penelitian etnografi (Spradley, 2007) terdapat empat tahapan yaitu: (1) analisis domain; (2) analisis taksonomi; (3) analisis komposensial,

dan (4) analisis tema budaya. Berdasarkan model analisis yang telah ditentukan, maka tahapan analisis data yang dilakukan peneliti sebagai berikut: setelah data terkumpul, peneliti melakukan reduksi data. Pada tahap reduksi data ini peneliti memilih, menyederhanakan, atau menyortir data kasar yang telah terkumpul atau tercatat dalam lembar observasi dan wawancara, sekaligus membuang data yang tidak perlu. Data tersebut kemudian dipilah-pilah dan dikelompokkan berdasarkan jenisnya. Setelah data direduksi, selanjutnya peneliti menyusun data tersebut ke dalam susunan yang sistematis dan kemudian dianalisis dengan cara mengkonsultasikannya dengan teori-teori dan hasil penelitian terdahulu yang relevan. Setelah proses tersebut selesai dilakukan, peneliti melakukan penarikan kesimpulan terhadap hasil analisis data tersebut yang sekaligus menjawab rumusan masalah penelitian. Kegiatan ini dilakukan peneliti secara terus-menerus setiap kali selesai observasi dilakukan.

## 3. HASIL DAN PEMBAHASAN

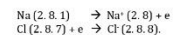
### Hasil

Berdasarkan temuan penelitian membuktikan bahwa kearifan lokal Sasak yang terdiri dari produk budaya dan nilai-nilai kearifan lokal yang terkandung dalam budaya Sasak memiliki relevansi yang kuat dengan materi Kimia yang dapat dimanfaatkan sebagai sumber belajar kimia. Konsep-konsep kimia dapat diintegrasikan dengan kearifan lokal Sasak yang ditinjau dari perspektif analogi, representasi, aperepsi, visualisasi, dan interpretasi sehingga dapat memudahkan mahasiswa dalam memahami konsep kimia dengan pemanfaatan budaya sebagai sumber belajar dan laboratorium alam. Implementasi perspektif analogi antar domain dalam pembelajaran kimia berbasis kearifan lokal Sasak dapat diterapkan pada materi ikatan kimia. Adapun budaya Sasak yang memiliki relevansi (analogi antar domain) dengan materi ikatan kimia yaitu tradisi *merarik* (pernikahan) yang terdiri dari proses *nenarh* dan *sorong serah* (lamaran). Prosesi tradisi *merarik* seperti yang ditunjukkan pada Gambar 1. Adapun keterkaitannya yaitu adanya persamaan teori atau konsep yang mendasarinya, makna, dan nilai yang terkandung didalamnya. Nilai-nilai kearifan lokal yang mendasari konsep *merarik* dilandasi oleh konsep saling membutuhkan melalui serah terima antara pihak laki-laki dan perempuan yang disahkan melalui ikatan pernikahan. Konsep saling membutuhkan melalui serah terima pasangan elektron untuk mencapai kestabilan merupakan konsep yang mendasari terbentuknya ikatan kimia.

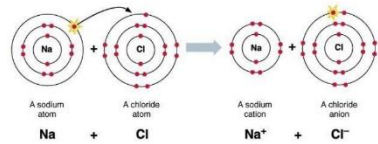


Gambar 1. Tradisi *merarik* (pernikahan) suku Sasak Lombok, NTB.

Ikatan ionik terbentuk karena adanya gaya tarik menarik antara ion yang bermuatan positif dan ion bermuatan negatif yang dihasilkan karena perpindahan (transfer) elektron antara atom-atom yang membentuk ikatan. Gaya tarik menarik yang bekerja pada ikatan ini disebut gaya elektrostatik atau gaya Coulomb. Suatu ikatan ion dihasilkan dari gaya tarik elektrostatik antara kation dan anion untuk mencapai kestabilan dengan konfigurasi elektron menyerupai gas mulia. Contoh ikatan ionik adalah terbentuknya natrium klorida atau NaCl (garam dapur). Pembentukan senyawa NaCl melalui adanya serah terima elektron, yaitu atom natrium melepaskan sebuah elektron valensinya sehingga terbentuk ion natrium atau Na<sup>+</sup> dan elektron ini diterima oleh atom klor sehingga terbentuk ion klorida atau Cl<sup>-</sup>.



Selanjutnya ion klorida dan ion natrium saling tarik menarik dengan gaya elektrostatis sehingga terjadi ikatan ionik. Terbentuklah natrium klorida atau NaCl seperti yang ditunjukkan pada Gambar 2.



Gambar 2. Serah terima elektron pada pembentukan natrium klorida atau NaCl

Implementasi pendekatan representasi dan visualisasi dalam pembelajaran kimia melalui pengintegrasian pokok bahasan materi dan perubahannya dengan kearifan lokal Sasak Lombok. Konsep materi dan perubahannya terintegrasi kearifan lokal Sasak tercermin dalam pemanfaatan unsur kimia dari berbagai jenis logam seperti emas, perak, perunggu, tembaga, kuningan, dan berbagai jenis logam lainnya untuk pembuatan alat-alat upacara adat dan kesenian tradisional suku Sasak. Misalnya, perhiasan pengganti perempuan Sasak terbuat dari emas, perak, dan perunggu. *Sengkang gigi due olas* (anting-anting) merupakan perhiasan pengganti perempuan Sasak sebagai simbol kesuburan seorang wanita. Menurut kepercayaan masyarakat setempat, wanita yang subur merupakan sosok wanita yang ideal sebagai seorang ibu. Khusus untuk golongan bangsawan *sengkang gigi due oladan kalong ringgit* (kalung) terbuat dari emas (Gambar 3 dan 4), sedangkan untuk golongan *jajar karang* (masyarakat biasa) terbuat dari bahan perak (Ag) dan tembaga (Cu). *Sengkang gigi due olas* biasanya digunakan pada pengganti perempuan ketika melangsungkan upacara perkawinan seperti yang ditunjukkan pada Gambar 5.

Senyawa dan campuran banyak dimanfaatkan dalam kehidupan masyarakat Sasak yaitu pembuatan alat-alat kesenian tradisional seperti *gong, terumpang, kencing* yang terbuat dari perpaduan antara dua logam atau lebih. Contoh perubahan fisika yang ditemukan dalam kearifan lokal Sasak seperti pewarnaan kain *Sesek*, pembuatan *sia* atau garam, dan tradisi *belulut* (pelapisan lantai rumah tradisional Sasak dengan kotoran sapi). Adapun contoh perubahan kimia ditemukan dalam pembuatan pembuatan *gula bea*, pembuatan *pateng reket* (tape ketan), *pateng ambon* (tape ubi), dan pewarnaan kain *Sesek*. Garam dapur dalam bahasa Sasak dikenal dengan istilah "*sia*" merupakan salah satu potensi lokal yang dimiliki oleh masyarakat Lombok yang terkenal sebagai daerah penghasil rumput laut dan penghasil garam dapur lokal yang berkualitas. Garam dapur diproduksi secara tradisional oleh petani garam di beberapa daerah seperti di daerah lombok timur, lombok utara dan lombok barat dengan cara memanaskan air laut dengan bantuan sinar matahari seperti ditunjukkan pada Gambar 6.



Gambar 3. *Sengkang gigi due olas* terbuat dari bahan emas



Gambar 4. *Kalong ringgit* terbuat dari bahan emas

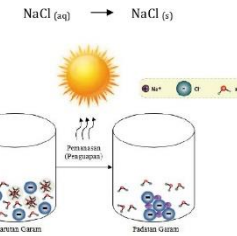


Gambar 5. *Sengkang gigi due olas* dipakai pengganti perempuan



Gambar 6. Proses pembuatan *sia* atau garam di daerah Lombok Barat

Garam adalah senyawa ionik yang terdiri dari ion positif (kation) dan ion negatif (anion) sehingga membentuk senyawa netral (tanpa bermuatan). Pembentukan garam juga dapat terjadi melalui reaksi asam basa. Komponen kation dan anion dapat terbentuk dari senyawa anorganik seperti ion klorida (Cl<sup>-</sup>) atau berupa senyawa organik seperti senyawa asetat (CH<sub>3</sub>COO<sup>-</sup>) dan ion monoatomik seperti fluorida (F<sup>-</sup>), ataupun dapat terbentuk dari ion poliatomik seperti sulfat (SO<sub>4</sub><sup>2-</sup>). Senyawa natrium klorida (NaCl) merupakan komponen utama garam dapur yang banyak dimanfaatkan masyarakat dalam kehidupan sehari-hari. Garam dapur diperoleh dari pengolahan air laut (larutan garam), setelah melalui pemanasan oleh cahaya matahari, kandungan air yang dimiliki akan menguap kemudian terbentuk kristal/padatan (Gambar 7). Adapun reaksi kimia yang terjadi pada pengolahan air laut menjadi garam yaitu:



Gambar 7. Proses terbentuknya kristal NaCl (mikroskopik)

Selain analogi, representasi, dan visualisasi pengintegrasian materi Kimia Dasar 1 dengan kearifan lokal Sasak sebagai sumber belajar kimia ditinjau dari aspek interpretasi dan persepsi. Pengintegrasian materi Kimia Dasar 1 dengan kearifan lokal budaya Sasak diterapkan melalui penerapan interpretasi dan pemberian persepsi pada kegiatan pembelajaran. Misalnya, untuk memahami konsep perubahan fisika dan kimia, pada awal pembelajaran dimulai dengan menggali pengetahuan peserta didik terkait dengan contoh-contoh perubahan fisika dan kimia yang ditemukan dalam kehidupan sehari-hari (kearifan lokal Sasak) yang bertujuan untuk meningkatkan rasa ingin tahu dan motivasi peserta didik. Adapun contoh penerapan konsep perubahan fisika yang ditemukan dalam masyarakat Sasak yaitu pada proses pewarnaan dan penunuban kain, serta pengolahan *kopi breng* (kopi hitam) khas Sasak. Selain itu, contoh perubahan kimia yang ditemukan dalam masyarakat Sasak yaitu pada *pateng reket* (tape ketan) dan pembuatan *gula*

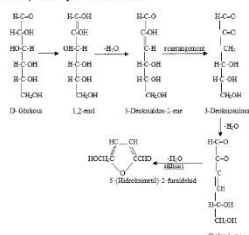


*beaq* (gula merah). Proses pembuatan *gula beaq* di Lombok melalui proses air nira dimasak selama + 4-5 jam sampe air nira mengental. Air nira yang sudah kental dan berwarna kemerahan dibumbui dengan parutan kelapa kering, dan cairan gula di aduk supaya kental sampe berubah jadi adonan sari tepung, kemudian dituangkan kedalam cetakan. Setelah kering cetakan dibuka dan *gula beaq* siap dikemas seperti yang ditunjukkan pada Gambar 8.



Gambar 8. Pembuatan *gula beaq* dari *tuak manis*

Adapun perubahan kimia yang terjadi yaitu gula aren (*gula beaq*) diproduksi dengan cara memanaskan *tuak manis* sehingga terbentuk endapan atau karamel yang melibatkan terjadinya reaksi karamelisasi. Reaksi karamelisasi adalah reaksi yang terjadi karena pemanasan gula pada temperatur diatas titik cairnya yang akan menghasilkan perubahan warna menjadi warna gelap sampai coklat. Proses karamelisasi terjadi melalui penguapan larutan sukrosa sehingga titik didihnya meningkat. Proses karamelisasi meliputi tiga tahap reaksi, yaitu tahap 1,2 enolisasi, tahap dehidrasi atau fusi dan tahap pembentukan pigmen, serta diikuti dengan pembentukan busa (Sutrisno, Wahyudiati, Louise, 2020). Adapun reaksi pembentukan senyawa 5-hidroksimetil-2-furaldehid yang merupakan tahapan dari proses karamelisasi seperti yang ditunjukkan pada Gambar 9.



Gambar 9. Reaksi pembentukan senyawa 5-hidroksimetil-2-furaldehid

**Pembahasan**

Pendekatan analogi merupakan suatu pendekatan untuk menjelaskan hubungan komparatif dengan mengacu pada keterkaitan antara dua konsep yang berbeda, akan tetapi memiliki makna yang relevan (Samara, 2016). Penerapan pendekatan analogi antar domain dalam pembelajaran kimia dapat dilakukan dengan cara mengintegrasikan situasi kehidupan sehari-hari yang memiliki relevansi dengan konsep kimia (Calki et al., 2015; Jofrihshal & Seprianto, 2020). Penerapan apersepsi pada pembelajaran biasanya dilakukan pada awal pembelajaran yang bertujuan untuk memotivasi peserta didik sehingga lebih aktif untuk mengkonstruksi pengetahuan secara mandiri. Hasil penelitian terdahulu membuktikan

bahwa peserta didik yang memiliki motivasi yang tinggi akan lebih aktif dalam mengerjakan tugas dan mengkonstruksi pengetahuan sehingga berdampak positif terhadap hasil belajar yang diperoleh (Abramova & Greer, 2013; Calki et al., 2015; Marasinghe, 2016; Wahyudiati et al., 2019). Faktor motivasi dan rasa ingin tahu yang tinggi dari peserta didik merupakan salah satu faktor penting yang mempengaruhi keberhasilan pembelajaran sains menjadi lebih efektif dan bermakna (Calki et al., 2015; Wahyudiati et al., 2019). Kelebihan penerapan pendekatan representasi dan visualisasi sangat diperlukan dalam pembelajaran kimia melalui pemberian contoh keberadaan unsur, senyawa, campuran yang terdapat dalam kehidupan sehari-hari yang relevan dengan pengalaman sehari-hari atau budaya mahasiswa itu sendiri. Pemberian contoh-contoh konkrit dalam kehidupan sehari-hari peserta didik dapat menjadikan pembelajaran menjadi lebih menarik dan bermakna sehingga dapat mengembangkan kemampuan representasi peserta didik dalam pembelajaran kimia di perguruan tinggi (Santosa & Arnis, 2016).

Tujuan hasil penelitian membuktikan bahwa kearifan lokal *Sasak* memiliki potensi yang sangat relevan untuk diintegrasikan dengan pokok bahasan pada mata kuliah kimia dasar yaitu materi dan perubahannya, pemisahan dan pembuatan campuran, struktur atom, sistem periodik unsur, dan ikatan kimia terintegrasi kearifan lokal *Sasak*. Kelebihan dari bahan ajar Kimia Dasar terintegrasi kearifan lokal *Sasak* ini mampu meningkatkan minat, motivasi, dan keaktifan peserta didik dalam memahami materi Kimia Dasar 1 yang memiliki relevansi dengan kehidupan sehari-hari peserta didik sehingga menjadikan pembelajaran menjadi lebih bermakna. Kebermanaknaan pembelajaran tersebut dengan mengintegrasikan konsep-konsep kimia dengan nilai-nilai kearifan lokal masyarakat yang secara faktual dalam aktivitas keseharian masyarakat menerapkan konsep kimia. Aktivitas masyarakat yang menerapkan konsep kimia dalam kehidupan sehari-hari misalnya pembuatan *poteng* (tape ketan) yang dalam prosesnya merupakan konsep terjadinya perubahan kimia sehingga dalam memahami konsep perubahan kimia akan lebih mudah dipahami oleh peserta didik karena dikaitkan dengan kehidupan sehari-hari. Kegiatan pembelajaran yang mengacu pada karakteristik dan konteks kehidupan peserta didik merupakan implementasi dari teori belajar konstruktivisme. Konstruksi pengetahuan dan pengalaman baru yang diperoleh peserta didik akan menjadi lebih bermakna apabila dikaitkan dengan pengetahuan dan pengalaman lama yang dimilikinya sehingga berpengaruh positif terhadap peningkatan kemampuan kognitif, afektif, dan psikomotorik peserta didik (Huitt & Dawson, 2011; Sumardi et al., 2020; Wahyudiati, 2016; Wahyudiati et al., 2020). Terbentuknya ikatan ion melalui serah terima pasangan elektron antara ion positif dan ion negatif untuk mencapai konfigurasi elektron yang stabil atau menyerupai konfigurasi elektron gas mulia (Agustina, 2017; Budiarawan, 2019; Prasetyawati, 2018).

Kelebihan penerapan analogi dalam pembelajaran menjadikan pembelajaran menjadi lebih bermakna sehingga pembelajaran menjadi lebih menyenangkan dan peserta didik lebih termotivasi untuk terlibat aktif dalam proses pembelajaran. Penerapan pendekatan analogi dalam pembelajaran kimia menjadikan pembelajaran menjadi lebih menarik dan bermakna sehingga dapat meningkatkan hasil belajar kimia (Lerman, 2003). Seni musik dan drama dengan konsep ikatan ion dengan mengalogikan ion positif dan ion negatif sebagai romeo dan juliet sehingga peserta didik menjadi lebih tertarik untuk mempelajari konsep ikatan ion yang dikaitkan dengan kehidupan sehari-hari dibandingkan dengan mempelajari konsep kimia yang bersifat abstrak. Temuan penelitian ini diperkuat dengan penelitian sebelumnya yang membuktikan bahwa proses ataupun kegiatan pembelajaran yang berbasis etnokimia berpengaruh terhadap peningkatan hasil belajar, sikap ilmiah, dan keterampilan proses sains peserta didik (Apriana, 2020). Kegiatan pembelajaran kimia yang didukung dengan ketersediaan sumber belajar kimia yang berbasis etnokimia mengacu pada konteks kehidupan peserta didik yang merupakan nilai-nilai kearifan lokal yang memiliki relevansi dengan konsep-konsep kimia dapat dijadikan sebagai sumber belajar pendukung dan acuan dalam melakukan penyelidikan ilmiah. Demikian juga berbagai hasil penelitian yang relevan juga menunjukkan bahwa implementasi etnokimia dalam pembelajaran, baik dalam bentuk integrasi dengan model pembelajaran, integrasi dengan strategi pembelajaran, ataupun sebagai sumber belajar dan penyelidikan ilmiah dapat mengembangkan sikap ilmiah, kemampuan berpikir kritis, keterampilan proses sains, serta meningkatkan hasil belajar kognitif peserta didik (Ador, 2017; Singh, 2016). Demikian juga dengan budaya atau nilai-nilai kearifan lokal yang dimiliki suku *Sasak* Lombok, NTB memiliki relevansi yang sangat kuat dengan konsep-konsep kimia ataupun konsep pembelajaran kimia yang tercermin dalam tradisi masyarakat *Sasak* yang tercermin dalam produk budaya, adat istiadat, sistem sosial dan sistem nilai yang terdapat pada masyarakat *Sasak*, Lombok, provinsi NTB. Dengan demikian, melalui eksplorasi potensi kearifan lokal *Sasak* sebagai sumber belajar kimia dan laboratorium alam yang telah dilakukan mampu mengembangkan aspek pengetahuan, sikap ilmiah, berpikir kritis, serta meningkatkan kecintaan generasi muda terhadap budaya yang dimilikinya.

## 4. SIMPULAN DAN SARAN

Relevansi materi Kimia Dasar 1 dengan kearifan lokal Sasak ditinjau dari perspektif analogi, representasi, persepsi, visualisasi dan interpretasi, serta potensi kearifan lokal Sasak Lombok sebagai sumber belajar pada mata kuliah kimia dasar yaitu pada 5 pokok bahasan yang terdiri dari; materi dan perubahannya terintegrasi kearifan lokal sasak, pemisahan dan pembuatan campuran terintegrasi kearifan lokal sasak, struktur atom terintegrasi kearifan lokal sasak, sistem periodik unsur terintegrasi kearifan lokal sasak, dan ikatan kimia terintegrasi kearifan lokal Sasak. Adapun kontribusi dari penelitian yang telah dilakukan yaitu berupa produk bahan ajar Kimia Dasar Terintegrasi Kearifan Lokal Sasak sebagai salah satu sumber belajar kimia yang berbasis etnokimia dan relevan dengan kehidupan sehari-hari peserta didik sehingga berpengaruh terhadap peningkatan hasil belajar kognitif peserta didik. Berdasarkan simpulan yang telah dikemukakan, beberapa saran yang diajukan untuk peneliti selanjutnya yaitu sangat urgen untuk dilakukan penelitian terkait studi komparasi ataupun studi korelasional tentang keefektifan penerapan sumber belajar kimia berbasis kearifan lokal Sasak, serta penelitian yang terkait etnokimia yang berbasis kearifan lokal daerah lainnya yang ada di Indonesia.

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# 16 Ethnochemistry: Analisis Relevansi Materi Sistem Periodik Unsur dengan Kearifan Lokal Sasak

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**ETHNOCHEMISTRY: ANALISIS RELEVANSI MATERI SISTEM PERIODIK UNSUR DENGAN KEARIFAN LOKAL SASAK**  
*ETHNOCHEMISTRY: MATERIAL RELEVANCE ANALYSIS OF THE PERIODIC SYSTEM OF ELEMENTS WITH SASAK LOCAL WISDOM*

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History Article Accepted: December 13, 2021 Published: December, 23 2021	<b>ABSTRAK</b> Penelitian ini bertujuan menganalisis relevansi materi sistem periodik unsur (SPU) dengan kearifan lokal Sasak yang memiliki potensi sebagai salah satu sumber belajar kimia. Jenis penelitian yang digunakan yaitu deskriptif kualitatif melalui teknik pengumpulan data yaitu wawancara, observasi, dan dokumentasi. Data hasil observasi, wawancara, dan dokumentasi yang diperoleh dianalisis menggunakan teknik analisis kualitatif Miles & Huberman. Hasil penelitian menunjukkan bahwa dalam tradisi masyarakat Sasak, timbal (Pb) sebagai salah satu contoh unsur golongan IVA dan besi (Fe) yang merupakan golongan VII dan terletak periode 4 banyak dimanfaatkan dalam kehidupan sehari-hari masyarakat Sasak bahan dalam membuat alat-alat musik tradisional ( <i>terumpang, gong, ocer atau petuk, keseng, dan rincek</i> ), alat-alat untuk upacara adat, upacara keagamaan, maupun kesenian tradisional. Selain besi (Fe), beberapa jenis unsur seperti emas (Au), perak (Ag), tembaga (Cu) yang merupakan golongan IB, dan unsur seng (Zn) yang berada pada golongan IIB. Unsur-unsur tersebut banyak dimanfaatkan karena berkaitan dengan sifat fisika dan sifat kimia unsur-unsur tersebut yaitu mudah ditempa, tidak mudah berkarat, mudah ditemukan dalam kehidupan sehari-hari, dan tidak bersifat reaktif. Kesimpulan penelitian yaitu terdapat relevansi materi sistem periodik unsur dengan kearifan lokal Sasak yaitu pada sub pokok bahasan penggolongan periodik unsur dan keragaman sifat unsur. Rekomendasi untuk penelitian selanjutnya perlu dilakukan penelitian untuk mengembangkan bahan ajar kimia terintegrasi kearifan lokal Sasak sebagai bentuk implementasi dalam pembelajaran.
Kata Kunci: Ethnochemistry; kearifan lokal sasak; sistem periodik unsur.	<b>ABSTRACT</b> <i>This study aims to analyze the relevance of the periodic table of elements (SPU) material with local Sasak wisdom which has potential as a source of learning chemistry. The type of research used is descriptive qualitative through data collection techniques, namely interviews, observation, and documentation. The data obtained from observations, interviews, and documentation were analyzed using Miles &amp; Huberman's qualitative analysis technique. The results showed that in the tradition of the Sasak people, lead (Pb) as an example of an element of group IVA and iron (Fe) which is group VII and located in period 4 are widely used in the daily life of the Sasak people as an ingredient in making traditional musical instruments (<i>terumpang, gongs, ocer or petuk, keseng, and rincek</i>), tools for traditional ceremonies, religious ceremonies, and traditional arts. In addition to iron (Fe), several types of elements such as gold (Au), silver (Ag), copper (Cu) which occupy group IB, and elements of zinc (Zn) which are in group IIB. These elements are widely used because they are related to the physical and chemical properties of these elements, namely easy to forge, not easy to rust, easy to find in everyday life, and not reactive. The conclusion of the study is that there is a relevance of the material on the periodic system of elements with local Sasak wisdom, namely on the sub subject of the periodic classification of elements and the diversity of elemental properties. Recommendations for further research need to be researched to develop teaching materials for chemistry integrated with Sasak local wisdom as a form of implementation in learning.</i>
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## PENDAHULUAN

Karakteristik Ilmu kimia yang diistilahkan dengan segi tiga kimia terdiri dari konsep yang bersifat makro, mikro, dan simbolik yang banyak diimplementasikan dalam kehidupan sehari-hari. Bentuk implementasi konsep kimia dalam kehidupan sehari-hari tercermin dalam sistem sosial, dan produk budaya masyarakat yang dikenal dengan etnokimia (*ethnochemistry*). *Ethnochemistry* didefinisikan sebagai implementasi konsep-konsep kimia dalam kehidupan masyarakat yang tercermin dalam tradisi budaya, simbol budaya, sistem nilai, sistem sosial dan produk budaya yang teridentifikasi memiliki relevansi dengan konsep atau praktik kimiawi yang dapat ditemukan dalam budaya apapun (Ador, 2017; Abramova & Greer, 2013). Pengintegrasian produk budaya dalam pembelajaran kimia sebagai sumber belajar memiliki dampak positif terhadap peningkatan pemahaman konsep kimia karena menjadikan pembelajaran menjadi lebih bermakna sehingga mampu meningkatkan hasil belajar peserta didik (Rosa & Clark, 2011; Sutrisno, dkk., 2020; Ismiani, dkk., 2017; Fadli & Irwanto, 2020). Akan tetapi, berbagai hasil penelitian terdahulu menunjukkan bahwa pengintegrasian budaya dalam bahan ajar kimia maupun dalam proses pembelajaran masih sangat jarang dilakukan dan pemahaman konsep cenderung bersifat abstrak sehingga materi kimia masih dianggap sebagai materi yang paling sulit dipahami pada semua tingkatan pendidikan (Abramova & Greer, 2013; Rahmawati, dkk., 2017; Wahyudiati, 2020).

Permasalahan dalam pembelajaran kimia tidak hanya terletak pada rendahnya pemahaman konsep peserta didik, tetapi juga masih terbatasnya sumber belajar

kimia yang bersifat kontekstual dan relevan dengan kehidupan sehari-hari peserta didik, salah satunya sumber belajar kimia yang berbasis *ethnochemistry*. Pengintegrasian materi kimia dengan kearifan lokal sangat mungkin dilakukan melalui pemberian contoh konsep kimia yang diintegrasikan dengan produk budaya, maupun melalui pemanfaatan produk budaya sebagai laboratorium alam (Wahyudiati, dkk., 2020; Wahyudiati, 2021a; Fadli, 2018). Akan tetapi, kondisi faktual yang terjadi membuktikan bahwa integrasi etnokimia dengan perangkat pembelajaran, petunjuk praktikum, maupun pengintegrasian etnokimia dalam kurikulum masih sangat jarang dilakukan (Sumardi & Wahyudiati, 2021b; Wahyudiati, 2016; Wahyudiati, dkk., 2019). Terlebih lagi, ketersediaan bahan ajar kimia yang berbasis etnokimia pada mata kuliah Kimia Dasar masih sangat jarang dikembangkan sehingga peserta didik mengalami kesulitan dalam menemukan panduan pembelajaran yang bersifat kontekstual dan relevan dengan kehidupan sehari-hari peserta didik.

Penyusunan bahan ajar kimia yang berbasis *ethnochemistry* salah satunya dapat dilakukan melalui pengintegrasian materi kimia yaitu sistem periodik unsur dengan kearifan lokal Sasak. Adapun kelebihan dari pengintegrasian materi kimia dengan kearifan lokal Sasak sebagai bentuk implementasi pendekatan etnochemistry dalam praktik pembelajaran kimia yaitu dapat memudahkan peserta didik dalam memahami teori dan konsep-konsep kimia karena memiliki relevansi dengan pengalaman sehari-hari peserta didik melalui konstruk pengetahuan dan pengalaman lama yang diperoleh dengan pengetahuan dan pengalaman baru yang sedang dialami sehingga berdampak pada

meningkatkan keaktifan dan hasil belajar kimia peserta didik (Wahyudiati, dkk., 2020; Wahyudiati, 2021b). Dengan demikian implementasi etnokimia dalam pembelajaran kimia sangat urgen untuk dilakukan melalui pengintegrasian materi kimia dengan kearifan lokal suatu daerah, salah satunya kearifan lokal Sasak.

Nilai-nilai kearifan lokal suku Sasak Lombok memiliki relevansi dengan materi ajar kimia yaitu materi Kimia Dasar pada pokok bahasan sistem periodik unsur (SPU). Relevansi materi sistem periodik unsur yang tercermin dalam tradisi masyarakat Sasak dapat bersumber dari sistem sosial, sistem nilai, dan produk budaya setempat. Urgensi penelitian ini adalah untuk menganalisis relevansi materi sistem periodik unsur dengan kearifan lokal Sasak sebagai salah satu solusi terbaik dari permasalahan pembelajaran kimia melalui pengintegrasian etnokimia dalam kurikulum yang direlevansikan dengan konteks kehidupan peserta didik dengan kearifan lokal (*local wisdom*) sebagai substansi pemahaman konsep dan penyelidikan ilmiah berbasis laboratorium alam (Ador, 2017; Wahyudiati, 2021c; Singh, 2016; Sumardi dkk., 2020; Wahyudiati, 2021a). Dengan demikian, melalui integrasi materi sistem periodik unsur dengan kearifan lokal Sasak sebagai sumber belajar kimia dan dapat dijadikan alternatif laboratorium alam sehingga diharapkan tidak hanya mampu mengembangkan aspek kognitif mahasiswa, tetapi juga dapat mengembangkan aspek afektif dan psikomotorik yang sangat relevan dengan tuntutan pembelajaran abad 21 dan sebagai bentuk pengintegrasian etnokimia dalam kurikulum di perguruan tinggi.

#### METODE

Pendekatan penelitian yang digunakan adalah pendekatan naturalistik/kualitatif dengan jenis penelitian etnografi. Penggunaan pendekatan naturalistik didasarkan atas pertimbangan sumber dan jenis data yang akan di ambil yang bersifat holistik atau menyeluruh. Selain itu, penelitian naturalistik didasarkan atas keseluruhan situasi sosial dan lingkungan yang diteliti. Teknik pengumpulan data yang digunakan dalam penelitian ini adalah teknik observasi, wawancara, dan dokumentasi. Penggunaan teknik-teknik tersebut didasarkan pada jenis data yang diambil. Dalam menganalisis data, peneliti menggunakan teknik analisis data kualitatif model Miles & Huberman. Penggunaan teknik tersebut didasarkan atas kesesuaiannya dengan jenis data yang akan dianalisis, yaitu data yang dikumpulkan dengan teknik observasi, wawancara, dan dokumentasi. Teknik analisis data model Miles dan Huberman mencakup tiga tahapan, yaitu; reduksi data, penyajian data, dan kesimpulan atau verifikasi (Creswell, 2009).

#### HASIL DAN PEMBAHASAN

Berdasarkan pengumpulan data penelitian yang telah dilakukan melalui kegiatan observasi, wawancara dan dokumentasi diperoleh temuan penelitian yang menunjukkan bahwa materi sistem periodik unsur (SPU) memiliki relevansi dengan kearifan lokal Sasak yang terdiri dari produk budaya dan nilai-nilai kearifan lokal yang terkandung dalam budaya Sasak sehingga dapat dimanfaatkan sebagai sumber belajar kimia maupun dapat dijadikan sebagai laboratorium alam. Adapun relevansi materi sistem periodik unsur (SPU) dengan kearifan lokal diuraikan sebagai berikut.

#### Penggolongan Periodik Unsur

Dalam tradisi masyarakat Sasak, timbal (Pb) sebagai salah satu contoh unsur golongan 4A banyak dimanfaatkan sebagai salah satu bahan dalam membuat alat-alat musik tradisional yaitu *terumpang*, *gong*, *oncer* atau *petuk*, *kenceng*, dan *rencek*. Alat-alat musik tradisional tersebut biasanya dibuat dari

bahan tembaga atau kuningan yang merupakan campuran tembaga dan seng.

#### Terumpang

*Terumpang*, alat ini berbentuk seperti wajan besar yang tengahnya terdapat bundaran kecil yang berupa benjolan. *Terumpang* terbuat dari kuningan, dalam *gendang beleq* terdapat dua buah seperti yang ditunjukkan pada Gambar 1.



Gambar 1. *Terumpang*

#### Oncer

*Oncer* atau *petuk*, berbentuk seperti gong tetapi ukurannya lebih kecil dari *terumpang*,

terbuat dari kuningan atau tembaga seperti yang ditunjukkan pada Gambar 2.



Gambar 2. *Oncer*

#### Gamelan Barong Tengkoq

*Barong Tengkoq* adalah salah satu ensambel musik tradisional Sasak yang biasanya dipergunakan untuk mengiringi prosesi pawai adat Sasak. Dinamakan Barong Tengkoq karena penyangga instrumen reyong dikombinasikan dengan bentuk *barong* dan ketika mengiringi prosesi instrumen tersebut dimainkan dengan cara dipangku di atas lengan atau bahu yang

dalam bahasa Sasak disebut dengan "tengkoq". Dalam orkestrasinya gamelan ini terdiri dari beberapa instrumen diantaranya: *riyong*, *hendang*, *ceng-ceng kopyak*, *ceng-ceng penyelar*, *suling*, *preret*, *petuk* dan *gong*. Instrumen petuk, gong, dan ceng-ceng inilah yang biasanya terbuat dari unsur tembaga atau kuningan seperti ditunjukkan pada Gambar 3.



Gambar 3. Gamelan barong lengkoj

#### Keragaman Sifat-Sifat Kimia Unsur Golongan Utama

Logam aluminium merupakan logam yang banyak dimanfaatkan secara turun temurun sebagai bahan dalam pembuatan salah satu alat musik tradisional yang dikenal dengan nama "gula gending". Gula Gending merupakan salah satu

instrument yang bersifat individual yang biasanya dimainkan secara perorangan dan tergolong alat musik perkusi yaitu yang dipukul dengan menggunakan jari tangan pada bagian sisi luar dari kotak-kotak nada yang menyatu dengan tempat gula seperti yang ditunjukkan pada Gambar 4.



Gambar 4. Alat musik gula gending

Alat musik tradisional ini biasanya digunakan oleh para pedagang manisan "gula serabut" untuk memanggil para pembeli yang biasanya dari kalangan peserta didik-peserta didik. Instrumen ini dimainkan dengan cara digendong sambil memainkan lagu-lagu yang diambil dari gending-gending Sasak dan lagu-lagu yang

populer di kalangan peserta didik seperti ditunjukkan pada Gambar 5. Di samping sebagai instrumen untuk berjualan, sebagai sebuah alat musik tradisional, gula gending juga sering dipadukan dengan beberapa instrumen lain dan membentuk sebuah ensambel musik tradisional.



Gambar 5. Penggunaan alat musik gula gending untuk berjualan "gula gending"

Berdasarkan tradisi turun temurun suku Sasak Lombok, pemanfaatan berbagai jenis unsur telah dilakukan. Beberapa jenis unsur yang banyak sekali dimanfaatkan dalam kehidupan sehari-hari, baik untuk upacara adat, upacara keagamaan, maupun kesenian tradisional pada umumnya adalah besi (Fe) yang merupakan golongan VIB dan periode 4. Selain besi beberapa jenis unsur seperti emas (Au), perak (Ag), tembaga (Cu) yang menempati golongan IB, dan unsur seng (Zn) yang berada pada golongan IIB. Unsur-unsur tersebut banyak dimanfaatkan karena berkaitan dengan sifat fisika dan sifat kimia unsur-unsur tersebut. Unsur-unsur golongan IB termasuk logam, adapun unsur-unsur golongan IB, yaitu tembaga (Cu), perak (Ag), dan emas (Au) banyak dimanfaatkan karena bersifat tidak reaktif secara kimiawi, ketiga logam ini terdapat langsung sebagai logamnya, dapat sehingga mudah dibentuk, dan menjadi sangat berharga karena kelimpahan yang sangat jarang untuk perak dan emas.

#### Tembaga (Cu)

Tembaga adalah logam berwarna kemerahan, dengan kekonduksian elektrik yang tinggi. Ciri warnanya tersebut disebabkan oleh struktur jalmurnya, yaitu memantulkan cahaya merah dan jingga dan menyerap frekuensi-frekuensi lain dalam spektrum tampak. Dengan kata lain Tembaga terletak pada golongan IB, sama seperti perak dan emas dalam susunan berkala (Tabel Periodik Unsur) sehingga mempunyai sifat-sifat yang serupa dengan kedua logam itu yaitu logam yang mudah ditempa dan unsur yang relatif tidak bersifat reaktif sehingga tidak mudah berkarat. Selain itu, perkakas-perkakas yang terbuat dari emas dan perak selalu mengandung tembaga untuk menambah kekuatan dan

kekerasannya. Tembaga atau *Cuprum* dalam tabel periodik yang memiliki lambang Cu dan nomor atom 29. Di alam tembaga tidak begitu melimpah, ditemukan dalam bentuk bebas maupun dalam bentuk senyawa. Tembaga memiliki sifat fisika, antara lain; (1) merupakan logam yang berwarna kuning seperti emas dan keras bila dalam keadaan tidak murni, (2) mudah ditempa (liat) dan bersifat mulur sehingga mudah dibentuk menjadi pipa, lembaran tipis dan kawat, dan (3) merupakan konduktor panas dan listrik yang baik, kedua setelah perak. Adapun sifat kimia tembaga antara lain; (1) tembaga merupakan unsur yang relatif tidak reaktif sehingga tahan terhadap korosi, (2) pada kondisi yang istimewa yakni pada suhu sekitar 300°C tembaga dapat bereaksi dengan oksigen membentuk CuO yang berwarna hitam, dan (3) pada suhu yang lebih tinggi, sekitar 1000°C, akan terbentuk tembaga(I) oksida (Cu<sub>2</sub>O) yang berwarna merah, dan Tembaga tidak bereaksi dengan alkali, tetapi larut dalam amonia oleh adanya udara membentuk larutan yang berwarna biru dari kompleks Cu(NH<sub>3</sub>)<sup>4+</sup>.

#### Perak (Ag)

Perak (Ag) memiliki nomor atom 47. Perak muncul secara alami dan dalam bijih-bijih argentite (Ag<sub>2</sub>S) dan horn silver (AgCl). Bijih-bijih timah, timbal-timah, tembaga, emas dan perunggu-nikel merupakan sumber-sumber penting untuk menambang perak. Adapun sifat-sifat fisika dan kimia perak antara lain; (1) perak murni memiliki warna putih yang terang, (2) unsur ini sedikit lebih keras dibanding emas dan sangat lunak dan mudah dibentuk, (3) perak murni memiliki konduktivitas kalor dan listrik yang sangat tinggi diantara semua logam dan memiliki resistansi kontak yang sangat kecil; dan (4) sangat stabil di udara murni dan air, tetapi langsung ternoda

ketika diekspos pada ozon, hidrogen sulfida atau udara yang mengandung belerang.

#### Emas (Au)

Simbol kimia emas adalah Au (dari bahasa Latin *Aurum* yang berarti fajar bersinar). Emas (Au) bernomor atom 79. Susunan elektron terluar dari emas adalah  $4f^{14}5d^{10}6s^1$  (konfigurasi elektron [Xe]  $4f^{14}5d^{10}6s^1$ ). Susunan elektron ini berkaitan dengan sifat warna kuning emas. Warna logam terbentuk berdasarkan transisi elektron diantara ikatan-ikatan energinya. Kemampuan menyerap cahaya pada panjang gelombang untuk menghasilkan warna emas yang khas terjadi karena transisi ikatan d yang melepaskan posisi di ikatan konduksi. Penambahan unsur-unsur campuran berdampak pada warna emas. Misalnya, penambahan unsur nikel atau palladium akan memutihkan emas. Emas dianggap sebagai logam mulia dan berharga. Keistimewaan emas secara kimiawi ditunjukkan dengan stabilitas unsur kimianya yang mampu bertahan dari karat dan proses oksidasi. Adapun sifat fisika dan kimia dari emas, antara lain; (1) emas merupakan logam lembut, berkilat, berwarna kuning, padat, mudah ditempa, dan mudah ditarik, (2) merupakan logam peralihan (trivalen dan univalen) dan stabil, (3) tidak bereaksi dengan kebanyakan bahan kimia. Walau demikian, emas dapat bereaksi dengan klorin, fluorin dan aqua regia. Logam ini ditemukan dalam bentuk bongkahan, butiran batuan, dan pendaman aluvial, (3) merupakan logam yang sangat berharga karena keberadaannya yang sangat langka di alam, tidak mudah berkarat atau memudar, tahan lama, serta memiliki warna yang menarik, dan (4) emas murni memiliki tekstur yang halus. Emas biasa dikeraskan dengan mencampurnya dengan kuningin atau

perak. Bagian emas yang terdapat dalam campuran diukur dalam karat. Emas murni memiliki kadar 24 karat. Campuran seimbang bagian emas dan perak adalah 12 karat, emas 18 karat  $\rightarrow$  18/24 berarti emas 75 %. Emas dapat dibentuk jadi lembaran demikian tipis sehingga tembus pandang.

Pemanfaatan unsur-unsur tersebut maupun paduan logamnya banyak dijumpai seperti pada pakaian adat pengantin suku *Sasak*. Pakaian adat pengantin suku *Sasak* ini dilator belakang oleh adanya tingkat stratifikasi sosial pemakainya, yang dilihat dari bahan dan warna yang digunakan. Untuk golongan bangsawan perhiasan yang digunakan dari bahan emas dan masyarakat biasa dilihat dari bahan perak atau tembaga, sedangkan warna baju yang digunakan oleh bangsawan terdiri dari warna hitam, coklat tua, biru dongker (biru hitam) dan jio lumut.

#### Pending atau Sabuk Emas

*Pending* merupakan perhiasan yang berharga, biasanya dipergunakan di pinggang sebagai sabuk pengantin yang berbentuk lipatan-lipatan yang panjang, kurang lebih seukuran pinggang pengantin wanita, yang pada bagian kepala sabuknya terdapat sebuah permata terbuat dari intan yang berukuran lebih besar terdapat ditengah-tengahnya sehingga menciptakan keserasian dan keindahan tersendiri. *Pending* terbuat dari bahan emas yang di dalamnya dilapisi kain yang berwarna merah, mempunyai makna keberanian dalam mengarungi bahtera rumah tangga, sedangkan untuk masyarakat biasa bahannya terbuat dari bahan perak atau tembaga seperti ditunjukkan pada Gambar 6.



Gambar 6. Pending

#### Selongkak Gendit Ime (gelang)

*Selongkak Gendit Ime* juga disebut *teken ime*, perhiasan ini merupakan perhiasan lengan pengantin wanita yang terbuat dari bahan emas tembaga, sebagai simbol bahwa pemakainya dari kalangan

bangsawan atau *pemenak*. Pada kalangan masyarakat biasa bahannya terbuat dari bahan perak, tembaga, berbentuk bulat dengan model melingkar melilit seperti ditunjukkan pada Gambar 7.



Gambar 7. Selongkak gendit ime

#### Kancing Rupiah Emas

Kancing rupiah emas merupakan perhiasan yang terbuat dari bahan emas dan perak biasanya digunakan pada baju wanita dengan tujuan memperindah serta mempercantik pengantin wanita, yang

terdiri dari tiga buah koin emas (angka ganjil) dan dibagian koin terdapat gambar seorang wanita muda cantik sebagai simbol dari keindahan serta kelembah-lembutan seorang wanita seperti ditunjukkan pada Gambar 8.



Gambar 8. Kancing rupiah emas

### SIMPULAN

Berdasarkan rumusan masalah, hasil analisis data yang telah dilakukan, dapat disimpulkan bahwa relevansi materi sistem periodik unsur dengan kearifan lokal Sasak yaitu pada sub pokok bahasan penggolongan periodik unsur dan keragaman sifat unsur. Dalam tradisi masyarakat Sasak, timbal (Pb) sebagai salah satu contoh unsur golongan IVA dan besi (Fe) yang merupakan golongan VIB dan terletak periode 4 banyak dimanfaatkan dalam kehidupan sehari-hari masyarakat Sasak bahan dalam membuat alat-alat musik tradisional (*terumpang, gong, oncer atau petuk, kencing, dan renok*), alat-alat untuk upacara adat, upacara keagamaan, maupun kesenian tradisional. Selain besi (Fe), beberapa jenis unsur seperti emas (Au), perak (Ag), tembaga (Cu) yang menempati golongan IB, dan unsur seng (Zn) yang berada pada golongan IIB. Unsur-unsur tersebut banyak dimanfaatkan karena berkaitan dengan sifat fisika dan sifat kimia unsur-unsur tersebut yaitu mudah ditempa, tidak mudah berkarat, mudah ditemukan dalam kehidupan sehari-hari, dan tidak bersifat reaktif sehingga unsur-unsur tersebut yang banyak dimanfaatkan dalam kehidupan masyarakat Sasak, Lombok, NTB.

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# 17 Effects of Ethnochemistry Instructional Strategy on Secondary School Students' Achievement in Chemistry in Onitsha Education Zone

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## Effects of Ethnochemistry Instructional Strategy on Secondary School Students' Achievement in Chemistry in Onitsha Education Zone

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### Abstract

The study investigated the effects of ethnochemistry instructional strategy on secondary school students' achievement in chemistry. Two research questions guided the study and three hypotheses were tested. The design of the study was quasi-experimental. The population of the study was 2,345 senior secondary school year two (SS2) chemistry students, out of which 94 were involved in the study. The instrument for data collection was Chemistry Achievement Test (CAT) validated by experts and which had a reliability coefficient of 0.73 established using Kuder-Richardson formula 20. The finding of the study revealed that there was significant difference in the mean achievement scores of the students in favour of ethnochemistry instructional strategy and gender had no significant influence of students' achievement. The researchers recommended that chemistry teachers should critically analyze cultural practices of the school community and relate them to chemistry learning.

**Keywords:** Ethnochemistry, Acid, Base, Water, Achievement

### Introduction

Chemistry is the branch of science that deals with the study of matter, identification of the substances of which matter is composed; the investigation of their properties and the ways in which they interact, combine, and change as well as the use of processes to form new substance. The knowledge of chemistry is essential to students in other field of study such as biology, geology, physics and therefore is central to the study of science (Nwanze, Izuegbunam, Plus, Emerhiona & Okoli, 2018). It is thus perceived as ancient science and activity-oriented subject. Research has shown that chemistry is generally a difficult subject for all levels of student despite the fact that its study is closely associated with nature and the physical world around us (O'dwyer, 2012). The study of chemistry also requires students to possess good level of science process skills to be able to conduct experimental verification into natural phenomena. These challenges have been reflected in the achievement of secondary school chemistry students which over the years is greeted with several appalling remarks from Chief Examiners.

The reports of the West African Secondary School Certificate Examination (WASSCE) Chief Examiner's show that from 2007-2012, the percentage of students who obtained a credit pass in chemistry was below 50% except in 2010. The reports further revealed a continual decline in the achievement of students from 2013 to 2016 from 72.34% to 57.74% of the percentage number of students with credit passes and further decline below 50% in 2018 and 2019. Studies have continued to show that instructional approach has remained the most implicated factor for students' poor achievement in chemistry (Okoli & Nwanze, 2018; Enekeuchi, Okeke, Nwanze & Chikwenda, 2019; Konyefa & Nwanze, 2020). The implication of instructional approach as the major problem of students is because the mastery of chemistry concept may not be achieved without the adoption of effective instructional strategies that could link chemistry learning to reality and nature.

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The study of chemistry is foreign and of euro-centric origin making its study problematic for students because it seems unreal and abstract (Oluwatosin, Emmanuel & Peter, 2017). Oluwatosin et al. asserted that chemistry teachers need to begin chemistry instructions from students' previous knowledge as an intervention to engage students in meaningful learning. They further asserted that chemistry students' previous knowledge that may be of significant relevance to learning is the inclusion of indigenous knowledge and cultural and domestic practices with scientific background. Such ethnochemistry practices are believed among researchers to lay the basis for reflective thinking and to instill a sense of ownership of the concepts (Am, 2012; Oluwatosin, et al., 2017). The effects of the inclusion of ethnochemistry practices as a strategy during chemistry instructions on students' achievement is however, not widely known. There is the need for further empirical investigation into the effects of ethnochemistry instructional strategy on students' achievement.

Ethnochemistry instructional strategy in this study involved the situation of chemistry learning within the chemically related cultural and community practices and indigenous knowledge (Idra & Bitwell 2016). It is a strategy of instruction that engages the students with discussions and analysis of chemically related real life experiences in the socio-cultural practices of their immediate community (Fasasi, 2018). Ethnochemistry instructional strategy may bear potential boost on students' achievement in chemistry as students are actively engaged in the learner process. It also enables the teacher to deal with misconceptions which the students bring to class and which may impede science learning (Abonyi, Achimugu & Njoku, 2014; Abonyi, 1999). Ethnochemistry instruction affords students the opportunity to be cognitively active during instruction, facilitating meaningful understanding and fair retention of learning materials (Fitria & Wisudawati, 2018). It may help students to gradually increase their learning of chemistry concepts as the teacher progresses in the scientific analysis of their ethnochemistry practices unlike the conventional instructional approaches common among chemistry teachers (Okwara & Upu (2017).

In a Nigerian cultural setting including the cultural settings of the study area, responsibilities are often assigned by gender. For instance, such cultural practices as hunting, fishing are reserved for males and sieving, cooking, washing reserved for females. The assignment of responsibilities and roles in cultural practices may lead to gender dichotomy in the understanding of some chemistry concept when ethnochemistry practices are integrated in the learning process. This because the nature of different ethnochemistry practices may influence understanding of different chemically related concepts. For example, females who often are assigned with domestic chores may gain understanding in hard water and use of detergents when washing while males who may often be engaged in palm wine tapping may gain better knowledge in acid and bases given the fermentation process of the wine. Also, research studies on the influence of gender on academic achievement have remained inconclusive. Some study result revealed significant influence of gender on achievement (Ugwu & Diou, 2016) while others found no significant influence of gender on achievement. The need to further investigate the influence of gender in such a study as this is therefore a worthwhile quest. The study investigated the therefore, effects of ethnochemistry instructional strategy on the achievement of secondary school students' in chemistry. The study specifically sought to determine the:

1. mean achievement scores of students taught chemistry using ethnochemistry instructional strategy and those taught using conventional method.
2. the difference between the mean achievement scores of male and female students in chemistry.

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- the interaction effect of teaching methods and gender on students' achievement in chemistry.

#### Research Questions

- What are the mean achievement scores of students taught chemistry using ethnochemistry instructional strategy and those taught using conventional method?
- What are the mean achievement scores of male and female students in chemistry?

#### Hypotheses

- There is no significant difference between the mean achievement scores of students taught chemistry using ethnochemistry instructional strategy and those taught using conventional method?
- There is no significant difference between the mean achievement scores of male and female students in chemistry.
- There is no significant interaction effect of teaching methods and gender on achievement of students in chemistry.

#### Method

The design of the study was quasi-experimental. The pretest posttest non-equivalent control group design with a 2x3 factorial design was used. The study was carried out in Onitsha Education Zone of Anambra state. The population of the study was 2,345 senior secondary year two chemistry students. The total sample size for the study was 94 SS2 chemistry students. First, Ogbaru local government council was purposively selected out of the three local government council under Onitsha Education Zone. The reason was because the other two local government councils namely: Onitsha North and South were mainly urban. On the second stage, purposive sampling was used to select two schools that are distant apart but has similar characteristics such as cultural similarities and common indigenous occupations. In each of the selected school, chemistry students in SS2 were involved in the study. The experimental group school had 43 students (18 males, 25 female) while the control group school had 51 students (32 males, 19 females).

The instrument for data collection was chemistry achievement test (CAT) developed by the researchers on the concepts of acid and bases and water. The test items were construction with four answer options lettered A-D. A table of specification was used to ensure that contents taught were adequately covered. The instruments and instructional plans were validated by experts in the Departments of Science Education and Educational Foundations, Faculty of Education, Nnamdi Azikiwe University, Awka. The reliability of the instrument was established using Kuder-Richardson formula 20. The instrument was administered once to 25 SS2 chemistry students in a school in Onitsha Education Zone not used for the study. The generated scores were used to compute the reliability which gave a coefficient of internal consistency of 0.73.

The study was carried out by first briefing the regular chemistry teachers in the schools used for the study who were engaged as research assistants. They were briefed on the purpose of the study, the instructional plans and strategy, administration of instrument and data collection. CAT was administered as pretest prior to the treatment without any feedback on students' scores/achievement or corrections. The experiment was carried out under the supervision of the researchers with the experimental school taught acid, base and water using ethnochemistry instructional strategy. In the ethnochemistry classroom, students were first presented with the objectives of instruction after stating the topic. A brief explanation of the topic was given, followed by presentation of cultural practices such as palm wine tapping, cassava and corn

fermentation, gin production, water purification techniques, hard and softwater uses. Indigenous knowledge of these practices that have significantly relationship with the concepts taught were used as the focus of classroom discussion with students presenting their own cultural and indigenous knowledge and the teacher analyzing them in relation to the concepts of chemistry. The main objective at that stage of instruction was to identify relevant cultural practices and knowledge that were compactible with science of chemistry especially acid, base and water and the principles common to both their practices and chemistry as science. The teacher summarized the instruction by relating the cultural practices to the concepts of acid, base and water using questioning technique to evaluate the objectives of instruction at each step.

The students in the conventional group classroom were taught the same concepts of acid, base and water but no mention was made of cultural practices and indigenous knowledge relevant to their learning. At the end of the treatment, the students in both groups were given posttest and their scores collated for analysis. Data generated from the study was analyzed using mean, standard deviation and analysis of covariance (ANCOVA). The decision rule for the hypothesis was: reject null hypothesis when p-value is less than 0.05 and do not reject null hypothesis when p-value is greater than 0.05.

#### Results

**Table 1: Mean Achievement Scores of Students taught Chemistry using Ethnochemistry Instructional Strategy (EIS) and Conventional Method (CM)**

Source of Variation	N	Pretest Mean	Posttest Mean	Gain in Mean	Pretest SD	Posttest SD
TPIS	43	31.09	55.44	24.35	6.97	7.17
CM	51	34.80	48.22	13.42	9.22	6.59

Table 1 reveals that the students taught chemistry using ethnochemistry instructional strategy has gain in mean achievement score of 24.35 while those taught using conventional method has gain in mean achievement score of 13.42. In the posttest, students taught using ethnochemistry instructional strategy had a less homogeneous score (7.17) than those taught using conventional method (6.59).

**Table 2: Mean Achievement Scores of Male and in Chemistry**

Strategy	Gender	N	Pretest Mean	Posttest Mean	Gain in Mean	Pretest SD	Posttest SD
EIS	Male	18	29.94	52.72	22.78	7.64	7.81
	Female	25	31.92	55.68	24.76	6.48	8.36
CM	Male	32	31.75	46.72	14.97	8.58	7.86
	Female	19	37.26	49.74	13.48	9.45	6.54

Table 2 shows that male students taught using ethnochemistry instructional strategy has gain in mean achievement score of 22.78 while the females have gain in mean achievement score of 24.76 where the males taught using conventional method has gain in mean achievement score of 14.97 and the females a gain in mean achievement score of 13.48.

**Table 3: ANCOVA on test of Significant Difference in the Mean Achievement Score of Students taught Chemistry EIS and CM**

Source of variation	SS	Df	MS	F	P-value	Decision
Corrected Model	2122.556 <sup>a</sup>	4	530.639	10.577	.000	
Intercept	7658.960	1	7658.960	152.663	.000	
Pretest	934.143	1	934.143	18.620	.000	

Method	1011.355	1	1011.355	20.159	.000	S
Gender	84.429	1	84.429	1.683	.198	NS
Method * Gender	.668	1	.668	.013	.908	NS
Error	4465.061	89	50.169			
Total	251694.000	94				
Corrected Total	6587.617	93				

Table 3 shows that at 0.05 level of significance, 1df numerator and 93df denominator, there was a significant main effect of the treatment on students' achievement in chemistry  $F(1,93) = 20.159$ . Therefore, the null hypothesis was rejected. Thus, there is a significant difference between the mean achievement scores of students taught chemistry using ethnochemistry instructional strategy and those taught using conventional method in favour of ethnochemistry instructional strategy.

Table 3 also shows that at 0.05 level of significance, 1df numerator and 93df denominator, there was no significant main influence of gender on students' achievement in chemistry  $F(1,93) = 1.683$ . Therefore, the null hypothesis was not rejected. Thus, there is no significant difference between the mean achievement scores of male and female students in chemistry.

Table 3 further shows that at 0.05 level of significance, 1df numerator and 93df denominator, there was no significant interaction effect of teaching methods and gender on achievement of students in chemistry  $F(1,93) = .013$ . Therefore, the null hypothesis was not rejected. Thus, there was no significant interaction effect of teaching methods and gender on students' achievement in chemistry. The plot of interaction is shown in Figure 1.

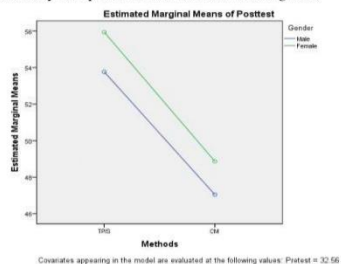


Figure 1: Plot of interaction effect of teaching methods and gender on students' achievement in chemistry

The plot of the interaction effect of teaching methods and gender was not significant and ordinal.

#### Discussion

The finding of the study revealed that there was a significant difference between the mean achievement scores of students taught chemistry using ethnochemistry instructional strategy and conventional method in favour of ethnochemistry instructional strategy. The observed result of

the study could be attributed to the fact that learning chemistry through ethnochemistry instructional strategy presents students with learning experiences that are close reality. In the ethnochemistry classroom, learning was situated within the learners' cultural background enabling students to understand the concept more properly. The analysis of the cultural practices and ideologies relative to the chemistry concepts of acid and bases and water reduced the cognitive load common with learning abstract concepts which is a common issue in chemistry learning. The teacher therefore, by relating the concepts to the cultural activities, practices and ideologies of the students brought the learning within the confines of students' existing scientific knowledge.

The improvement in chemistry achievement among students in the ethnochemistry group could also be explained from the arising interest in chemistry instruction due to discussions about their cultural practices in relation to chemistry. Students' interest led to active participation in the learning process and became an incentive that drove their motivation to learn and understand the concept of acid and bases and water. The analysis and comparison drawn between their cultural knowledge and practice and the standard scientific understanding of the concept facilitated better understanding of acid and bases and water. Thus, students' learning was meaningful to them leading them to seek deeper understanding into the concept with a great appreciation of their cultural background knowledge and practices. The finding of the study lends credence to the finding of Ohwatosin et al. (2017) that students taught chemistry using ethnochemistry instructional approach achieved significantly higher than the students in the control group. The finding of the study also supports the finding of Okwara and Upu (2017) and Peni (2011) that the experimental group taught using ethno-science enriched instructional approach had a significantly higher mean achievement score than their counterparts in the control group.

The findings of the study further revealed that gender has no significant influence on the achievement of the students in chemistry and there was no significant interaction of teaching methods and gender on the achievement of the students in chemistry. The result of the students showed that students irrespective of gender were carried along during the instruction. The findings of the study are in line with the findings of Abonyi (1999) that although ethno-science based instructional package was superior to conventional approach, gender had no significant influence and no significant interaction effect of teaching methods and gender was observed. The finding of the study also is in line with the findings of Ugwu and Diovu (2016) gender has no significant influence on achievement and no interaction of teaching methods and gender was observed but students taught with integration of indigenous knowledge and practices had higher mean achievement score than their counterpart.

#### Conclusion

The findings of the study showed that ethnochemistry instructional strategy significantly improved achievement in chemistry. It can therefore be concluded that relating the learning of chemistry concepts to the indigenous knowledge and cultural practices of the students facilitates proper understanding of the concepts and results to better achievement.

#### Recommendations

The following recommendations were made based on the findings of the study.

1. Chemistry teachers should seek an understanding into the scientific relevance of the cultural practices and knowledge of the immediate community of their schools and relate chemistry teaching and learning to those knowledge and practices.

2. Critical analysis of cultural practices and indigenous knowledge relevant to chemistry should be done during chemistry instruction with a view to bring students to the knowledge of those that are compatible with science and therefrom widen their understanding of chemistry.

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# 18 Effectiveness of Blood Learning Based on the Ethnochemical Approach Module on Improving Science Literation Abilities



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## Effectiveness of Blood Learning Based on the Ethnochemical Approach Module on Improving Science Literation Abilities

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### Abstract

The purpose of this study was to determine the effectiveness of module-based online learning with an ethnochemical approach in improving students' scientific literacy skills. This research is a quasi-experimental study with a pretest-posttest nonequivalent control group design. The study population was students of the Faculty of Teacher Training and Education, Samudra University who were taking basic chemistry courses. The results showed an increase in science literacy skills based on the N-gain value in the experimental class of 0.54 in the medium category and 0.33 in the control class who were also in the medium category. Analysis with t test based on the posttest value obtained sig. (2-tailed) 0.030 or <0.05, which indicates a significant difference in the posttest scores of the two classes. Based on these two Kés, it can be concluded that module-based online learning with an ethnochemical approach is effective for improving students' scientific literacy skills. The results showed an increase in science literacy skills based on the N-gain value in the experimental class of 0.54 in the medium category and 0.33 in the control class who were also in the medium category. Analysis with t test based on the posttest value obtained sig. (2-tailed) 0.030 or <0.05, which indicates a significant difference in the posttest scores of the two classes. Based on these two Kés, it can be concluded that module-based online learning with an ethnochemical approach is effective for improving students' scientific literacy skills. The results showed an increase in science literacy skills based on the N-gain value in the experimental class of 0.54 in the medium category and 0.33 in the control class who were also in the medium category. Analysis with t test based on the posttest value obtained sig. (2-tailed) 0.030 or <0.05, which indicates a significant difference in the posttest scores of the two classes. Based on these two Kés, it can be concluded that module-based online learning with an ethnochemical approach is effective for improving students' scientific literacy skills.

### Keywords

online learning module  
ethnochemistry, scientific literacy



### 1. Introduction

In the era of globalization, the world is experiencing rapid changes in all areas of life. This change needs to be anticipated by mastering 21st century skills (Redhana, 2019). One of the skills needed to survive in the era of globalization is scientific literacy. Science literacy namely ability to engage with science-related issues and with scientific ideas, as a reflective citizen (OECD, 2019a). The 2018 PISA results show that the scientific literacy of students in Indonesia is ranked 70th out of 78 participating countries with an average score of 396 (OECD, 2019b). Meanwhile, ability scientific literacy of education students in Indonesia is known to be low (Sujana, et al., 2014), including chemistry education students in Aceh (Seprianto, et al., 2017).

The rapid development in information technology has made the flow of information exchange faster. The process of globalization and cross-cultural interactions between ethnic groups in Indonesia creates different cultural identities and loses their original cultural identities (Rahmawati, et al., 2017). In identity, there is no ethnic group that can maintain an identity that can be believed without signs, symbols, which underlies the values that show a clear identity, however the signs and symbols are the result of interaction with the group - other groups and comprehensive signs of ethnic values and development as such to bring out a positive image to transcend boundaries (Suharyanto and Hidayat, 2018). One form of cultural identity that ethnic groups in Indonesia have is ethnochemistry. Ethnochemistry is a certain cultural behavior in a community group that is chemically related (Rosa & Orey, 2011). Initial research shows that there are several ethnochemicals that are owned by the Acelmese ethnicity in eastern Aceh, such as the use of natural materials as medicines, food additives, cleaners, and others (Seprianto & Jofrisal, 2019). Ethnochemistry can be integrated in learning.

Every society has several concepts that are supernatural, spirits, gods or impersonal forces that are different from the others and in some meanings are superior to other forces that are used by humans as regulators of natural events and nature. And its activity is somehow capable of giving meaning to aspects of unusual human experience such as a phenomenon which makes logic unreasonable. In this case humans need religion which then gives birth to culture or vice versa is also a religious culture (Angkat et al, 2019). Organizational culture is a set of assumptions or systems of beliefs, values, and norms developed in organizations that serve as guidelines for behavior for its members to overcome the problem of external and internal adaptation. Organizational culture is a pattern of beliefs and organizational values that are believed and imbued by all members in doing work as an appropriate way to understand, think, and feel about related problems, so that it will become a value or rule within the organization (Sihombing et al, 2020). Furthermore, to meet the interactional needs in the learning process the teacher must know and understand the character education development procedures that are neatly arranged in the semester learning plan. So that in its application and inculcation of character values it will be easy to read with the cognitive psychomotor and affective aspects that have indicators of assessment (Perdana, 2020).

Advances in information and communication technology in the era of the digital revolution have been used as a learning delivery strategy, such as through online learning (Kirna, 2014). In learning that combines face-to-face learning and online learning, it is possible for students to develop 21st century skills (Redhana, 2019). Online learning can use multiple platforms such as Google Classroom, Edmodo, and others. Therefore, it is necessary to do a study to determine the effectiveness of module-based online learning with an ethnochemical approach to improving students' scientific literacy skills. If the effectiveness is high, then this study can be recommended as a way to increase the science literacy score in Indonesia. The urgency of this research includes: Online learning is increasingly needed in the era of the digital revolution, starting from the loss of ethnochemistry which is the local wisdom of ethnic groups in Indonesia, and national targets in education to increase the scientific literacy score of Indonesian students.

## II. Research Methods

This research is a quasi-experimental research using the pretest-posttest nonequivalent control group design. The study population was the students of the Faculty of Teacher Training and Education at Samudra University who were taking basic chemistry courses. Sampling using purposive sampling technique. The experimental group is a class with module-based online learning with an ethnochemical approach with a sample size of 10 students, while the control group is a class with non-module based online learning with an ethnochemical approach with a sample size of 10 students.

**Table 1.** Research design

Group	Pretest	Treatment	Posttest
Experiment	Y1	Xa	Y2
Control	Y1	Xb	Y2

Information:

Y1 = Pretest of scientific literacy skills

Xa = online learning based on ethnochemistry module

Xb = online learning is not based on ethnochemical module

Y2 = Posttest science literacy skills

The data of this research are in the form of pretest and posttest scores of students' scientific literacy abilities. Students' scientific literacy abilities were measured using a scientific literacy test instrument. The increase in students' scientific literacy was analyzed based on the N-gain, using the formula:

$$g = \frac{\text{Skor posttest} - \text{Skor pretest}}{\text{Skor maksimal} - \text{Skor pretest}}$$

With the gain score analysis criteria:  $g \geq 0.7$  high category,  $0.3 \leq g < 0.7$  medium category, and  $g < 0.3$  category low (Hake, 1998). The difference in the increase in scientific literacy between the experimental class and the control class was tested for differences using the t-test in the SPSS program.

## III. Results and Discussion

The average scores of students' scientific literacy skills are presented in Table 2. From Table 2, it can be seen that there is an increase in scientific literacy skills in both the control and experimental classes. Based on the average pretest score, the initial scientific literacy abilities of the two classes are relatively the same. However, the posttest average and N-gain of the experimental class were better than the control class because the experimental class got online learning with the help of modules that emphasize ethnochemistry or chemistry in local culture. This is in line with the research of Nisa<sup>1</sup>, et al. (2016) who show that the average scientific literacy ability increases with the use of ethnochemistry integrated modules.

The N-gain for both classes is 0.54 for the experimental class and 0.33 for the control class. The increase in scientific literacy skills in the experimental class and control class is classified as moderate based on Hake's (1998) criteria. However, a higher N-gain in the experimental class indicated an increase in scientific literacy skills with the application of online learning using ethnochemical based modules. Afrianawati, et al. (2016), stated that

the ethnochemistry-based learning model links learning in the classroom with what students encounter in everyday life and encourages active participation of students in the learning process.

**Table 2.** The average pretest, posttest, and N-gain scores in the experimental class and control class

No.	Class	Pretest	Posttest	N-gain	Category
1.	Control	51	68	0.33	Moderate
2.	Experiment	50	79	0.54	Moderate

Testing normality and homogeneity were carried out to meet the requirements of the t-test. The results of the data normality test are presented in Table 2. Normality testing uses the Shapiro-Wilk method because of the relatively small number of samples. From Table 3, it can be seen that the significance in the experimental class and control class is  $> 0.05$ , so it can be concluded that the data in the two classes are normally distributed. Test results The homogeneity of the two classes is presented in Table 4. From Table 4, the significance obtained is  $> 0.05$ , which means that the two classes have the same or homogeneous variance.

**Table 3.** The results of the normality test for the experimental class and the control class

No.	Class	df	Sig.	Interpretation
1.	Control	10	0.412	Normal
2.	Experiment	10	0.569	Normal

**Table 4.** Homogeneity test results for both classes

Class	df1	df2	Sig.	Interpretation
Control and Experiment	1	18	0.442	Homogeneous

The t-test was used to determine differences in scientific literacy skills in the experimental class and the control class. The t-test was performed on the posttest and n-gain data. The results of the t-test on the posttest data are presented in Table 5, while the results of the t-test for the N-gain data are presented in Table 6. Table 5 shows the sig. (2-tailed)  $< 0.05$ . These results indicate a significant difference in the scientific literacy abilities of the two classes after being given treatment. Meanwhile, Table 6 also shows sig. (2-tailed)  $< 0.05$ , which means that the increase in scientific literacy skills in the two classes is significantly different. These results indicate that module-based online learning with an ethnochemical approach has an effect on improving scientific literacy skills.

**Table 5.** The t-test results of the posttest data of the experimental class and the control class

Data	t	df	Sig. (2-tailed)	Interpretation
Posttest	2,356	18	0.030	There are significant differences

**Table 6.** The results of the t-test for the N-gain data of the experimental class and control class

Data	t	df	Sig. (2-tailed)	Interpretation
N-gain	2,198	18	0.041	There are significant differences

The results of the analysis of the average posttest, n-Gain and t-test results show that online learning based on modules with an ethnochemical approach is effective for improving scientific literacy skills. This is in line with the research of Setiawan, et al. (2017) which shows that the use of science modules based on local wisdom can improve students' scientific literacy skills both theoretically and empirically. Like modules, worksheets with ethnosience are also effective in improving students' scientific literacy skills (Ariningtyas, et al., 2017). The application of ethnosience-filled learning can be used to improve students' scientific literacy skills (Perwitasari, et al., 2016). In addition to improving scientific literacy skills, implementing modules and learning with an ethnochemical approach can also improve learning outcomes and learning effectiveness (Rosa & Orey, 2011; Ajayi, et al., 2017).

#### IV. Conclusion

The results showed an increase in scientific literacy skills based on N-gain in the experimental class of 0.54 which is in the medium category and in the control class of 0.33 which is also in the moderate category. Analysis with t test based on the posttest value and N-gain obtained sig. (2-tailed) <0.05 which indicates a significant difference in the posttest and N-gain scores of the two classes. Based on these two analyzes, it can be concluded that online learning based on modules with an ethnochemical approach is effective for improving students' scientific literacy skills.

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# 19 The Design of Vlogs as Ethnochemical Learning Media by Project Based Learning



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Advances in Social Science, Education and Humanities Research, volume 603

## The Design of Vlogs as Ethnochemical Learning Media by Project Based Learning

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### ABSTRACT

This study aims to design a vlog as a project-based ethnochemistry learning medium and maintain its validity. This type of research is qualitative research. The designs produced at this research stage have gone through planning based on the results of preliminary studies, which contain activities; identification, formulation of objectives, determining the sequence of learning media (storyboard), and expert validation. Data obtained through various data collection techniques, such as interviews, questionnaires, and documentation. Based on the results of vlog validation based on material content is 94% and IT content is 98%. The overall vlog percentage was 96%, with excellent validity. In conclusion, the vlog design as a project-based ethnochemistry learning medium has very good validity.

**Keywords:** vlog, ethnochemistry, learning media, project base learning.

### 1. INTRODUCTION

The government has a telework policy. This is an attempt by the community to complete homework. Education in Indonesia is also one of the covid19 areas affected. In addition to these sanctions, the Indonesian Ministry of Education has also dropped out of school and set a goal of replacing teaching and learning activities with the use of the Internet [1]. With this online curriculum, teachers can address a variety of issues facing students and teachers, including subject issues. Not finished, the teacher replaced it with another activity. This is a dissatisfaction with the students as the teacher did more work.

Various methods of distance learning are tested. Features that can be used as online learning media include learning curves, zoom applications, Google classes, YouTube, WhatsApp social networks, and more. These elements can be used to the fullest as a learning management tool, just like in the classroom. By using this online platform, students and faculty have gained the ability to use technology directly and indirectly [2]. Using technology to carry out student projects can lead to creativity to improve student knowledge. Because teachers learn differently, you can create positive learning patterns that can enhance your thinking through self-study without leaving the teacher [3].

The student nature of Z is a factor in choosing the means to use in the history of learning. Social media is the medium that people use to spread and convey information [4]. History is not always an interesting topic, so you need to promote the media to attract students about learning history. We need media that can encourage motivated students, as good reasons can have a positive impact on their learning history. According to Sanjaya [5] media, it may increase interest and interest in reading.

Using social media for learning can increase students' interest in learning and improve their learning experience. Learning and motivational learning can help increase the value of learning. Learning outcomes can affect learning disabilities. Therefore, the more motivated you are, the better your learning outcomes may be. Depending on the learning outcomes of Jihad [6], students have the ability to learn after experiencing a learning activity. In learning activities, teachers usually prioritize learning. Successful students are those who are able to achieve their goals and objectives.

Vlogs are a solution for the generation of smart devices, a generation that can't erase devices from their daily lives. Vlog (video video) is a column in video format. Vlogs are videos that contain ideas, news, or daily activities commonly found on websites. By developing an evolving environment, everyone can have

their own goals and ways of expressing themselves. One is to create a pop-up video clip. That is, make a video or shorten it like a Vlog. The Vlog service is an audio and video recording service managed by vlogger as a vlog developer.

There are many reasons why every vlogger interested in success may be interested in running a vlog. Another reason is that Vlog broadcasts are used to provide more conversations than just blog posts. One of the most popular vlogs posted on social media is YouTube, a social networking site that provides services for sharing and watching videos. YouTube is a innovation in new media, divided into many organizations in the production of video shows and advertising services. YouTube is an online television channel platform that manages video clip viewing and advertising activities individually, in groups, and directly through the distribution channels of various organizations. YouTube is an online television channel platform that manages video clip viewing and advertising activities individually, in groups, and directly through the distribution channels of various organizations. YouTube is an online TV channel with live and group management [7].

If the teacher can create a Vlog all the time by providing the material, the teacher can use the student to create a Vlog as the teaching method used to create the assignment. This study explores the potential of Vlog as a learning pathway in biology through a process-based learning approach.

### 2. RESEARCH DESIGN

The purpose of this study was to assess the impact of Vlog as an intermediate learning curve. The study was conducted from February to March 2020 at the Faculty of Training and Education, Musamus University. This type of research is qualitative research. The items developed at this research level are based on the results of the initial research that included activities. Identify, create policies, define a list of learning support (diction), and expert expertise. Data obtained through various data collection methods such as discussions, interviews, and documentation. The material is designed for discussion questions and information. Questions are provided in the device system with open questions to answer free of charge. This tool is intended to determine the quality of the product below. In contrast, the written method provides a queue to record some of the information you need. Effective data is retrieved through a process system, and data that is frequently displayed while describing various sources of information using triangulation techniques is considered efficient.

The data analysis method used is the comparative analysis method [8]. The computational analysis techniques used to quantify the final analysis from expert

evaluation / confirmation data are the points in the following table.

Table 1. Criteria for interpretation of scores

Information	Score
Very imprecise, appropriate, clear, attractive, easy	1
Imprecise, appropriate, clear, attractive, easy	2
Quite precise, appropriate, clear, attractive, easy	3
Precise, appropriate, clear, attractive, easy	4
Very precise, appropriate, clear, attractive, easy	5

The eligibility criteria for vlog media are shown in table 2.

Table 2. The results of the material expert validation

Qualification	Level of attainment
Very valid	84% ≤ score ≤ 100%
Valid	68% ≤ score ≤ 84%
Quite valid	52% ≤ score ≤ 68%
Less valid	36% ≤ score ≤ 52%
Invalid	20% ≤ score ≤ 36%

### 3. RESEARCH RESULT AND DISCUSSION

Instructor as an administrator in the use of Vlog is very important. Teachers need to be able to manage student activities from the beginning [9]. Below are the learning stages of the project by creating a Vlog for chemistry students.

- 1) The teacher has a problem with public chemistry. Students are divided into groups. Assume it with a karvalactose compound. Students are assigned to collect research reports based on historical research standards.
- 2) After asking a question, the student will be instructed to return to the research topic they are investigating and create a Vlog plan or purpose. For example, students explore the use of Watt leaves in traditional ceremonies. Students create a search system and a Vlog system.
- 3) Students are collecting preliminary results for research processes and Vlog purposes. The teacher evaluates the initial result of the student and contributes to the improvement so that the result can be improved. Teachers evaluate the sources of information used by students, the time required, and the impact of student activities.
- 4) Students initiate the survey and record the activities conducted in the survey. Students create a Vlog focused on the ideas presented. After recording, the

student prepares the video and adds dance to the student's style. After completing the Vlog for historical studies, students uploaded the Vlog to YouTube.

- Each group presents the result of the Vlog loaded in class using the projector.
- The teacher evaluates the Vlog created by the student. This assessment can be seen from the results of the historical research conducted by the students. From the results of user interviews, we will use the monthly sheet presented in the video to explain or communicate materials, student statements, and student-provided Vlog creation. The facilitator also evaluates the activities of each group.
- After the teacher completes the evaluation, other students will also evaluate (they will evaluate their peers). This is done so that students can provide assessments and evidence of their learning outcomes.

The student-created Vlog was developed by two professionals: a teacher as a teaching material expert and a teacher as a media expert. The vlog checking account contains 10 search areas. Quality was run twice. To interpret the variables, the results obtained from the two validators were modified as segments, resulting in the data as shown in Table 3.

Table 3. The results of the material expert's validation

Aspect of study	Validation 1	Validation 2	Average score	Level of validity	Inf
Suitability of material with core competencies and basic competencies	4	5	4.5	90	Very valid
The accuracy of material coverage	4	5	4.5	90	Very valid
Systematics of material presentation	5	5	5	100	Very valid
Truth and clarity of material description	5	5	5	100	Very valid
The accuracy of choosing vocabulary in the material	4	5	4.5	90	Very valid
Depth of material	4	5	5	100	Very valid

The accuracy of using the language rules used	5	5	5	100	Very valid
The variety of media forms makes it easier for students to understand the material	5	4	4.5	90	Very valid
Ease of use	5	5	5	100	Very valid
The suitability of writing variations makes it easier to understand the material	5	4	4.5	90	Very valid
Amount	46	48	47	94	Very valid
Average	4.6	4.8	4.7	94	Very valid

Table 3 shows that the first level optimization expert showed an average score of 4.6, while the second test increased it to 4.8. If the percentage is 94%, the average quality of professional equipment technicians is 4.7. Based on the translation table shown in Table 2, consumer experts conclude that modern media has developed standards.

Based on Amalliah's research, teachers can create Vlogs as student social media through learning activities aimed at increasing student involvement in learning. The process of teaching and learning through Vlog can raise student interest. In addition to explaining teacher creativity as a learning method, Vlog also allows students to convey creative ideas on the Vlog presentation platform based on learning objectives that affect individuals or groups [10].

The results of the media expert validation are shown in table 4.

Table 4. The results of the media expert validation

Aspect of study	Validation 1	Validation 2	Average score	Level of validity	Inf
Media display	4	5	4.5	100	Very valid
Serving order	4	5	5	100	Very valid

Completeness of information	5	5	5	100	Very valid
Ease of use	5	5	5	100	Very valid
Selection of the right and interesting typeface	4	5	5	100	Very valid
Readability of words or letters in the video	5	5	5	100	Very valid
Clarity of sound on video	5	5	5	100	Very valid
Image clarity in video	4	5	5	100	Very valid
The compatibility of colors, text, images, and animation on the video	5	4	5	80	Very valid
The compatibility of the accompanying music with the narration in the video	5	5	5	100	Very valid
Amount	46	49	47.5	95	Very valid
Average	4.6	4.9	4.75	95	Very valid

Table 4 shows that the first media expert gave an average of 4.6%, while the second media expert increased to 4.9. If the percentage is 95%, the average experience is 4.7. Based on the translation table shown in Table 2, media analysts agree that modern media has improved significantly.

The Internet has emerged as a new form of social media (new social media) to facilitate communication between individuals and groups, or between groups with other groups or parts of an organization. In addition to being used as an online platform, it is also used as a public relations platform and can be called a non-paper library. In its development, the Internet has been used as

a learning tool or e-learning that we are familiar with through the use of online tools in online marketing and online marketing [11].

While some of the Vlog making tutorials obtained by Google and other search engines make it easier to create Vlogs, there are a number of things that need to be considered when learning media:

- Inspiration is the beginning of vlog storytelling, which is used as a learning tool.
- The title of the article is the description of the story or what will be included in future videos.
- Stories should be organized in an orderly and detailed manner so that each story fits together.
- Before recording the video, you must prepare the site as a video source.
- Electricity to create improved videos
- Everything should be placed in position and section, not frequent photographs.
- To shoot, you need to find the appropriate definition of lighting.
- If you have a bad image, check the results and all you have to do is delete or report.
- Edit the captured image and re-select the appropriate image to upload. Use your creativity while editing the created video.
- Review the prepared video.
- Post via your personal site or YouTube channel after being verified by an expert and media expert.

From the results of this confirmation, it can be concluded that the vlog has improved as a learning medium for humanities science through practical learning methods that can be used and published.

#### 4. CONCLUSION

Vlog validation is based on 94% material content and 98% TI content. The overall vlog percentage was 96%, with excellent validity. In conclusion, the vlog design as a project-based ethnochemistry learning medium has very good validity

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## 20 Effect of Ethnochemistry Instructional Approach on Secondary School Students' Achievement in Chemistry in Bayelsa State

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### Effect of Ethnochemistry Instructional Approach on Secondary School Students' Achievement in Chemistry in Bayelsa State

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#### Abstract

The study investigated the effects of ethnochemistry instructional approach (EIA) secondary school students' achievement in chemistry. Two research questions and three hypotheses guided the study. The quasi-experimental design was adopted, specifically the pretest-posttest non-randomized control group was used. The population of the study was 4, 955 senior secondary year two (SS2) students offering chemistry in Yenagoa Education Zone out of which 153 students were selected for the study using purposive and random sampling techniques. The instrument for data collection was Chemistry Achievement Test (CAT) validated by three. The reliability of CAT was established using Kuder-Richardson to be 0.70. Analysis of data for the study was done using mean and standard deviation and analysis of covariance. The result of the study showed that students taught using EIA had higher gains in mean achievement scores than those in the conventional instructional approach. The findings of the study revealed that there was a significant difference between mean achievement scores of students taught chemistry using EIA and conventional instructional approach in favour of EIA. It was concluded that EIA is an effective instructional approach for improving students' achievement. It was recommended that seminars and workshop should be organised by Science Teachers Association of Nigeria on how to plan chemistry lessons using EIA and how to use the approach in teaching chemistry.

**Keywords:** ethnochemistry, conventional, chemistry, interest, acid

#### Introduction

The importance of chemistry to the nations of the world is indisputable and Nigeria is not an exception. The usefulness of chemistry in relation with other science disciplines has become glaringly clear to all in the face of the severe acute respiratory syndrome coronavirus two (Covid-2) pandemic, which surfaced in the later part of year 2019 (Helen, 2020). The sickness which is now code-named CoVid-19 spread at alarming rate across countries of the world and requires the development of antiviral drugs which can suppress or cure the disease. Drugs are chemical compounds (Teak, Scarth & Hudson, 2012) which have their origin from chemistry.

In recent time, chemical compounds like hydroxychloroquine and azithromycin a higher version of erythromycin have been recommended for clinical trials by the United States and NAFDAC (Noah & Maggie, 2020; Opejobi, 2020). Alcohol hand-sanitizers which are needed to disinfect and sanitize our hands are being produced today in large quantities by

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local residents who have the chemistry know-how and skills. These chemicals and more are needed not just in Nigeria but in the world at large to curb the menace of the pandemic which is throwing every nations of the world into economic and social recession. In the event of the attempt to develop antiviral drugs (chemicals) vaccines or find out any combination of chemicals that could suppress or cure the coronavirus disease, among others, one sees the glaring importance of chemistry in human survival or extinction.

The importance of chemistry notwithstanding, O'dwyer (2012) noted that from the earliest times, chemistry has proved to be generally a difficult subject to all students at all levels. The assertion though old still holds true today, as evidenced in students' achievement in external examinations in chemistry. In Nigeria for instance, students' achievement in chemistry in the West African Secondary School Certificate Examination (WASSCE) has remained abysmal. The Chief Examiner's Reports over the years shows that students continue to manifest various weaknesses in the examinations especially poor knowledge of chemistry concepts. An analysis of students' achievement from 2007-2009, the percentage number of students' made a credit pass in chemistry ranged from 44.16%-46.16%. From 2010-2012, the percentage of students who obtained a credit pass was below 50% except in 2010 with 50.7%. From 2013-2016, there was a persistent decline in the percentage of those who made a credit pass from 72.34% in 2013, to 62.49% in 2014, to 60.6% in 2015 and 57.74% in 2016. From 2017 to 2019, reports on the worst performances of students in chemistry were observed. This is because in 2018, students' highest point of decline was observed.

The poor achievement of students in chemistry is attributed to number of factors. Some of the contributory factors to students' poor achievement in chemistry include among others: the teaching method adopted by chemistry teachers, lack of laboratory apparatuses and reagents as well as inadequacy of laboratory facilities, high cost of laboratory installation and maintenance, students' attitude towards science subjects including chemistry and teachers knowledge of instructional pedagogies (Adalinkwu & Iorokpighi, 2013; Udoifa, 2009). Several research studies (Ogbeba & Ajayi, 2016; Ruggaber, 2017) have focused on finding innovative instructional approaches that could improve students' achievement in chemistry. In spite of these studies, students' achievement in chemistry in recent times seem not to be appreciating as expected.

Studies however, have not focused fully on the role of situating or contextualizing chemistry learning within the indigenous knowledge of the students (ethnochemistry instructional approach), in their achievement in the subject. Teachers of chemistry also have not always used traditional knowledge common within the immediate environment of the learning to make chemistry learning easier for students. One of the reasons for the lack of research in these instructional approaches is because teachers and most researchers do not know that poor achievement in chemistry and science in general is caused by cultural clashes that exist between students' life-world and world of modern science (Fasasi, 2018). The fundamental question arising from this idea therefore is: Can achievement in chemistry be improved through ethnochemistry instructional approach?

Ethnochemistry stems from the materials, ideas, beliefs and technology in a given society or environment, that derived from the past and present cultural practice and traditions. The prefix 'ethno' according to Rosa and Orey (2011) denotes a broad term that implies the socio-cultural context and includes language, jargon, codes of behaviour, myths and symbols. Ethnochemistry therefore, are the various chemically related cultural and community practices (Indra & Bitwell, 2016). Kurumeli and Opara (2008) explained that ethno-method of teaching involves situating learning and, problem solving in real life context where the environment is very rich in information with physical materials that serve as a source of manipulative and interactive processes. Ethnochemistry teaching approach therefore means a

teaching approach bordering on teaching chemistry using indigenous chemically related practices and local materials. These indigenous chemically related practices and local materials may be used to make the unfamiliar chemistry content familiar to students.

In the present study, ethnochemistry instructional approach involved the chemistry teacher giving a brief introduction of the chemistry concept to be taught. This was closely followed with a demonstration using local materials from the students' immediate environment or that are used culturally. Then, enumeration and discussion of related common Bayekan cultural practices which have chemical/scientific relevance was done by the teacher. The teacher asked and encourage the students to list more cultural related ideologies, practices or indigenous knowledge that are related to the concept. Thereafter, the teacher presented the chemistry concept in details comparing them to the related cultural beliefs and practices. The comparison was used as the focus of discuss in the classroom with the teacher identifying areas where cultural beliefs and practices are compatible, modifiable or contradictory with the science of chemistry. The lesson ended with teachers' evaluation of instructional objectives of the lesson after a summary of the important points to in the lesson have been noted.

Ethnochemistry instructional approach is hoped to benefit the chemistry students by helping them sequence teaching/learning processes through previous knowledge of the culture or other indigenous knowledge offering them the opportunity to know more about reality, culture, society and science. It could encourage students to think chemistry within themselves and arrive at a meaningful learning and understanding for improved achievement. It could as well make learning all the more interesting just as materials within their immediate environment are used as instructional materials. According to Ama (2013), the use of local instructional materials in teaching and learning could make the concept more practical and subsequently reduce abstraction. They are cost effective and could be obtained from the immediate local environment of the learning. They are also relatively safe for demonstration especially where students are involved in its production as is intended in the present study. Locally sourced materials also minimize concern about breakages, repair, loss and other mishandling by students. Thus, they can be used frequently in practical exercises and such continuous experiments in a practical oriented science subject like chemistry could improve achievement.

Achievement is the performance outcome which expresses the extent students have accomplished specific goals that are associated with activities in instructional environments such as schools and colleges (Hattie, 2009), it is the outcome of education. Achievement is often determined by administering a teacher made or standardized test. Thus, in this study, achievement is the performance in a school subject expressed as a score, mark or grade in an achievement test. The achievement of a student is often affected by many factors among which the teachers' choice of instructional approach is prominent factors. This is even so with the teaching and learning of chemistry which requires practical/activity oriented instructional approach (Andersson & Gullberg, 2014). In the study, the students' achievement was determined using an achievement test. Good instructional approaches facilitate proper understanding in the students and result in better achievement irrespective of students' location (Atomatofa, 2014).

One of the important factors in students' learning that have not received wide publicity is the school location. School location is simply the geographical setting in which a school is situated (Babatunde, 2015). It is the environment in which a student grows or school is situated (Homby, 2006). According to Yusuf and Onyenwotu (2014), the society in which an individual is located can be classified as urban or rural. There is no generally agreed definition of what urban and rural settlements. However, School location means urban-rural setting (Nworgu, Ugwuanyi & Nworgu, 2013). Nworgu et al. noted that a school in the heart

of the government reserved area (G.R.A) or housing estate cannot be compared with a school located in an unsuitable place like motor garage, main street, noisy environment, and nearness to a big market among others. This is because noisy environment is capable of hampering teaching and learning conditions. Long journey to school can be drudgery. These variables have the potentials to influence the students' conceptual understanding. There is the perception that rural dwellers are slow-witted hillbillies with little education and uninformed view about what goes on in the "real world"; whereas, those living in the urban areas are more exposed to modern technology which can aid learning than those in the rural areas.

School locations may also influence academic achievement owing to the characteristics of such location such as infrastructure, electricity, accessibility and internet networks. These features affect the level of the provision of educational infrastructure. Thus, provision of education in rural areas according to Babatunde (2015) is normally fraught with the following difficulties and problems: qualified teachers' refusal of appointment to isolated villages; villagers refusal to send their children to schools because they are dependent on them for help; parents hesitating to entrust their daughters to male teachers; some villagers have few children for an ordinary primary school; lack of roads or satisfactory means of communication which makes it difficult to get books and teaching materials to the school which place difficulties in the way of organizing school transport among others. It can simply be understood that with changed economic incentives the level and distribution of educational services change along with the locational decisions of households. This has direct ramifications for a number of educational policy and finance decisions. Urban Location Models in Urban economics has largely focused on household location and urban form as dictated by accessibility concerns. These have wide implication for schools in rural areas and as results may affect the learning of students in such location. Thus, there is need to examine academic achievement difference among schools located in urban and rural areas.

#### Purpose of the Study

The purpose of the study was to find out the effects of ethnochemistry instructional approach on secondary school students' achievement in chemistry. Specifically, the study determined the:

1. Difference between the mean achievement scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA).
2. Difference between the mean achievement scores of urban and rural secondary school students taught chemistry using EIA.
3. Interaction effect of instructional approaches and school location on students' achievement in chemistry.

#### Research Questions

The following research questions guided the study.

1. What is the difference between the pretest and posttest mean achievement scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA)?
2. What is the difference between the pretest and posttest mean achievement scores of students from urban and rural secondary school taught chemistry using EIA?

#### Hypotheses

The following hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the mean achievement scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA).
2. There is no significant difference between the mean achievement scores of students from urban and rural secondary schools taught chemistry using EIA.
3. There is no interaction effect of instructional approaches and school location on secondary school students' achievement in chemistry.

#### Method

The study adopted the quasi-experimental design. The study was carried out in Yenagoa Education Zone of Bayelsa State, Nigeria. The population of the study comprised 4, 955 senior secondary year one (SS1) chemistry students in Yenagoa Education Zone. The sample size for the study was 153 SS1 chemistry students. Experimental group one (ethnochemistry instructional approach group) has 79 students (37 urban, 42 rural) while the control group (conventional instructional approach) has 74 students (36 urban, 38 rural).

The instrument for data collection was Chemistry Achievement Test (CAT) which validated by two lecturers in the Departments of Science Education and of Educational Foundations, Nnamdi Azikiwe University, Awka, and one experienced secondary school chemistry teacher for validation. The reliability of CAT was established using Kuder-Richardson Formula 20 (KR-20). KR-20 was chosen because it is suitable for determining the internal consistency of dichotomously scored instruments. CAT was administered once to 40 SS1 chemistry students in Ogbia Education Zone of Bayelsa state which is not part of the study. The generated scores from the exercise were collated and reliability computations was carried out using the stated formulae. The index obtained for CAT was 0.70.

The general step by step procedures that was taken in teaching the chemistry concepts to the students in the ethnochemistry experimental group is as follows: The teacher in the first step briefly introduced the concept to be taught, with students attention drawn to the contents under the concepts to be learnt and briefly explain them to enable them have a grasp of what they were learning and to know also, what cultural knowledge and practices to present when asked, that is related to the contents.

The brief introduction was followed by the teacher presenting some of the ingenious knowledge and cultural practices through a demonstration with local materials obtained from the students' immediate environment. The teacher asked the students to present other cultural practices or knowledge of such practices that are related to the concepts. A demonstration of some of the cultural practices was done by the students. The teacher explained the practices presented by the students in relation to the concept taught and classify them into three categories namely: compatible with science, compatible with science with modifications and misconception. Under the compatible with science category, the teacher presented only those ethnochemical practices that are compatible with science. In the category for compatible with science with modification, the teacher presents those ethno-related practices that can be modified and made compatible with science whereas in the misconception category, only those cultural ideas and practices that are not compatible with science were presented. Students during this comparison were allowed to state their opinion to make the class more interactive and to further clear misconceptions that may further be made known. Students were also allowed to ask questions on confusing subjects that may form the quantum for discussion at any instance. The teachers' interaction with the students, was with the view to further explore other the cultural practices and indigenous knowledge known to them and emphasized the scientific connotations in each of the cultural practices mentioned by the students.

The teacher summarized the important points of the lesson, emphasizing the misconceptions discovered and evaluated the students' learning by asking questions based on what was learnt. Every class ended with an assignment given to students to enable them explore cultural practices and ingenious knowledge that are related to the next concept to be taught. The conventional group was taught using the conventional instructional approach. It involved presentation of lesson content to the students with in-depth explanation for their understanding. Students were allowed to ask questions about what they understand and get further clarification.

Data generated through the study was analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). The decision rule was to reject null hypothesis where Probability value (p-value) was less than or equals significance value of 0.05 ( $P \leq 0.05$ ) and not to reject null hypothesis where P-value was greater than 0.05 ( $P > 0.05$ ).

#### Results

**Research Question 1:** What is the difference between the pretest and posttest mean achievement scores of students taught chemistry using EIA and those taught using CIA?

**Table 1: Pretest and Posttest Mean Achievement Scores of Students taught Chemistry using EIA and those taught using CIA**

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gained Mean
EIA	79	24.04	4.85	74.03	6.69	49.99
CIA	74	30.36	2.40	63.51	6.25	33.15
Mean						
Difference		6.32		10.52		16.18

Table 1 reveals that the students taught chemistry using EIA has pretest mean achievement score of 24.04 and posttest mean interest score of 74.03 with gained mean achievement score of 49.99, while those in the control group taught with conventional instructional approach has pretest mean achievement score of 30.36 and posttest mean score of 63.51 with gained mean 33.15. The spread of scores in the posttest of students in the experimental is slightly higher than that of those in the control group. The difference between the between the mean gained achievement scores of the students is 16.18 in favour of EIA.

**Research Question 2:** What is the difference between the pretest and posttest mean achievement scores of students from urban and rural secondary school taught chemistry using EIA?

**Table 2: Pretest and posttest mean Achievement Scores of Urban and Rural Students taught Chemistry using EIA**

Gender	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gained Mean
Urban	37	23.81	4.59	73.32	7.54	49.51
Rural	42	24.24	5.11	74.64	5.86	50.40
Mean						
Difference		0.43		1.32		0.89

Table 2 reveals that the urban students taught chemistry using EIA has pretest mean achievement score of 23.81 and posttest mean achievement score of 73.32 with a gain in mean scores of 49.51 while the rural students have pretest mean posttest score of 24.24 and

posttest mean achievement score of 74.64 with a gain in mean scores of 50.40. The difference in mean achievement score of the urban and rural students in 0.89 in favour of rural students.

**Hypothesis 1:** There is no significant difference between the mean achievement scores of students taught chemistry using EIA and those taught using CIA.

**Table 3: ANCOVA Test of Significance of Difference between the Mean Achievement Scores of Students taught Chemistry using EIA and CIA**

Source of variation	SS	Df	MS	F	P-value	Decision
Corrected Model	4303.662 <sup>a</sup>	2	2151.831	51.621	.000	
Intercept	16331.780	1	16331.780	391.787	.000	
Pretest	81.627	1	81.627	1.958	.164	
Method	1972.082	1	1972.082	47.309	.000	Sig
Error	6252.809	150	41.685			
Total	737748.000	153				
Corrected Total	10556.471	152				

Table 3 shows that there is a significant main effect of the treatment on students' achievement in chemistry  $F(2, 150) = 47.309, P = 0.000 < 0.05$ . Therefore, the null hypothesis is rejected meaning that there is a significant difference between the mean achievement scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA) in favour of EIA.

**Hypothesis 2:** There is no significant difference between the mean achievement scores of students from urban and rural secondary school taught chemistry using EIA.

**Table 4: ANCOVA Test of Significance of Difference between the Mean Achievement Scores of Urban and Rural Students taught Chemistry using EIA**

Source of variation	SS	Df	MS	F	P-value	Decision
Corrected Model	183.117 <sup>a</sup>	2	91.558	1.699	.190	
Intercept	20017.641	1	20017.641	371.444	.000	
Pretest	164.936	1	164.936	3.061	.084	
Location	23.309	1	23.309	.433	.513	Not Sig
Error	4095.744	76	53.891			
Total	434961.000	79				
Corrected Total	4278.861	78				

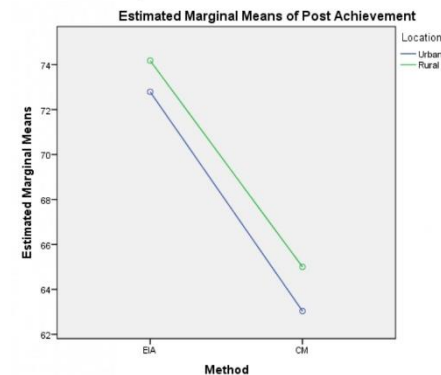
Table 4 shows that there is no significant main influence of location on students' achievement in chemistry  $F(2, 76) = 0.433, P = 0.513 > 0.05$ . Therefore, the null hypothesis is accepted meaning that there is no significant difference between the mean achievement scores of students from urban and rural secondary schools taught chemistry using EIA.

**Hypothesis 3:** There is no interaction effect of instructional approaches and school location on secondary school students' achievement in chemistry.

**Table 5: ANCOVA for Testing the Interaction Effect of Instructional Approaches and School Location on Secondary School Students' Achievement in Chemistry**

Source	SS	df	Mean Square	F	Sig.	Decision
Corrected Model	4411.225 <sup>a</sup>	4	1102.806	26.560	.000	
Intercept	15410.428	1	15410.428	371.139	.000	
Pretest	57.347	1	57.347	1.381	.242	
Method	1996.110	1	1996.110	48.074	.000	
Location	105.951	1	105.951	2.552	.112	
Method * Gender	3.096	1	3.096	.075	.785	Not Sig.
Error	6145.246	148	41.522			
Total	737748.000	153				
Corrected Total	10556.471	152				

Table 5 shows that there is no significant interaction of instructional approaches and school location on secondary school students' achievement in chemistry  $F(4, 148) = 0.075, P = 0.785 > 0.05$ . Therefore, the null hypothesis is accepted meaning that there is no interaction effect of instructional approaches and school location on secondary school students' achievement in chemistry.



Covariates appearing in the model are evaluated at the following values: Pretest Achievement = 27.10

**Figure 1: Plot of interaction effect of instructional approaches and school location on secondary school students' achievement in chemistry.**

The plot of interaction effect of instructional approaches and school location on secondary school students' achievement in chemistry is not significant and ordinal. This shows that

effect of the instructional approaches did not change when location was put into consideration.

#### Discussion

The findings of the study also revealed that there was a significant difference between the mean achievement scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach in favour of EIA. This finding of the study may have resulted from the fact that the adoption of EIA enabled the students to link the concepts taught to the day to day activities in their immediate environment. This way, students understood the concepts better, established a strong connection between theory and practice and reduced the abstract ideas associated with the science of chemistry. By relating the learning with the cultural understanding of the students, they were able to interpret chemistry concepts in the light of their prior understanding, removing their misconceptions and holding a better conception of chemistry.

The whole process of learning in EIA enabled students to construct their own knowledge since the concepts were well understood. Students were able to cognitively see chemistry as it is, imagine it and apply it to their various home and community practices. The use of EIA also made the students to understand chemistry in their native language given the import of the indigenous knowledge and cultural practices. Getting to borrow certain terminologies from their culture to explain chemistry concept drove the learning home leading to better achievement.

The finding of the study lend credence to the finding of Olawatosin, Emmanuel and Peter (2017) that students taught mixture separation techniques using ethnochemistry approach had significantly higher mean achievement scores than those taught using discussion method. The finding of the study is in line with the findings of Abonyi (1999) revealed that the ethnoscience based Instructional package is superior to the conventional approach in facilitating modern science concept formation in learners. The finding of the study lend credence to the findings of Ugwu and Diovu (2016) that students taught with integration of indigenous knowledge and practices had higher mean achievement score than their counterpart. The finding of the study is also in line with the findings of Omenka and Kurume (2004) that ethnomathematics approach was more effective in facilitating students' achievement in geometry and mensuration.

#### Conclusion

The findings of this study showed that students taught chemistry using EIA had significantly higher achievement scores than those taught using CIA. It is concluded that EIA is an effective instructional approach for improving students' achievement in chemistry.

#### Recommendations

The following recommendations are made in the light of the findings of the study:

1. Textbook writers should incorporate cultural practices and realities that are compatible with science so as to make the learning of chemistry and its understanding easier for students. This may also reduce the level of abstraction in the learning of chemistry.
2. Seminars and workshop should be organised by Science Teachers Association of Nigeria on how to plan chemistry lessons using EIA and how to use the approach in teaching chemistry.

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# 21 Development of Colloid System Electronic Module Based On Problem Solving Integrated Ethnochemistry for High School Students

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## Development of Colloid System Electronic Module Based On Problem Solving Integrated Ethnochemistry for High School Students

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**Abstrak.** The colloid system is one of the chemical materials that contains many concepts and is related to everyday life, so that students still find it difficult to understand. The aim of this research is to evolve a module electronic based on problem solving integrated ethnochemistry on colloid system. The exploration method applied is Research and Development (R & D) with a 4D research design modified into 3D (define, design, and develop). Data was collected using interview techniques, expert validation, user response questionnaires, and implementation observation sheets. The results of the feasibility assessment by the expert validator were 86.73% with a very feasible category. The results of the readability, practicality, and student answers to the e-module each attained a score of 87.9%, 91.3%, and 86.9% in the verifiably practicable category. The results of the learning implementation test using the e-module obtained a score of 96.4% in the very well implemented category. The conclusion of this exploration is that the expansion of an e-module based on problem solving integrated ethnochemistry is very feasible to use and gets a positive response by users to the e-module that has been evolved.

**Keywords:** Electronic module, colloid system, problem solving, ethnochemistry

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### INTRODUCTION

Learning chemistry is still difficult for students. This may be because chemistry covers very broad and abstract material. Besides, chemistry according (Middlecamp & Kean, 1985) chemistry includes a very broad material consisting of facts, concepts, rules, laws, principles, theories and problems. From the scope of chemistry material, most of it consists of abstract concepts.

One of the chemical materials that contains many concepts and is related to everyday life is colloidal system material (Akbar *et al.*, 2015). The application of the properties of colloidal systems are widely encountered in various fields, both in the agricultural and medical industries. Therefore, colloidal system material becomes very important to be studied and understood, not just memorized. In fact, students are only required by the teacher to simply memorize without requiring students to understand the material in depth. Learning by rote or theoretical makes students less understand what they are learning (meaning). This is due to the lack of learning experiences that stimulate their curiosity and motivation to learn. This learning obstacle also occurs in several schools, one of

which is MA Riyadhiotul Thalabah Sedan

The results of observations and debriefings with chemistry educators at MA Riyadhiotul Thalabah Sedan stated that in learning colloid systems some students didn't understand the concept, this can be seen from the learning results of some students who are still below the KKM. According to the chemistry teacher on colloidal system material, students consider the material to be abstract and in understanding it needs to be linked to real examples. The results of the dissection of handbooks operated in varied academies such as MAN 2 Rembang, SMA N 1 Pamotan and MA Riyadhiotul Thalabah Sedan still use printed textbooks, there is no development of online-based textbooks such as e-modules. The teaching materials used aren't all problem solving based. Abstract chemistry material so that it is delicate for learners to reason the substance, one strategy to overcome abstract chemistry problems by using easy teaching materials and appropriate learning models.

The existence of obstacles in the education proceeding can be minimized by the existence of learning media that can present applicable material. Learning media can provide knowledge about colloid systems and be developed by

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applying problem solving elements based on local culture. The learning media is expected to generate interest and invite students to actively build their knowledge so that learning objectives are achieved.

Learning media can prevent the saturation of the learning process of students. One of the education media that can be evolved is electronic tutoring accountments similar e-modules. Module electronic is a tutoring accountments that's relatively suitable for the prevalent scene because it can be accessed anytime and anywhere through computers, tablets, androids, and others. Module electronic permit learners to be suitable to get singly and laboriously. E-modules don't just contain substance or textual definitions, but audio, moving pictures, or videos can be fitted that brace masteryship of concepts and are suitable for use (Herawati & Mulitadi, 2018).

One of the appropriate learning models is by using a problem solving learning model. Problem solving is one of the innovative learning models that can provide more active learning conditions for students (Nugroho *et al.*, 2017). Problem solving is a learning model that trains students' ability to solve a problem through the stages of the scientific method so that students can learn knowledge related to the problem and at the same time have the skills to solve problems (Nugroho *et al.*, 2017). The development of teaching materials developed with problem solving-based learning models can improve problem solving abilities (Aji *et al.*, 2017).

Learning base on problem solving will be more expressive if it's integrated with ethnochemistry which is wisdom of pearson's comprehensions of some natural sensations and is bonded to the community's original wisdom (Sudarmin, 2014). Ethnochemistry is delineated as the implementation of chemical concepts in people's lives which are reflected in cultural traditions, cultural symbols, value systems, social systems and cultural products identified as having relevance to the concept or practice of chemistry (Norolayn, K. & Said-Ador, 2017). The integration of local wisdom in chemical materials can be done through providing examples of chemical concepts that are integrated with cultural products, or through the

use of cultural products as natural laboratories (Wahyudiati *et al.*, 2020). Chemical material that is integrated with ethnochemistry can make students understand more understanding in absorbing new knowledge in scientific concepts (Wahyudiati, 2021).

The ethnochemistry that is integrated into the colloid system material is local wisdom related to the kinds of colloids, the nature of colloids and the process of making colloids. The ethnochemistry that supports all of this is the process of making *es cinau*, *lontong uyuhan*, *dumbeg cake*, and *batik tulis Lasem* which are local wisdom in Rembang Regency.

Grounded on the problems over, in this research an e-module of colloidal system based on problem solving integrated ethnochemistry will be developed for high school students. The developed e-modules are bargained in the form of a flipbook. Flipbook includes tutoring substances in the form of electronic media. Flipbooks can be run with the help of smartphones, computers, laptops and others. The advantage of tutoring substances in the form of flipbooks is that they can display pictures and videos that make it simple for learners to reason the learning material or give the impression of learning that is more real to students. The development of this flipbook was chosen for the reason that it can be used as a practical independent learning resource that can be used anytime and anywhere.

### METHODS

This exploration is an elaboration exploration that will produce tutoring substance products shaped of a module electronic in the form of a flipbook. The research method used is Research and Development (R & D). Research and Development is an exploration system with the goal of having given outputs, and sampling the conclusiveness of these yields (Sugiyono, 2015). The design of the research and development applied is a 4D research and development design which's quantified into 3D so that the steps taken are define, design, and develop. The design stages of developing an e-module for a colloid system based on problem solving an integrated ethnochemistry are presented in Figure 1.



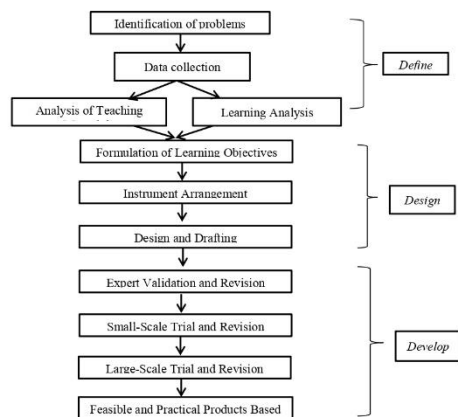


Figure 1. Diagram of research and Development Research Procedure Diagram (4D model adaptation of Thiagarajan, 1974) modified into 3D

The research was carried out at MA Riyadlotut Thalabah Sedan in the even semester of the 2021/2022 educational time. The research problems for the small group were 20 students of class XI specialization in Mathematics and Natural Sciences, while the large group trials were 65. The small group trials were used to see the readability of the e-module, while the large group trials were to see the students' responses to the e-module.

The research instruments used were teacher interview sheets as an initial study, e-module validation sheets, legibility questionnaire sheets, practicality, student responses, and implementation observation sheets. Validation in question is to provide assessments, suggestions and input from the validators. Assessment of the validity of the module electronic consists of 4 assessment scores, namely explosively agree = 4, agree = 3, differ = 2, and explosively differ = 1. Suggestions and inputs from the validator are then followed up to improve the e-module and

obtain an e-module that is suitable for use. E-modules that were suitable for use are then tested into small groups to see the readability of learners towards the module electronic. The results of the small group trial improvement were then tested in large groups. Eligibility criteria for e-modules can be looked in Table 1.

Table 1. Percentage of module electronic eligibility criteria (Riduwan, 2003)

Percentage	Criteria
21 - 40	Not feasible
41 - 60	Feasible enough
61 - 80	Feasible
81 - 100	Veritally feasible

RESULTS AND DISCUSSION

Results

This research was conducted with the aim of developing an e-module based on a problem

solving colloid system that was integrated with ethnochemistry in class XI specialization in Mathematics and Natural Sciences and to analyze the feasibility of the module electronic. This product research and development is obtained through a 4D development model which's qualified to 3D (define, design, and development). The explanation of the stages of the development model can be described as follows:

Define Phase (Problem Observation)

The define stage begins with a literature study and unstructured interviews with high school chemistry teachers about the learning models and teaching materials used so far. In addition, interviews related to ethnochemistry related to the colloid system were also conducted.

Unstructured interviews were conducted on initial observations to find out the teacher's opinion on several things. The questions given to the teacher were about the teaching materials used, learning models, problem solving learning, ethnochemistry learning, and other facts in the field. The interview method chosen by the researcher is an unstructured interview to help researchers if in the interview process there is a problem development (Sugiyono, 2015).

The informants in this interview were three teachers from different schools consisting of 1 MAN teacher, 1 high school teacher, and 1 MAS teacher. The results of observations and interviews with chemistry educators at MA Riyadlotut Thalabah Sedan stated that in learning colloid systems some students did not understand the concept, this can be seen from the learning results of some students who are still below the KKM. According to the chemistry teacher on colloidal system material, students consider the material to be abstract and in understanding it needs to be linked to real examples. The results of the dissection of handbooks used in varied schools such as MAN 2 Rembang, SMA N 1 Pamotan and MA Riyadlotut Thalabah Sedan still use printed textbooks, there is no development of online-based textbooks such as e-modules. The teaching materials used are not all problem solving based and in the learning process not all materials are integrated with ethnochemical concepts. Ethnochemical contexts that can be related to colloidal system materials include local wisdom in Rembang Regency including the process of making *es cincin*, *lontong tuyuhan*, *batik tulis*

*Lasem*, and *dumbeg cakes*.

The next stage after analyzing the problems that exist in the school is compiling the material according to the ethnochemistry context and the content of the colloid system. The material can be presented between original science and scientific science or called ethnochemistry, so that students can understand the relationship between the two. The ethnochemistry that is integrated into the colloid system material is local wisdom related to the kinds of colloids, the nature of colloids and the process of making colloids. The ethnochemistry that supports all of this is the process of making *es cincin*, *lontong Tuyuhan*, *batik tulis Lasem*, and *dumbeg cake* which are local wisdom in Rembang Regency. In the process of making *es cincin*, there is a colloid system concept related to the type and manufacture of colloids, while in the process of making *lontong tuyuhan* and making *dumbeg cakes* there is a colloid concept related to the types and properties of colloids. The concept of colloid related to the adsorption properties of colloid is found in the dyeing process of *batik tulis Lasem*.

Design Phase (Design)

The design phase begins with designing an e-module based on problem solving integrated ethnochemistry on colloidal system. The design of the e-module is done by making a module matrix and a draft module. The e-module matrix contains a design in the form of an initial framework. The sections displayed in the matrix include the frontal cover, introduction (foreword, table of problems, material description, learning objects, and concept maps), content (learning activities 1, 2, and 3), closing (final evaluation of learning, answer keys, and feedback), glossary, bibliography, about the author, and back cover.

The matrix that has been created is then developed into a draft whose content is written in more detail than the matrix. The face and back covers of the module are made applying the canva operation, while the content of the material is made using Microsoft word which is then converted into pdf form. Making e-modules with the help of Flipbook applications. The colors used in the e-module are dark blue, light blue, and white. The type of font used is Times New Roman with size 16. The e-module draft is completed with figures and videos supporting the material in accordance with the colloid and ethnochemical system concepts in *es cincin*, *lontong tuyuhan*, *batik tulis Lasem*, and *dumbeg*

cake.

The design of this research e-module contains three main points, namely introduction, content and closing. E-modules are made with links to videos or additional information related to the subject of colloid systems. The addition of links goals to make it simple for learners to browse all

learning resources. The e-module design was produced by the researchers as the initial product of developing an e-module for a colloid system based on problem solving integrated ethnochemistry. The e-module cover design can be looked in Figure 2.

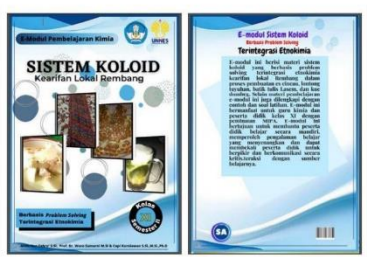


Figure 2. E-module cover design

The content section of the module electronic consists of learning activity 1 (types of colloids), learning activity 2 (colloidal properties), and learning activity 3 (making and using colloids). Each learning activity is equipped with learning

success indicators, material definitions, learners worksheets, and resumes. The design of the contents of the e-module can be looked in Figure 3.

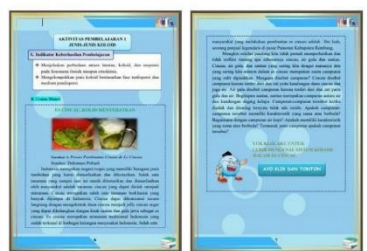


Figure 3. E-module content snippet design

The last part of the module electronic that was developed is the cover which contains the final evaluation of learning, answer keys, feedback, glossary and bibliography. The design of the module electronic cover can be looked in Figure 4.

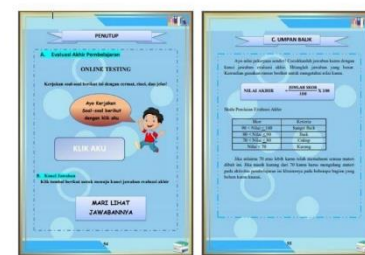


Figure 4. E-module cover piece design

**Develop Phase (Development)**

The development phase is applied to test the feasibility of the module electronic base on problem solving integrated ethnochemistry on colloid system carried out by an expert validator. Components assessed in the research instrument

include components assessed in the research instrument which include aspects of content assessment, presentation, language, graphics, and ease of use. The data on the results of the validator assessment of the research instrument are shown on Table 2.

**Table 2. Validator Assessment Results on E-modules**

No.	Assessment Aspect	V1 (%)	V2 (%)	V3 (%)	Average (%)
1	Contents	90.63	96.88	78.13	88.55
2	Presentation	95	90	80	88.33
3	Language	87.5	91.67	75	84.72
4	Graphics	89.29	85.71	78.57	84.52
5	Ease of use	87.5	100	75	87.5
Amount					86.73

Based on Table 2, the data from the validator's assessment on all aspects of the feasibility of the e-modules attained a mean of 86.73% with a veritably decent category. After the e-module was declared feasible by the validators, it was followed by a small group trial. The small group trials are intended to see the readability of the module electronic. The results of small group trials are used as input to researchers about products developed before being tested in large groups. E-module readability data in small group trials are presented in Table 3.

**Table 3. Readability Test Results for E-modules**

No.	Assessment Aspect	Average Score (%)
1	Learning	88.1
2	Contents	88.75
3	Appearance	86.25
4	Language	87.5
Amount		87.9

Table 3 shows that the students' readability of the e-module obtained an average of 87.9% with a very decent category. After the e-module readability test, the practicality test is filled in by the practitioner (teacher). The results of the practicality test on the module electronic are

shown in Table 4.

**Table 4.** Practicality Test Results for E-modules

No	Assessment Aspect	Average Score (%)
1	Layout	91.67
2	Language	87.5
3	Contents	90
4	Development	87.5
5	Ethnochemistry	100
	Amount	91.3

The results of the practicality test in Table 4 state that the e-module is very practical to use with a mean score of 91.3%. After the e-module is said to be feasible by the validator and tested in small groups, then it is tested in large groups. The results of student responses in large groups are shown in Table 5.

**Table 5.** Results of Student Responses to E-modules

No.	Assessment Aspect	Average Score (%)
1	Learning	86.8
2	Contents	85.2
3	Appearance	89.6
4	Language	88
	Amount	86.9

The outcomes of learners responses to module electronic based on Table 5 show that students respond strongly to e-modules with an average score of 86.9%. The results of the observation of learning implementation using module electronic can be looked in Table 6.

**Table 6.** Results of Learning Implementation on E-modules

Meeting-	Score	Percentage (%)
1	17	100
2	16	94
3	16	94
4	17	100
5	16	94
Amount		96.4

Based on Table 6, the results of the observation of the execution of getting using e-modules stated that it was implemented very well with a percentage of 96.4%.

#### DISCUSSION

Grounded on the results of the e-module exploration that has been developed in accordance with the 2013 curriculum which includes basic competencies (KD) and indicators

of competency achievement (IPK). Learning substances can be said to be valid if they are in accordance with the existing curriculum (Hafshah *et al.*, 2016). The e-module is said to be valid by looking at several aspects. First, the aspect of the module electronic material that has been evolved has the correctness of the material, the suitability of the practice questions with the material and the e-module can increase students' knowledge.

Second, aspects of language and attractiveness. E-modules have been developed using communicative language and do not cause double meaning. Teaching materials must be prepared using clear and easy-to-read sentences and language (Yerimadesi *et al.*, 2016). The e-module has an attractive appearance, layout placement, font selection, font size and overall display design is considered good and attractive. However, there are some suggestions from the validator including writing words, adding sources to figures and videos, and smoothing figures. All suggestions are accepted and improvements have been made.

The e-module has a very practical category value from the readability test, the practicality of the teacher and the response of the students. This shows that the module electronic that has been developed can be used to help learners understand the subject problem, especially the colloid system material. E-modules are prepared using a problem solving model that is integrated with local wisdom or called the ethnochemistry approach. Problem solving is a learning model that trains the ability of students to break a trouble through the stages of the scientific method so that learners can learn wisdom communed to the trouble and at the same once have the skills to break troubles (Nugroho *et al.*, 2017). Chemical material that is integrated with ethnochemistry can make learners understand more about absorbing new knowledge in scientific concepts (Wahyudiati, 2021). Based on this, the module electronic is decent and practical to use in the studying process.

This finding is reinforced by previous research which states that the development of teaching materials developed with problem solving models can increase problem solving abilities (Aji *et al.*, 2017), improve students' critical thinking skills (Wahyuni *et al.*, 2020), improve student learning results and critical thinking (Sugihartini & Jayanta, 2017), and improve oral and written communication skills (Maridi *et al.*, 2019). Learning by integrating ethonychemistry can be used to measure

learning results (Yusnidar & Epimur, 2021) and creativity skills (Mirawati *et al.*, 2021).

#### CONCLUSION

The module electronic based on problem solving integrated ethnochemistry on colloidal system material has been developed with results of the feasibility evaluation by expert validators are 86.73% with very decent category. The results of the readability, practicality, and learners reactions to the module electronic each attained a score of 87.9%; 91.3%; and 86.9% in the veritable applicative category. The results of the learning implementation test using the e-module obtained a score of 96.4% in the very well implemented category. The conclusion of this research is that a module electronic based on problem solving integrated ethnochemistry is very feasible to use and has received a positive response from users.

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## 22 Exploring Chemistry Education Students' Critical Thinking Skills and Ethnochemistry-Based Learning Experiences based on Gender

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### Exploring Chemistry Education Students' Critical Thinking Skills and Ethnochemistry-Based Learning Experiences based on Gender

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**Abstract**-This study explores critical thinking skills and ethnochemistry-based learning experiences in chemistry education students. A total of 200 students' (70 men and 130 women) were selected as the sample with the cluster random sampling technique. The research design was a cross-sectional survey. The data collection instrument on critical thinking skills utilized was the Oliver Hoyo rubric (OHCR). Meanwhile, ethnochemistry-based learning experience data were collected through a CAEQ (chemistry attitudes and experiences questionnaire based on ethnochemistry) questionnaire. The quantitative data were analyzed by the MANOVA test at a significance level of .05. At the same time, interview data were examined using the Patton technique. This study resulted: 1) the CTS and ELE levels of chemistry education students were higher in female and freshman grades, and 2) there were differences in CTS and ELE based on Gender. In which, the interview data strengthen the survey findings since female students have higher CTS abilities and have more positive attitudes towards implementing ethnochemistry-based learning.

**Index Terms**- critical thinking skills, ethnochemistry-based learning experience, gender differences, chemistry education students.

#### 1. INTRODUCTION

The new direction of chemistry learning goals in universities is oriented toward achieving 21st-century learning demands to face in the phase of the industrial revolution 5.0. The role of universities is required to generate graduates who have adequate hard skills and soft skills to live in the era globalization (Cheung, 2011; Wahyudati et al., 2020). Since critical-thinking skills are 21st-century skills needed by chemistry education students to strive in the industrial revolution 4.0 (Villafane & Lewis, 2016; Syaifal et al., 2022). Unfortunately, looking at the previous research, it has proven that lecturers focus more on cognitive learning outcomes than soft skills to achieve chemistry learning objectives. It leads to chemistry education students' being categorized as low of their critical thinking skills (Tiruneh et al., 2018; Wahyudati, 2022). In addition, the neglect of students' soft skills development in learning activities also affects their

low critical thinking skills at the primary, secondary, and tertiary levels (Taber, 2011; Fadli, 2020).

Education experts believe that students' critical thinking skills as one of the 21st-century skills which need to be developed in creating competent graduates in their fields and have the competitive capability in the job market (Sumardi, Rohman, & Wahyudati, 2020; Wahyudati, 2022; Pataoah et al., 2021). Critical thinking is the ability to analyze problems logically and rationally to find solutions to the issues faced. Aspects of critical thinking skills are reflected in the ability to analyze, evaluate, identify, assess, and develop thinking to think logically and systematically in solving a problem. The student's critical thinking skills development can be explored through classroom learning activities and experimental activities in the laboratory to foster their curiosity, self-confidence, responsibility, problem-solving skills, and social awareness. These can be the main provisions for each individual to survive in a global society (Wahyudati, Sutrisno, & Louise, 2019; Tiruneh et al., 2018; Bandjopadhyay & Szostek, 2019). In addition, CTS skills cannot be taught using textbooks or based on theory only. Contextual activities such as the ability to investigate, express opinions, respond to other people's views, and dare to make decisions are needed as supporting elements (Aljafri, 2019). Thus, providing contextual and relevant learning experiences to students' daily lives can be the way to develop critical thinking skills.

The learning experience is one of the indicators of attitudes toward science. Attitude towards science are defined as an individual's ability to solve a problem through a systematic scientific method (Wahyudati, 2021). Learning experiences relevant to students' daily lives and culture are believed to improve students' critical thinking skills and problem-solving abilities (Farel & Barbera, 2015; Wahyudati et al., 2020). This situation hints that there is a close relationship between the learning experience and critical thinking skills. Moreover, a contextual learning experience that combines science and culture (ethnochemistry) could train students to develop analytical skills, formulate and prove hypotheses, and think logically in constructing knowledge, attitudes, and skills independently (Fadli & Irwanto, 2020; Sumardi & Wahyudati, 2021). However, research studies that examine critical thinking skills and ethnochemistry-based learning experiences are still very limited and are focused more on scientific attitude (Sutrisno,

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Wahyudati, and Louise, 2019). On top of that, the measurement of both aspects (critical thinking skills and ethnochemistry-based learning experiences) has never been done simultaneously. Therefore, more studies are needed to measure critical thinking skills and ethnochemistry-based learning experiences in universities.

Critical thinking skills and ethnochemistry-based learning experiences must be acquired to achieve chemistry learning objectives, including soft skills and hard skills domains. However, based on empirical studies, the factual conditions of chemistry learning at universities in Indonesia show that chemistry learning prioritizes mastery of concepts rather than the development of soft skills (Irwanto, Rohaeti, & Prodjosantoso, 2018; Wahyudati, 2021; Wivit, Ginting, & Firdaus, 2013). Referring to these results, it further explains that the problem of learning chemistry in universities is the use of learning models that are less varied and methods and the lack of learning activities that allow students to construct knowledge based on real everyday life experiences. Likewise, the student's learning experience is less related to their cultural background, so the concepts taught tend to be memorization and ignore factual and contextual ideas that make learning less exciting and meaningful for them (Sutrisno, Wahyudati, & Louise, 2019; Fadli & Masnun, 2020; Sumardi & Wahyudati, 2021). All in all, ineffectiveness in applying learning models, methods, or media and must be balanced with improving the quality of lecturers (Zaidan & Jayosi, 2014; Taber, 2011).

In addition to strategy and learning environment factors, relevant previous research studies reveal an interesting fact that there is a link between the chemistry learning experience and critical thinking skills based on gender. This condition is in line with Cheung (2007), Cahk, U'Thay, Kolozenc, and Aytard (2014) studies, which show that there are differences related to students' gender and grades level learning experience. This factual condition is supported by other research in various countries, such as Villafane, Garcia, and Lewis (2014) in the United States, in Hongkong by Cheung (2011), Xu, Villafane, and Lewis (2013) in America, Salta and Tzougraki (2004) in Greece. In conclusion, gender affects the learning experience and scientific attitude. The findings of these studies from several different countries have illustrated the current state of gender-influenced learning experiences. However, studies regarding critical thinking skills and ethnochemistry-based experiences from a gender perspective in Indonesian universities are still rare. Therefore, it is urgent to research and map the factual conditions of ATC, LE, and SE for prospective chemistry teachers in Indonesia in terms of gender and grades level. The research findings could help tracing the factual conditions of critical thinking skills and ethnochemistry-based experiences of chemistry education students simultaneously, which has never been done so far. Furthermore, the benefits of research are: 1) as a basis for planning and implementing chemistry learning to develop critical thinking skills, 2) as a reference in developing ethnochemistry-based learning experiences, 3) improving the quality of chemistry education graduates through developing critical thinking skills and ethnochemistry-based learning experiences. Hence, based on the elaborated information above, This study aims to determine

whether there are differences in critical thinking skills and ethnochemistry-based learning experiences based on gender.

#### II. METHOD

The research approach uses a quantitative approach with the type of survey research using a cross-sectional survey design (Creswell, 2006). The interview technique for collecting research data uses a focus group interview with a structured technique. The focus group interview aims to collect qualitative data that has relevance to the research data from the questionnaire (Ismail & Jarrah, 2019). The use of a cross-sectional survey design has the advantage that it can measure the relationship between two or more variables through the interpretation of the actual research object (Cohen, Manion & Morrison, 2007).

The research samples were taken from two different universities, Mataram State Islamic University and Mataram University, in the chemistry education study program. The number of participants is 200 students. At the survey stage, 130 women and 70 men were determined as samples, which were determined using the cluster random sampling technique. The next research stage is to conduct in-depth interviews with the research sample (Creswell, 2006).

Research data collection was carried out in stages and sequentially through the provision of questionnaires and interviews (Teddie & Tashakkori, 2009). The instrument for measuring critical thinking skills refers to Oliver Hoyo's (2003) rubric with 5 selected indicators, namely (1) analysis, (2) attitudes towards scientific investigations, (3) the application of scientific attitudes, (4) curiosity attitudes, and (5) behavioral tendencies to learn chemistry. The ethnochemistry-based experiential learning instrument used in this study adopted the CAEQ (questionnaire of chemistry attitudes and experiences) developed by Coll, Dalgety, & Saller (2002). The researchers developed it into an ethnochemistry-based CAEQ instrument. Before the instrument used, an expert validation test was performed and an empirical test was completed to measure instrument reliability. Based on statistical tests, Cronbach's alpha coefficient value was  $= .89 > .70$ , which means that the instrument already met the reliability requirements (Hair, Black, Babin, & Anderson, 2006).

Research data analysis activities were carried out in two stages. The first stage of data was obtained from the administration of OHCR and CAEQ questionnaires and analyzed using the Manova test. Prior to the Manova test, the homogeneity prerequisite test was conducted through the Levene test with  $p\text{-value} > 0.05$ , which means the data is homogeneous (Bernard, 2000). Likewise, the results of the normality test obtained  $p\text{-value} > 0.05$  so that the research data were normally distributed. For the multicollinearity test, the VIF value was  $= 0.40$  (there is no multicollinearity). In the second stage, the data from the interviews were compiled and categorized into recurring themes or patterns regarding the qualitative analysis suggested by Patton (2002). The main reason for using the Patton technique was to ensure that the repeated patterns or themes obtained were relevant to the research objectives to support quantitative data from the questionnaire. In addition, the use of the Patton method assisted in identifying the emergence of elements that could not



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# 23 Ethnochemistry-based Adobe Flash Learning Media Using Indigenous Knowledge to Improve Students' Scientific Literacy



## ETHNOCHEMISTRY-BASED ADOBE FLASH LEARNING MEDIA USING INDIGENOUS KNOWLEDGE TO IMPROVE STUDENTS' SCIENTIFIC LITERACY

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### ABSTRACT

This study aims to measure the effectiveness of using ethnochemistry-based Adobe Flash learning media using indigenous knowledge on scientific literacy. The study used a quasi-experimental method. The research subjects were 68 students who used ethnochemistry-based Adobe Flash learning media using indigenous knowledge on secondary metabolite material. The research is a quantitative study with pretest and posttest design. Data in the study were collected through tests to determine students' scientific literacy skills, including aspects of knowledge and competence in analyzing scientific phenomena, connecting chemical concepts to existing phenomena, and interpreting data or scientific evidence and questionnaires. Supporting data was obtained through a questionnaire to determine learning media users' opinions. The test was conducted with ten multiple-choice questions and a questionnaire with ten statements using a Likert scale of 1-4. The data analysis technique calculates the average score of test questions that have criteria according to scientific literacy and the percentage of user satisfaction. Based on the research results, the average value of 81.50 for scientific literacy skills on the concept of secondary metabolites with an N Gain of 80% is in a good category, and it is also known that the average percentage of user satisfaction is 83%, in a good category. Based on the hypothesis testing using the right test, it has a t count of 16,160 and a t table of 2,021. The study concludes that applying ethnochemistry-based Adobe Flash learning media on secondary metabolites is effective for students' scientific literacy. Thus, it could be excluded that interactive media can support students' learning and improve scientific literacy.

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Keywords: ethnochemistry; indigenous knowledge; scientific literacy

### INTRODUCTION

Since the COVID-19 pandemic severely damaged many aspects of human life, including the economy, social, health, and education, the application of learning has opened a new era (Adedoyin & Soykan, 2020; Carrillo & Flores, 2020). The educational aspect has changed in the curriculum and the learning media. The usual offline learning in the classroom or the labo-

ratory has turned into online learning following health protocols. This change eventually resulted in learning methods becoming more integrated with educational technology, such as electronic learning, mobile learning, and Android-based game learning (Saifi et al., 2020; William et al., 2021). Digital technology finally plays a vital role in enabling teachers to teach synchronously or asynchronously with online modes.

In the health aspect, a new phenomenon has emerged where people are trying to return to traditional medicine by utilizing various native

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natural ingredients in various countries (Muhammad, 2020), including Indonesia (Maharani & Fernandes, 2021). This phenomenon shows how important it is for the community to recognize and study natural materials rich in biodiversity in each region. One way to introduce these natural materials is to study indigenous knowledge, which is local people's knowledge, belief, and behavior through scientific understanding (Maz-zochi, 2020). The introduction of different indigenous knowledge in each region is essential for students to protect the culture and wealth of local wisdom for future generations (Parmin & Fibrina, 2019).

The indigenous knowledge approach can also be applied in ethnomedical and ethnochemistry research (Amalia, 2021; Bradley, 2021). Ethnochemistry, part of ethnoscience, is a cultural perspective from a scientific perspective (Dewi et al., 2019) and a specific cultural behavior related to chemistry (Rosa & Clark, 2011). Ethnochemistry and ethnoscience are integrated into educational curricula in various countries with the hope that students can develop new opportunities and innovations in using indigenous knowledge as regional cultural identities (Victor et al., 2016). Previous research on ethnochemistry was conducted to identify the local wisdom of the Sasak tribe in West Lombok (Sutrisno et al., 2020), explore the potential of native Kalimantan herbal medicines for body immunity (Maharani & Fernandes, 2021), and find out the use of the Gwang plant (*Corypha utan Lami*) in East Nusa Tenggara which is commonly used for its seed extract as a fish poisoning by local people it has potential as an anti-cancer drug (Heliawati et al., 2015). The existence of various information in various media today requires students to have the skills to respond, think critically and creatively, and have sufficient knowledge to be mastered through students' scientific literacy skills.

Scientific literacy is an understanding or knowledge of scientific concepts and processes that individuals need, especially when making decisions, contributing in social and economic terms with problem-solving skills (Spitzer & Fraser, 2020; Dewi et al., 2021; Prasetya & Adlan, 2022). According to Woodin et al. (2010), students with good scientific literacy skills will have several characteristics: better understanding of scientific processes and their application in society, competence in communicating and collaborating, skills in interpreting data, and skills in modeling or simulation related to the field of computerization. These student characteristics can be obtained through digital technology such

as multimedia (Ahied et al., 2020; Widodo et al., 2020; Taitingfong & Ullah, 2021; Isaeni et al., 2021).

Multimedia is one of the alternative learning media, especially during a pandemic. It can integrate experimental simulations with interactive animations and videos. The choice of the most supportive software as an alternative to making interactive learning media is Adobe Flash CS 6 (Sheeba & Begum, 2018; Putha et al., 2021). Applications made with Adobe Flash CS 6 have the advantage of presenting animations in motion, images, and sounds like interactive multimedia (Saputro et al., 2018; Siburian et al., 2020). Adobe Flash CS software has all the multimedia elements needed to create an application with simulations that describe natural phenomena and a chemical process so that the concept of ethnochemistry will be easier to understand (Sukariasih et al., 2019). Multimedia from Adobe Flash will increase students' learning interest to support the online chemistry learning process.

Before the pandemic, a practicum on secondary metabolites was carried out in a physical laboratory using an isolation method consisting of extraction, fractionation, and purification. Learning chemistry courses so far is more appropriate through the practicum method because this method requires students to understand the concept and solve the existing problems (Parmin et al., 2017; Hakim et al., 2020). This practicum costs a lot because the tools are not available, and the materials needed are expensive. During the pandemic, natural material chemistry learning faced obstacles when students could not carry out practicum in the laboratory. Based on the preliminary study results, these obstacles cause problems that impact the lack of students' scientific literacy skills by 60% based on the preliminary study results. There is a need for innovation in making interactive multimedia so that learning runs optimally even though it is done online.

Various innovations in digital technology that are developing more rapidly during the pandemic encourage educators to plan innovative and creative learning strategies by choosing suitable media (Maitizra et al., 2021; Krokuska et al., 2021; Lin et al., 2021; Pebriani, 2022). Learning media suitable for the characteristics of secondary metabolites is a virtual laboratory simulation as one of the essential components of the e-learning system (Rowe et al., 2018; Eljack et al., 2020). Digital-based learning media should meet the criteria in the guidelines for technology assessment which include: the quality of objectives and content, relating to the elements of accuracy and suita-



bility of students' conditions, instructional quality, through increased motivation, the nature of instructional flexibility, instructional social quality, quality of tests and assessment evaluations and technical quality which includes aspects of readability, ease of use, and quality of media design (Azhar, 2011; Martin & Betrus, 2019).

This study aims to measure students' scientific literacy skills after using ethnochemistry-based Adobe Flash multimedia in secondary metabolite learning. This material requires presentation with the Adobe Flash program because it can provide the virtual laboratory needed to support successful learning by making it easier for students to learn the material. The criteria for scientific literacy skills in this study were that students could work on ten multiple-choice questions that met the criteria for higher-order thinking. The result of this study is an application of ethnochemistry-based Adobe Flash learning media using indigenous knowledge as an innovation for developing online teaching materials. The ethnochemistry-based Adobe Flash has steps of determining the ethnochemistry concept, built by design, collecting enough material, getting assembly, validation through testing, and distribution as learning media. This application can be accessed through a computer and downloaded via the link shared on the android device.

#### METHODS

This research method is quasi-experimental, referring to Creswell (2009). The research was conducted on several students taking natural materials chemistry courses. The ethnochemistry approach to secondary metabolites was chosen so that students can apply biodiversity as a source of secondary metabolites producing natural compounds in Indonesia, for example, the Gwang plant (*Corypha utata Lamb*) that grows in the savanna of East Nusa Tenggara. This plant is commonly used for fish poisoning by indigenous people in East Nusa Tenggara and can be used for cancer treatment. This study used an experimental group with a particular treatment and a control group that external variables cannot fully control.

The research used a non-equivalent control group design with a pretest-posttest control group design technique (Cohen et al., 2000). Respondents were divided into experimental and control groups. The population in the study was 306 students majoring in chemistry, while the research sample was 68 students from two different

groups. The sampling technique was purposive sampling type. The researcher randomly chose two groups and gave a pretest question to determine the difference between the experimental and control groups in the initial conditions. The pretest results are considered good if there is no significant difference between the experimental and control groups. The test is ten multiple-choice questions oriented to scientific literacy, including the cognitive level of applying (C3) and analyzing (C4). The questions given refer to the following criteria: (1) the provision of data in the form of graphs and articles on the use of Gwang, (2) an analysis of environmental problems related to the use of Gwang as fish poisoning, (3) interactive questions related to environmental issues and traditional local technology in West Lombok. Scientific literacy questions went through validity and reliability tests before being given to students.

The following research stage is treating the experimental group using learning multimedia, made from Adobe Flash based on ethnochemistry using indigenous knowledge material. The conventional learning using the learning media based on Microsoft PowerPoint in the control group. The posttest was given to the experimental group and the control group in the final stage to prove the impact of using multimedia on increasing scientific literacy. The research design is in Table 1.

Table 1. Research Design

Group	Pre-test	Treatment	Post-test
Experimental	O1	X	O2
Control	O3	C	O4

(Cohen et al., 2000)

Experimental Group: O1 (Giving a test before using Adobe Flash multimedia based on ethnochemistry using Indigenous knowledge); O2 (Giving a test after the treatment of ethnochemistry-based Adobe Flash multimedia using Indigenous knowledge); and X (Adobe Flash treatment based on ethnochemistry using Indigenous knowledge). Control Group: O3 (Providing a test before conventional learning); O4 (Giving a test after conventional learning); and C (Conventional learning without special treatment).

Quantitative data were obtained after giving scientific literacy tests and questionnaires to determine students' responses to ethnochemistry-based Adobe Flash multimedia using indigenous

knowledge. This study used a scientific literacy instrument consisting of 10 questions that include four indicators of scientific literacy skills, referring to Chiappetta et al. (1991). The instru-

ment was then processed by giving a scale of 0 for the wrong answer and 1 for the correct answer. The multiple-choice content outline of scientific literacy skills is in Table 2.

Table 2. Indicators of Scientific Literacy Questions

Indicators of Scientific Literacy	Sub-indicator of question
Science as a Body of Knowledge	A picture is presented, and students can determine the right concepts and facts related to ethnochemistry.
Science as Ways of Investigation	Various case examples are given, and students can provide reasons for each answer.
Science as Ways of Thinking	A problem is presented, and students can conclude based on valid information.
Interactions between Science, Technology, and Society	Various cases related to using Gwang plants are given, and students can provide appropriate answers to the context of problems related to indigenous knowledge.

The research data were taken twice at the pretest and posttest. The data was processed by calculating N-Gain and interpreted in several categories. The results are then analyzed as a unified whole in each indicator. The results of N-Gain were analyzed through categorization based on Hake (1999). The categories obtained generally describe the increased scientific literacy after treatment with ethnochemistry-based Adobe Flash using indigenous knowledge. The scientific literacy ability data is then processed by determining the percentage score of the division between the acquisition score and the maximum score in Table 3, referring to Yusuf (2014).

Table 3. Category of Scientific Literacy Percentage

Interpretation (%)	Category
81,26 < X ≤ 100	Very high
71,26 < X ≤ 81,25	High
62,51 < X ≤ 71,25	Moderate
43,76 < X ≤ 62,50	Low
0 < X ≤ 43,75	Very low

Collection of response data of the use of ethnochemistry-based Adobe Flash multimedia using Indigenous knowledge refers to a Likert scale with four alternative answers. A score of 4 means strongly disagree, a score of 3 means disagree, a score of 2 means agree, and a score of 1 means strongly agree. The scientific literacy instrument was tested for validity and reliability before being applied to research. Based on the validity and reliability test, the validity of all instrument items was decided with a reliability coefficient of 0.833. The Cronbach Alpha value

reaches > 0,60, so all items are considered reliable or consistent, and this research instrument is valid (Sujarweni, 2015). The next stage is the normality test of the pretest and posttest scores to determine the normality of the data distribution using the Kolmogorov-Smirnov SPSS version 26.0 test.

The data is normally distributed at the value of  $\alpha = 0.05$  if it is under the provisions of the Asymp. Sig. (2-tailed) > 0.05. If the value shows that it is normally distributed, then the independence sample t-test is performed so that there is evidence of a significant difference between the results of the pretest and posttest. The next step can be decided based on the value results, Sig. (2-tailed)  $p < 0.05$ , which indicated a significant difference between the two. When the value of Sig. (2-tailed) obtained  $p > 0.05$ , then there is no significant difference. The N-Gain test is carried out if the research data is normally distributed.

The effectiveness of using ethnochemistry-based Adobe Flash multimedia using Indigenous knowledge can be seen in the increasing pretest and posttest scores (N-Gain score). Ethnochemistry-based Adobe Flash multimedia using Indigenous knowledge will be declared effective if the N-Gain score is 0.3 in the moderate or high category. Table 4 refers to Hake (1999).

Table 4. N-Gain Category

N Gain (%)	Interpretation
$g \geq 70$	High
$30 \leq g < 70$	Moderate
$g < 30$	Low

**RESULTS AND DISCUSSION**

Experts and lecturers have validated the development of ethnochemistry-based Adobe Flash learning media using indigenous knowledge on secondary metabolite material. Multimedia

is an application that can be downloaded via Android or laptop. This multimedia is divided into three sections: introduction, content, and evaluation. The appearance of the introduction section in multimedia is presented in Figure 1.



Figure 1. Introduction of Ethnochemistry-based Adobe Flash Multimedia (Heliawati, 2021)

The specifications for ethnochemistry-based Adobe Flash learning media compared to printed learning media are in Table 5.

Table 5. Specification Comparison of Ethnochemistry-based Adobe Flash Multimedia using Indigenous knowledge

Aspect	Ethnochemistry-based Adobe Flash Multimedia using Indigenous knowledge	Printed Learning Media
Duration	According to individual learning speed	No duration
Efficiency	Multimedia can be published online or offline as an Android application, CD, word processing, web, or Learning Management System	The cost to print a book is expensive
Flexibility	Multimedia can be used for learning without being limited by place and time	Printed media tends to be cumbersome to carry
Feedback	Exercise with direct feedback can provide learning motivation	There is only one-way feedback and no interaction
Ease of Use	Using multimedia on smartphones or laptops is relatively easy and does not require certain smartphone specifications.	Printed media is hard to obtain, especially during online learning.
Audio Visual	The visualization is fascinating and suitable for use by students with visual and auditory learning types	Less able to meet the needs of students with visual and auditory learning types
Scientific Literacy Learning	The learning is constructivism. Students build their knowledge through virtual laboratories and videos.	The available information tends to be factual.
Learning Evaluation	The evaluation results are immediately obtained at the end of the third part (closing)	Students cannot obtain the results directly

The validation of ethnochemistry-based Adobe Flash multimedia using indigenous knowledge by lecturers includes four aspects: software engineering, audio communication, visual

communication, and presentation materials. The results of the validation carried out are shown in Figure 2.

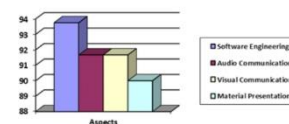


Figure 2. Validation Results of Ethnochemistry-based Multimedia using Indigenous knowledge

In Figure 2, the validity of ethnochemistry-based multimedia using indigenous knowledge from two lecturers as experts has the highest percentage in the software engineering aspect (93.75%), followed by audio communication and visual communication aspects with the same score (91.67%). The lowest aspect (90%) is in the presentation material aspect. The validator generally

considers this multimedia appropriate as teaching materials in universities.

Based on the analysis of student responses regarding ethnochemistry-based multimedia using indigenous knowledge, this media is considered to make an essential contribution as an alternative to chemistry learning on secondary metabolites.

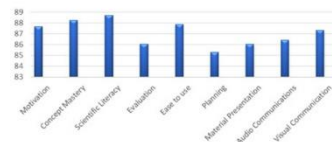


Figure 3. Students' Responses to the Use of Ethnochemistry-based Multimedia

The percentage of students' responses to the use of ethnochemistry-based Adobe Flash learning media using indigenous knowledge in Figure 3 shows an increase in learning motivation (87.68%), with attractively designed teaching media, but still easy to understand so that the evaluation results showed an increase (86.03%). Students can check their level of scientific literacy skills once they have finished working on the questions. Online learning that uses an ethnochemistry approach using indigenous knowledge improves scientific literacy skills (88.69%) and concept mastery of secondary metabolites

(88.24%). In the media aspect, students assume that ethnochemistry-based Adobe Flash multimedia using indigenous knowledge is a learning medium with the selection of a suitable virtual laboratory and video (87.32%). Narrative delivery follows the learning theme (86.40%) so that it is easier for students to plan their learning (85.29%) because the characteristics of this multimedia are easy to use (87.87%). From the research on 22 male and 46 female students in the experimental and control groups, there were differences in the results of the pretest and posttest (Table 6).

Table 6. N-Gain Descriptive Statistical Score

	Experimental Group			Control Group		
	Pretest	Posttest	N-Gain	Pretest	Posttest	N-Gain
Minimum	20	60	-	20	50	-
Maximum	60	100	-	70	100	-
Average	40,29	83,82	0,72	39,71	74,71	0,57

Table 6 shows that the minimum score of students in the experimental group at the pretest was 20, and the posttest was 60. The maximum score at the pretest was 60, and the posttest was 100. This score shows that the average score at the posttest is 83.82, much higher than the average score at the pretest (40.29) and the acquisition of N Gain scores (0.72 in the high category). The difference in the results was also shown in the control group. The minimum and maximum scores at the pretest were almost identical to those in the experimental group (20 and 70). However, the posttest results showed a minimum score of

50 and a maximum of 100. It was accompanied by an N-Gain score (0.57 in the medium category). The difference in N-Gain score between the experimental and control groups was then tested for normality by the Kolmogorov-Smirnov test. The experimental and control score showed the results of the normality test score reaching Sig. 0.200 > 0.05. This result means that the research data is normally distributed. An independent t-test was carried out, as shown in Table 7, to determine the effect of ethnochemistry-based Adobe Flash multimedia using indigenous knowledge, which has significant effectiveness.

Table 7. Results of the Independent T-Test on N-Gain

Levene's Test for Equality of Variances	t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	0.630	0.430	-2.837	66	0.006
Equal variances not assumed			-2.837	64,629	0.006

Table 7 shows that the significance value (Sig) on the Levene Test for Equality of Variances is 0.430 > 0.05, so the variance in the N-Gain data (%) in the experimental group and the control group is homogeneous. Value of Sig. (2-tailed) obtained is 0.006 < 0.05, so there is a significant difference in effectiveness in the treatment with ethnochemistry-based Adobe Flash multimedia

using indigenous knowledge against the control group. The results of the analysis of the provision of scientific literacy-oriented multiple-choice questions during the posttest in the control and the experimental groups obtained different percentages for each scientific literacy indicator, referring to Chiappetta and Fillman (2007) as in Figure 4.

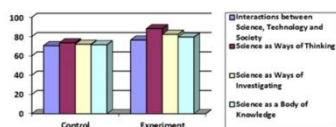


Figure 4. Comparison of Achievement of Scientific Literacy Indicators between Two Groups

The achievement of scientific literacy in Figure 4 shows that the experimental group has a higher average score on all indicators than the control group. On the indicators, Science as Ways of Thinking (88.24%), Science as Ways of Investigating (82.35%), Science as a Body of Knowledge (79.41%), and the lowest indicator is the Interactions between Science, Technology, and Society (76.47%). In the control group, the highest indicator was also obtained in the Science Ways of thinking (73.53%), Science as Ways

of Investigating (72.06%), Science as a Body of Knowledge (71.57%), and the lowest indicator is Interactions between Science, Technology, and Society (70.59%).

The most significant increase in scientific literacy skills was achieved on the Science as Ways of the Thinking indicator. This aspect focuses on thinking, concluding, and reflecting on experiments through simulations in virtual laboratories. This interactive simulation has five instructional design principles, including guided

activities (instruction guides), reflection, direct feedback, freedom to explore, and pre-training (Miyamoto et al., 2019). A virtual laboratory has more advantages than a laboratory practicum on secondary metabolic material because it is a learning media that prioritizes user safety (Kaplan et al., 2021) and high efficiency (Faour et al., 2018; Asrizal et al., 2022).

The Science as a Way of Investigating indicator received the second largest percentage. This indicator is where students can solve problems in the form of scientific literacy questions according to the criteria for higher-order thinking skills in pictures or tables. Students in the experimental group are better able to solve problems related to scientific literacy because, in ethnochemistry-based Adobe Flash multimedia, there is a virtual laboratory simulation of secondary metabolites. This finding is reinforced by previous research on virtual laboratory simulations, which are proven to improve students' scientific literacy, especially in the ability to apply scientific concepts in everyday life (Bortnik et al., 2017; Putri et al., 2021). Students' skills in applying the concept of secondary metabolites using indigenous knowledge will affect their quality of life.

The third-largest percentage is the Science as Body of Knowledge indicator, which includes information, facts, concepts, principles, laws, and theories in ethnochemistry-based Adobe Flash multimedia using indigenous knowledge. Learning materials in the context of indigenous knowledge help students achieve their purposes and more understand real-life scientific principles (Sajja et al., 2022). The material is presented in written or video form that the user quickly understands. Another advantage of using video is that it allows users to watch it repeatedly at an unspecified time (Danjou, 2020). Students can better understand the provided material, so there will be no misconceptions (Ruhmi et al., 2018; Wargadinata et al., 2020). The video about secondary metabolites embedded in this multimedia comes from the Youtube channel, which is proven to present various scientific facts in an informative way (Rosenthal, 2018). After watching the video, students can freely collaborate and express their opinions in scientific discussions (Nidholimbawo et al., 2020).

The lowest percentage is the indicator of Interaction between Science, Technology, and Society. This indicator relates to applying ethnochemistry to secondary metabolites in the context of indigenous knowledge issues in East Nusa Tenggara. Other research by Nisa et al. (2021) revealed that the same thing was caused by the material

regarding ethnochemistry associated with the technology of the people of East Nusa Tenggara, which was not well known by respondents from the local area of West Java. The material about the Gewang plant (*Corypha utan Lamé*), commonly used for fish poisoning by the people in East Nusa Tenggara, has other medical technology benefits such as an anti-cancer or others (Heliawati et al., 2015; Hilaria & Octavia, 2020; Lazarus & Lawa, 2022). It opens students' insight, especially in ethnochemistry, to improve.

## CONCLUSION

The students' scientific literacy skills were significantly obtained in the experimental group compared to the control group. The use of various elements in multimedia, such as virtual laboratory, videos, and interactive questions with direct feedback, has been shown to improve scientific literacy skills on secondary metabolite materials using the indigenous knowledge approach of the people of East Nusa Tenggara. Using ethnochemistry-based Adobe Flash multimedia, learning materials that explore the potential of Gewang (*Corypha utan Lamé*) seed extract as an anti-cancer open students' insight into the importance of recognizing the benefits of various biodiversity in Indonesia. This research is expected to encourage discoveries by utilizing natural ingredients native to Indonesia in health and other fields.

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## 24 Ethnochemistry: Exploring the Potential of Sasak and Java Local Wisdom as a Teaching Materials



### Ethnochemistry: Exploring the Potential of Sasak and Java Local Wisdom as a Teaching Materials

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#### ABSTRACT

The lack of availability of learning resources in the form of teaching materials is one of the problems found in chemistry learning, both in secondary schools and in tertiary institutions, so it is very urgent to develop contextual chemistry teaching materials as an implementation of the ethnochemical approach in learning. The purpose of this study was to explore and develop chemistry teaching materials as learning resources by exploring the potential of local Sasak and Javanese wisdom. This research approach uses a qualitative approach with data collection techniques through literature, interviews, and documentation. The data obtained were analyzed using Miles & Huberman's qualitative analysis. The research subjects consisted of community leaders, chemical content experts, and chemical literature relevant to the research study. Based on the research findings, it can be concluded that Sasak and Javanese local wisdom can be used as a source of chemistry learning through integrating Sasak and Javanese local wisdom with chemical bonding materials and changes in elements, compounds, and mixtures. Thus, the implications of this research can be a source of reference in developing contextual chemistry teaching materials so as to make learning more meaningful.

#### 1. INTRODUCTION

Chemistry learning characteristics include three main aspects: macro, micro, and symbolic. Therefore, chemistry lecturers or teachers have to introduce students to those characteristics through a constructivism-based learning approach. One implementation of a constructivism-based learning approach is through the development of chemistry teaching materials relevant to students' daily lives to create an exciting learning experience (Khan et al., 2017; Wahyudiati et al., 2020). The advantages of constructivism-based teaching materials are students could involve actively in constructing knowledge and learning experiences both physically and mentally as a means of acquiring new knowledge, skills, and experiences (Fadhil, 2019; Hasanah et al., 2016; Said-Ador, 2017; Sumardi et al., 2020; Wahy et al., 2019). The sensory

experiences that stimulate students' knowledge, skills, experiences, and scientific thinking processes must be supported by the availability of constructivism-based chemistry learning resources to achieve positive learning outcomes (Raikou et al., 2017; Wahyudiati & Fitriani, 2021).

The unavailability of constructivism-based chemistry learning resources is one of the problems in chemistry learning. The development of chemistry learning resources causes this problem since it focuses on abstract concepts by providing examples that tend to be theoretical and result in monotonous materials, less factual, and difficult for students to understand (Collins et al., 2018; Sutrisno et al., 2020; Wahyudiati, 2016). To overcome these problems, presenting factual and contextual material through the availability of learning resources in the form of teaching materials and learning media relevant to students' daily lives could be the answer since it is also an ethnochemistry implementation approach in learning. The implementation of ethnochemistry in learning can be through associating chemical concepts related to the local wisdom value and the chemistry practices in everyday life (Duding, 2020; Helawati et al., 2022; Wahyudiati, 2022).

Ethnochemistry is a variety of chemically related cultural practices or community traditions that describe chemistry practice as the study of chemical concepts, practices, or ideas in any culture (Abramova & Green, 2013; Rahmawati et al., 2017). Various ethnochemistry studies employing cultural products as learning resources increased students' conceptual understanding and trained critical thinking skills and had a positive effect on students' scientific attitude skills and human rights (Fadhil, 2020; Sumardi & Wahyudiati, 2021). Therefore, the implementation of ethnochemistry using cultural products as learning resources and natural laboratories is highly suggested.

Conducting this particular research by integrating ethnochemistry learning is one of the best solutions to chemistry learning problems. Various studies showed the integration of ethnochemistry in the curriculum makes the learning process based on cultural heritage context the substance of understanding concepts and scientific investigations based on natural laboratories grounded on local wisdom values (Ajayi et al., 2017; Druker-Ibáñez & Cáceres-Jensen, 2022; Rahmawati & Ridwan, 2017). The novelty of this study was to explore the values of the Sasak and Javanese local wisdom relevant to the chemistry concept so it can be a learning resource and a natural laboratory. Hence, it is expected not only to develop students' cognitive aspects but also to develop affective and psychomotor aspects that are important to the demands of 21<sup>st</sup>-century learning.

#### 2. METHOD

This ethnographic study adopted a qualitative approach. The research subjects involved were community leaders, chemistry content experts, and relevant chemistry literature. The research stages consisted of three stages: description, analysis, and interpretation. The description stage was employed to explore the background of the problem through initial observations and interviews involving community leaders and content experts to obtain information related to the research object. Next, the analysis stage was performed to collect data based on the problem formulation and research objectives through analysis of research findings in the form of Sasak and Javanese local wisdom cultural products and values relevant to the subject of chemical bonds and changes in elements, compounds, and mixtures. The last stage was the interpretation stage; it was conducted to get precise conclusions based on the data analysis.

Data collection techniques utilized were observation, interviews, and documentation based on the data type. Meanwhile, the research instruments used were interview guidelines, observation guidelines, and documentation guidelines. The collected data were analyzed using Spradley's technique which consisted of four analysis steps, namely: (1) domain analysis; (2) taxonomic analysis; (3) componential analysis; and (4) cultural themes analysis. Domain analysis and taxonomic analysis functions were to select and simplify the recorded rough data in observation sheets, interviews, and documentation and discard unnecessary or irrelevant data. After the data were reduced and analyzed, the next step was compiling the data to be more systematic and then looking at its relevance to theories or previous research results (componential analysis and cultural themes). The final stage was concluding the results and findings that answer the research problem formulation.

#### 3. RESULT AND DISCUSSION

##### Result

The local wisdom of the Sasak and Javanese tribes in the *merariq* or *manten* (wedding) tradition has relevance to the concept of chemical bonds, the concept of stable electron configuration, and the concept of positive ions (releasing electrons) and negative ions (accepting electrons). The concept of material change and its transformation in Sasak and Javanese local wisdom is reflected in the use of chemical

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elements from various metals, such as gold, silver, bronze, copper, brass, and different other metals used in the making of the traditional ceremony tools and arts of the *Sasak* and *Javanese* tribes.

### 1. Sorong Serah and Srah-srahan in the Merariq or Manten (Marriage) tradition

Based on the traditional marriage procession (*merariq*) of the *Sasak* or *Javanese mantenan*, it is closely related to electron stability or a stable electron configuration. Also, the concept of positive ions (releasing electrons) and negative ions (receiving electrons) is similar to the tradition of *nenarhi* and *sorong serah*, known as *srah-srahan* in the *Javanese* tribe. The similarities underlie the theory, concept, meaning, and value. For instance, at the *sorong serah* or *srah-srahan* procession, an agreement is made between a woman and a man to get married, either asked by the man or through *Subandar* or *Jarumannya*. The basic concept is mutual need, giving, and acceptance to live together, with a relationship that binds it or through marriage. At the procession, the bride and groom's family meet to determine the *pisuka* (*seserahan*) agreement to be given to the bride, as shown in Figures 1, and Figures 2.



Figure 1. The Procession of Sorong Serah in the Merariq Tradition (*Sasak*)



Figure 2. The Procession of srah-srahan in the Manten Tradition (*Javanese*)

(Source: <https://ejakmedan.com/adat-istiadat-suku-jawa>)

The tendency of an atom to achieve stability is to have a noble gas configuration (stable), either by accepting or donating electrons in its outer shell so that positive ions and negative ions are formed by transferring electrons from one atom to another. For example, the unstable Sodium atom loses one valence electron to become an ion ( $\text{Na}^+$ ) with an electron configuration like neon; The  ${}_{11}\text{Na}$  (2. 8. 1) atom (2. 8. 1)  $\rightarrow$  Ion  ${}_{11}\text{Na}^+$  (2. 8), while the unstable Cl atom gains one electron, resulting in a Cl<sup>-</sup> ion with an electron configuration similar to argon. Atom  ${}_{17}\text{Cl}$  (2. 8. 7)  $\rightarrow$  Ion  ${}_{17}\text{Cl}^-$  (2. 8. 8). These two ions with opposite charges attract each other electrostatically in the ion lattice. The bond formation that occurs through the transfer of electron pairs between Na and Cl atoms is called an ionic bond. This concept is closely related to the *merariq* or *manten* because they are also based on mutual need and complementarity to achieve a goal that unites two individuals and unites two families in a strong bond.

### 2. Banjar Tradition

The term *banjar* in the *Sasak* language dictionary means a village council. The term *banjar* is also defined as a customary group or association of indigenous people whose members consist of residents in a village (*dasan*) or come from several *dasan*, whose membership is based on and has the same goal. *Krama banjar* works more in the *banjar* related to the people's living activities and death procession. The types include *krama banjar subak*, *krama banjar merariq*, *krama banjar mate*, and *krama banjar haji*.

*Banjar* is a social forum used in various traditional ceremonies of community activities that have the characteristics of togetherness and build social solidarity. Specifically, the problems faced by a member of a *banjar* become the problem for all members of the *banjar*. *Banjar* activities in the *Sasak* community are focused more on activities involving the life cycle as an alliance of social solidarity and togetherness in the *Besiru* event, as shown in Figure 3.



Figure 3. Banjar Tradition of *Sasak* Tribe

The concept of local wisdom in the *banjar* tradition is the concept of social solidarity and togetherness, which is closely related to Gilbert Lewis' theory that atoms combine to achieve a more stable electron configuration. Maximum stability is achieved when the atom has the same electron configuration (isoelectronic) as the noble gas electron configuration. So, the theory that underlies the formation of a stable electron configuration by handing over electron pairs to achieve stability has a strong meaning in social concepts such as cooperation, mutual need, promoting unity, and social solidarity to achieve the desired goals.

### 3. The material Concept and its Changes Integrated with *Sasak* and *Javanese* Local Wisdom

The concept of material and its changes integrated with local *Sasak* and *Javanese* wisdom is reflected in the use of chemical elements from various types of metals such as gold, silver, bronze, copper, brass, and various other metals for the manufacture of traditional ceremonial tools and traditional arts. For example, *Sasak* and *Javanese* brides' jewelry is made of gold, silver, and bronze. Compounds and mixtures are widely used in the *Sasak* and *Javanese* people's life; traditional art manufacturing tools such as *gong*, *terumpang*, *kenceng*, and *Javanese gamelan* are made from a combination of two or more metals. The examples of physical changes found in *Sasak* and *Javanese* local wisdom include the coloring of *Sesek* cloth, dyeing *batik* cloth, making *sia* or salt, and the tradition of *belulut* (floor coating of a traditional *Sasak* house with cow dung). Examples of chemical changes are also found in the manufacture of *gule beaq*, *poteng reket* (fermented sticky rice), *poteng ambon* (fermented cassava), *oncom*, *peuyeu*, and *Sesek* and *batik* fabrics coloring.



Figure 4. *Batik* and *Sesek* Fabrics Coloring with Natural Coloring

(Source: [Krjoja.com](http://krjoja.com) and [Mongabay environment news site](http://mongabay.com))

### Discussion

Integrating Basic Chemistry 1 material with *Sasak* and *Javanese* local wisdom as a learning resource can be prepared by implementing a visualization approach called the chemical triangle concept. Implementation of a visualization approach in chemistry learning through integrating the subject matter and its changes with *Sasak* and *Javanese* local wisdom can be found in the use of chemical elements from various types of metals such as gold, silver, bronze, and copper as the basic ingredients for making traditional ceremonial tools and arts traditional *Sasak* and *Javanese* tribes. The current research findings

align with the previous research, which proved that *Sasak* and *Javanese* local wisdom has the potential to be integrated with chemistry materials (Aminudin et al., 2019; Ida Ayu & Ni Made, 2019; Sutrisno et al., 2020; Wahyudiati & Fitriani, 2021). The advantage of the integration is that the learning experience could be more significant and increase students' motivation to learn because it is related to their everyday life experiences. Learning activities that refer to the context of students' lives are the implementation of constructivism learning theory which combines students' initial experiences with new knowledge. Various previous research also showed that students' constructs of knowledge, attitudes, skills, and new experiences would be more significant when associated with prior knowledge in order to increase students' cognitive, affective, and psychomotor abilities (Fadli, 2020; Galloway et al., 2016; Gupte et al., 2021; Sumardi et al., 2020).

Another interesting finding also revealed that the relevance of chemistry material to *Sasak* and *Javanese* local wisdom could be viewed from an analogous approach between domains. An analogy approach is an approach that is based on a close relationship between two different concepts but has a relevant meaning (Aligica & Tarko, 2012; Soetanto & Jack, 2016). The application of an analogous approach between domains in chemistry learning can be seen through integrating everyday life situations experienced by students, which are closely related to the chemistry concept (Rahmawati, 2018; Sutrisno et al., 2020; Wahyudiati & Fitriani, 2021). It can be found in the chemical bonds concept. The *Sasak* and *Javanese* cultures that have similarities to chemical bonding materials are the *merariq* (*Sasak* wedding) and *manten* (*Javanese* wedding) traditions, which consist of the *nenarh* and *sorong serah* processes to the *Sasak* tribe and the *srah-srahan* procession to the *Javanese* tribe. The values of local wisdom that underlie the concept of *merariq* or *manten* are based on mutual needs between men and women who are legalized through marriage bonds to achieve stability which has the same meaning as chemical bonds. The concept of needing each other through the transfer of electron pairs to achieve stability is the concept that underlies the formation of chemical bonds. The formation of ionic bonds through the transfer of electron pairs between positive and negative ions is to achieve a stable electron configuration or resemble the electron configuration of noble gases (Miao et al., 2015). Approaching chemistry learning using analogy has the advantage that it stimulates learning and is significant for students who become more motivated to be involved actively in the learning process. Likewise, other research results proved that implementing an analogous approach to chemistry learning can improve the outcomes (Sutrisno et al., 2020; Xue et al., 2022). In addition, ethnochemistry-based learning makes students more interested in learning chemical concepts since it used to be less exciting and dominated by abstract concepts.

The novelty of the current research is that implementing the ethnochemistry approach is infrequently done. Moreover, combining *Sasak* and *Javanese* local wisdom with chemistry concepts has never been conducted, so the findings of this study are expected to contribute to chemistry learning innovation. In addition, these results are similar to previous related research, that learning chemistry through the provision of concrete examples often experienced in students' daily lives transformed learning to be more fun, engaging, and meaningful. Moreover, they become more motivated to learn and increase their representational abilities in chemistry learning in universities (Osman & Lee, 2014; Santos & Arroto, 2016; Wahyudiati, 2016). In addition, chemistry learning resources integrated with *Sasak* local wisdom significantly affect scientific attitudes and student cognitive achievements (Hikmawati et al., 2021; Wahyudiati et al., 2020). In the end, the implementation of ethnochemistry in learning, either in the form of integration with learning models, as a resource of learning for scientific investigations, or as a natural laboratory, could develop students' critical thinking skills, science process skills, and improve students' cognitive learning outcomes (Said-Ador, 2017; Wahyudiati et al., 2020; Wahyudiati & Fitriani, 2021; Zidny et al., 2020). Thus, exploring the potential of *Sasak* and *Javanese* local wisdom as a resource for learning chemistry can be one of the innovations in chemistry learning and play a role in younger generations appreciating more of their cultures.

#### 4. CONCLUSION

Based on the research findings, it can be concluded that *Sasak* and *Javanese* local wisdom can be used as a resource for learning chemistry by integrating *Sasak* and *Javanese* local wisdom on the subject of chemical bonds and the subject of changes in elements, compounds, and mixtures. The relevance of Basic Chemistry 1 material with *Sasak* and *Javanese* local wisdom was analyzed based on the perspective of analogy, representation, and visualization. All in all, the implications of this research can be a reference in developing contextual chemistry teaching materials to create a more significant learning experience.

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### Implementation of Islamic Education Concept in Ethnochemistry

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#### ABSTRACT

**Article Info:** *The concept of Islamic education requires more than just a theoretical understanding. It concentrates only on Islamic studies because of the difficulties in using a chemical perspective to understand the concepts. Therefore, this study aims to implement an Islamic education concept in ethnochemistry using Sasak traditional wisdom. It uses qualitative methodologies such as observation, in-depth interviews, documentation, and curriculum analysis to obtain data. The results show that ethnochemistry based on the local wisdom of the Sasak tribe has a strong relationship with the Islamic education concept, especially in the merarik (marriage) ceremony. A fundamental part of Islamic education is a belief in the need for mutual respect, cooperation, open debate, and consensus, reciprocal give and take, collaboration, and the necessity for stability. These ideas are also very relevant to the chemical bond theory, which includes concepts such as electron stability, electron configuration, positive and negative ion formation, as well as chemical bond formation. Therefore, ethnochemistry based on Sasak local wisdom can be considered relevant to the Islamic education concept. Acknowledging intellectually and ethically intelligent students is essential to achieving national education goals.*

**Keywords:** Implementation; Islamic Education Concept; Ethnochemistry; Sasak Local Wisdom

#### ABSTRAK

Memahami konsep pendidikan Islam membutuhkan lebih dari sekedar pemahaman teoritis. Namun, kesulitan umum adalah bahwa pemahaman prinsip-prinsip Islam jarang ditangani dari sudut pandang kimia, sehingga konsep pendidikan Islam hanya berfokus pada bidang studi Islam. Tujuan dari penelitian ini adalah untuk melihat bagaimana konsep pendidikan Islam diimplementasikan dalam etnokimia dengan menggunakan kearifan adat Sasak. Penelitian ini menggunakan metodologi penelitian kualitatif seperti observasi, wawancara mendalam, dokumentasi, dan analisis kurikulum untuk memperoleh data. Hasil penelitian ini menyoroti fakta menarik yaitu etnokimia yang berbasis pada kearifan lokal suku Sasak memiliki kaitan yang kuat dengan konsep pendidikan Islam, khususnya dalam upacara merarik (pernikahan). Saling menghargai, gotong royong, debat dan muafakat, saling memberi dan menerima, kerjasama, saling menghormati, dan konsep saling membutuhkan untuk membangun stabilitas, yang merupakan konsep inti dalam pendidikan Islam, termasuk di antara prinsip-prinsip sosial, moral, dan spiritual yang ditemukan dalam tradisi uduian. Ide-ide ini juga sangat relevan dengan teori ikatan kimia, yang mencakup konsep-konsep seperti stabilitas elektron, konfigurasi elektron, ion positif dan negatif, dan teori pembentukan ikatan kimia, sehingga

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etnokimia berbasis kearifan lokal Sasak dapat disimpulkan relevan dengan konsep pendidikan Islam. Sebagai bagian dari pencapaian tujuan pendidikan nasional, perlu dikenal peserta didik yang tidak hanya cerdas secara intelektual, tetapi juga cerdas secara moral, sosial, dan spiritual.  
**Kata-kata Kunci:** Implementasi; Konsep Pendidikan Islam; Etnokimia; Kearifan Lokal Sasak

### 1. INTRODUCTION

Ethnochemistry is studying or applying a chemical concept in a tradition or culture (Singh & Chibuye, 2016). It refers to individuals in the community environment identified through cultural traditions, symbols, codes, products, and myths to consider and conclude a concept (Rosa & Clark, 2011). As a result, using cultural goods as learning materials is quite feasible as one implementation of contextual learning that refers to students' everyday life activities, making the concept taught easier to understand. The previous study showed that implementing this concept in learning activities affects students' cognitive, affective, and psychomotor learning outcomes (Sumardi & Wahyudiati, 2021; Sutrisno et al., 2020). However, the utilization of cultural artifacts as learning tools is still uncommon, hence, learning objectives are not met properly (Sumardi et al., 2020; Wahyudiati et al., 2019).

Educators could enhance learning outcomes by focusing more on cognitive development and less on emotional and psychomotor factors, often neglected. Cognitive, affective, and psychomotor aspects can be developed through integrating Islamic aspects, local wisdom, as well as moral and spiritual values in teaching chemistry and carrying out learning or practicum activities to optimally achieve learning outcomes (Fadli & Irwanto, 2020; Sungkharat et al., 2010; Villafañe & Lewis, 2016; Wahyudiati, 2016). Efforts can be made to integrate Islamic aspects, local wisdom, as well as moral and spiritual values through the implementation of ethnochemistry based on Sasak local wisdom (Sumardi & Wahyudiati, 2021; Sutrisno et al., 2020).

The implementation is one form of integrating Islamic education concepts with local wisdom, moral, and spiritual values as learning objectives. However, due to a division between science and religion, investigations integrating the scientific method with Islamic educational practices are still rare (Fadli, 2018). The lack of integration impacts the low achievement of affective learning outcomes or attitudes, which is reflected in the lack of development of students' moral, social, and spiritual values (Wahyudiati, 2021). This problem is very relevant to the previous study, which proves that integrating science and technology with Islamic religious education can make the learning more meaningful and easily understood (Chanifudin & Nuriyati, 2020). Related problems are still limited to the integration with the

science field in general, and the integration of an Islamic concept with a chemical concept has not been conducted using an ethnochemical approach. Therefore, this study is critical to be carried out as a first step to examining the integration, interconnection, and internalization between various disciplines, such as the integration of chemistry, social science, religion, and culture in the curriculum.

The Sasak Lombok tribe has diverse cultures, traditions, local languages, and religious ceremonies. The diversity of customs is manifested in patterns of thought, behavior, and attitudes that contain noble cultural, wisdom, moral, social, and spiritual values in the implementation of Islamic education (Fadli, 2018; Sumardi & Wahyudiati, 2021; Suprpto, 2017). According to Imam Al-Ghazali, studying science is a form of worship to Allah SWT as a means of forming *akhlakul karimah* (noble characters) (Fadli, 2018). Islamic education aims to deliver students to achieve happiness in the world and the hereafter (Musrifah, 2016).

One value of local wisdom, which is also a manifestation of the local Islamic wisdom in the Sasak tribe, is the *merarik* tradition with a series of events such as *nenarikh* (ask), *sorong serah ajikrame* (family consultation), *nyongkolan* (visit to women's houses), and *begawe* (traditional party). The values contained in Sasak local wisdom include cooperation, mutual sharing, mutual respect, mutual give and take, as well as the responsibility to achieve peace and happiness.

Sasak tribal values, such as local and local Islamic knowledge, are closely related to the chemical bond theory as an ethnochemical application of the Islamic education concept (Sutrisno et al., 2020). Therefore, this study aims to examine the relevance of chemical bond theory to the Islamic education concept based on the concepts of ionic bond formation, positive and negative ion formation, as well as electron pair transfer to achieve stability. It is critical to be carried out as a first step to examining the integration, interconnection, and internalization between various disciplines such as science, social studies, religion, and culture in the curriculum. Therefore, future generations of students will be academically, ethically, socially, and spiritually intelligent due to contextual learning in the curriculum.

## 2. METHOD

This study uses a descriptive qualitative approach to obtain data from written words and observable individual or community behavior supported by literature studies (Sutrisno et al., 2020). Data collection techniques used are observation, in-depth interviews, and documentation studies. Furthermore, the three instruments used are (1) observation sheets for collecting data related to cultural products or traditions of the Sasak people that have relevance to chemistry and Islamic education concepts; (2) guidelines as a guide in conducting interviews with respondents to

strengthen the data from the observations; and (3) documentation for collecting data sourced from the scientific literature that discusses the chemistry concept, Sasak culture, and Islamic education in the form of books, articles, and documents. Data collection activities explore local Sasak wisdom by referring to the ethnochemical approach. The literature studies carried out are to (a) investigate the relevance of Sasak local wisdom values to the chemical concept through an ethnochemical approach, (b) examine the relevance of Sasak local wisdom-based ethnochemistry with the Islamic education concept, and (c) analyze various previous studies as a reference source. Subsequently, Miles & Huberman's analysis technique, including reduction, presentation, and the conclusion was used to analyze data (Creswell, 2014).

## 3. RESULTS AND DISCUSSION

### a. The Merarik (marriage) Tradition of the Sasak Lombok Tribe

Some cultures and customs of the Sasak tribe have meanings or are analogous to the concept of chemical bonds, such as an ionic bond formation, positive and negative ion formation, and electron pair transfer to achieve stability (Fadli, 2018). The *merarik* (marriage) tradition in the Sasak community consists of *memaling* (a woman is brought to be married) and *belako* (asking for a woman to be married) (Budiwanti, 2000).

The order of marriage customs and ceremonies is as follows: 1) *Nenarikh* or *beketaan* (ask), the question of whether or not a man and a woman are ready to get married should be asked at this point. Such questions are asked directly by the man or their *subandar* or *jerumannya* called *Nenarikh*. 2) *Sebo* or hide when a lady is taken from her home, she is placed in the care of family or friends who will keep her concealed from prying eyes. In these conditions, the woman and her future husband are bound by customary rules, such as not being seen by the woman's family, and will get deosan or customary sanctions in the form of fines when violated. 3) *Sejati*, after the woman is successfully brought, people perform *sejati* one or two days later. The tradition is to tell the parents or bride that a man has brought their child, and this notification is made by two men wearing traditional clothes. 4) *Selabor*, this tradition is the stage of marriage after *sejati*. It is carried out by a *pembayun* whose job is to talk about the amount of dowry, *aji adat*, *aji krama*, and other traditional rituals. 5) *Sorong serah* is the tradition of handing over all fees carried out in a ceremony. This ritual is performed before the prospective husband and wife signing the Islamic marriage contract. This is meant to prevent future issues after receiving guardianship and without paying the standard fee. Muslims are permitted to wed as soon as their *sorong serah* rite is

complete. 6) *Nyongkolan*, this tradition comes from the word *songkol* or *nyondol*, which means to accompany. In this context, accompanying implies following the couple to keep in touch with the bride's family after the wedding. The man's family carries out *Nyongkolan* to meet with the woman's family, accompanied by traditional Sasak music such as *Gamelan Beleq*, *Kecimol*, *Tawak-Tawak*, and *Kedadak*. The purpose is to ask for the blessing of the woman's family as a sign that their daughter has been officially brought by her husband.

*Merarik* (marriage) can integrate the chemical bond concept and the Sasak local wisdom values. The ethnochemical method can be used in education by incorporating a chemical concept into the local culture. Ethnochemistry is the application of a chemical concept or practice with a chemically related tradition or culture identified in a society's tradition or culture. One implementation of this approach in learning can be carried out through culture integrated with the chemical concept in the form of learning resources. The previous study stated that ethnochemistry-based learning resources could be in the form of textbooks, reference books, and practical instructions and act as natural laboratories (Singh & Chibuye, 2016).

The use of cultural products as learning resources is one implementation of contextual learning that refers to the daily life activities of students. The previous study stated that implementing ethnochemistry in learning activities affects students' cognitive, affective, and psychomotor learning outcomes (Sumardi & Wahyudiati, 2021; Sutrisno et al., 2020). Furthermore, a chemical concept can be combined with Sasak local wisdom and the Islamic education concept. The electron pair handover concept to achieve stability or perfection relates to the Islamic education. According to Al-Ghazali's concept of thought, the success of education will be realized through the formation of human beings who have good morals, hence happiness can be achieved in this world and the hereafter (Djnelani, 2013). Furthermore, the heart is the most crucial part of a creature that focuses on developing noble character (*akhlakul karimah*). The reflection of *akhlakul karimah* is identified through cooperation, respect, tolerance, and give and take to achieve mutual prosperity (Fadli, 2017).

#### b. Analyzing the Implementation of Islamic Education Concept in Ethnochemistry Based on Sasak Local Wisdom

The processions relevant to the ionic bond formation theory are *nenarih*, *sorong serah*, and *nyongkolan*. In the Sasak community, marriage is the primary condition for obtaining rights and obligations in a relative group, such as the right to inherit. It also denotes uniting two prominent families, the man's and the woman's relatives.

The relationship between the *merarik* tradition and the ionic bond formation is analogous (with the same meaning) with *nenarih*. *Nenarih* is a tradition of asking for a woman's willingness to be ready for marriage. This is asked directly by the prospective groom or representatives known as *subandar* or *jerumannya* (Wahyudiati, 2020). The underlying similarity is based on the concepts of needs and give and take, hence stability is realized through unification in the marriage bond (Fadli, 2018). In the theory of ionic bond formation, the underlying concept is the transfer of electron pairs between positive and negative ions. As a result, a stable electron configuration of noble gases or group VIII A is formed (Prasetiawan, 2009) through the transfer of the electron pair to achieve stability (Morgong, 1988).

There is a tendency for an atom to reach stability by bonding with another (Achamad, 2001) to achieve a noble gas configuration. This is achieved by releasing or giving electrons in their outer shell to form positive or negative ions (Achamad, 2001). The concept of handing over electron pairs to achieve stability has relevance to the concept of Islamic education. The primary purpose is under Al-Ghazali's concept of thought, which emphasizes that the success of education will be realized through the formation of human beings who have good morals (Djaelani, 2013; Fadli, 2017). Furthermore, the primary key in education is the heart which is the most critical essence of a creature. Hence the concept is more directed or focused on the formation of noble character. The reflection is identified through mutual help, tolerance, and giving and receiving to achieve mutual prosperity (Fadli, 2017). The concept of ionic bond formation is closely related to the mutual need to attain stability through reciprocal give-and-take, founded on the principle of complementarity. It occurs through the transfer of electron pairs to achieve stability (Sutrisno et al., 2020), such as between sodium and chlorine atoms. Sodium atom (Na) achieves stability by releasing one valence electron to form an ion ( $\text{Na}^+$ ) with a configuration like neon; the  ${}_{11}\text{Na}$  (2. 8. 1) atom becomes  ${}_{11}\text{Na}^+$  (2. 8). Likewise, the unstable chlorine (Cl) atom receives an additional electron from the  $\text{Na}^+$  ion to form a  $\text{Cl}^-$  ion and achieve the configuration of argon, hence  ${}_{17}\text{Cl}$  (2. 8. 7) atom becomes  ${}_{17}\text{Cl}^-$  (2. 8. 8) ion. Electrostatically,  $\text{Na}^+$  and  $\text{Cl}^-$  attract each in the ion lattice because they have opposite charges called ionic bonds.

Metallic bonding also relates to the tradition of attracting the Sasak tribe of Lombok. These bonds are formed because of the attraction between the positive charges possessed by metal ions and electrons' negative charges (Wahyudiati, 2021). The relevance of metal ties with the *nenarih* and *sorong serah* traditions includes the handover of responsibilities based on the need to accept each other's strengths and weaknesses (Sutrisno et al., 2020). In this elopement custom, the

bride-to-be is not immediately returned to the groom's home, but instead is concealed with a close family member or friend, therefore this tradition is known as *te ta sebo'* or hidden.

The process of ionic bond formation through interactions between two or more atoms is accompanied by energy expenditure. The concept has a relevant meaning or is analogous to the tradition of *sorong serah* (handover from the woman to the man) and *aji krama*, known as *krama gubuk*. The *aji krama gubuk* is the handover of standard fees with a certain amount agreed through the *sorong serah aji krama* ceremony. The amount of customary payment is usually in the form of money or jewelry according to the request of the bride's family. Molecules and compounds are created when two or more elements contact chemically and form a cohesive chemical bonding unit (Achamad, 2001). The meaning contained in the *sorong serah* concept is relevant to implementing the Islamic education. The book Ihya Ulum Ad-Din, as one of the greatest works of Imam Al-Ghazali, explains that the method of forming morality (*akhlakul karimah*) can be performed through the application of two methods (Ainiyah, 2013; Fadli, 2017; Musrifah, 2016), namely; 1) *riyadah* or habituation, which is to get students to practice or implement good and noble character while interacting with their environment and when worshipping God Almighty; and 2) experience or *at-tajribah*, namely providing examples from teachers, making friends with people with good morals, and taking lessons through direct interaction with the community.

The *nyongkolan* has relevant meanings or is analogous to the concept of ionic bond formation. This is based on the principles of tolerance, cooperation, and mutual help because they complement each other and need to achieve stability or prosperity. Ionic bonds occur between positive and negative ions to form molecules or compounds between metallic and nonmetallic elements (Chang, 2004). This *nyongkolan* tradition emphasizes the principle of tolerance or mutual respect, cooperation, and help. It strengthens the relationship between the family of the woman and the groom (Budiwanti, 2000; Fadli, 2018). The meaning contained in the *nyongkolan* concept has relevance to implementing the Islamic education guided by moral education. The formation of noble character can be pursued through habituation and example obtained by students in social life (Djaelani, 2013). This is achieved through local cultural wisdom and spiritual values such as the principles of cooperation, kinship, cooperation, and tolerance. The concept of Islamic education places great importance on the development of moral and spiritual aspects. Therefore, good human beings are formed by implementing divine values or religiosity in every aspect of life.

The growth and development of moral and spiritual values are manifested in Chemistry, Physics, Biology, Citizenship Education, Social Studies, History, Islamic Religious Education, Arabic, Nahu, and Fiqh. This is relevant to implementing the educational concept proposed by Imam Al-Ghazali, which has characteristics through the development of student interests and talents. The implementation focuses on developing cognitive or knowledge values and prioritizes the development of moral, social, and spiritual aspects (Fadli, 2017; Musrifah, 2016; Subur, 2016; Rasmun, 2019). Meanwhile, the context of the approaches and methods applied in Islamic education places more emphasis on acquiring concepts through the habituation and experience of students as well as educators acting as the person in charge and guiding all learning activities. Spiritually intelligent students can be identified through learning activities accompanied by constructing knowledge and developing morality, social values, mental and spiritual skills. Therefore, the learning objectives, which are the mandate of the 1945 Constitution, can be achieved maximally.

#### 4. CONCLUSION

Customs as local wisdom of the Sasak Lombok tribe with relevance (analog) to the theory of ionic bond formation are the *merarik* (marriage) tradition which consists of *nenarib*, *sorong serah aji krama* and *nyongkolan*. The chemical bond theory, which has relevance to the Islamic education concept, is analyzed based on electron configuration, handing over electron pairs to achieve a stable electron configuration (similar to a noble gas) through the formation of negative ions and positive ions, energy expenditure, as well as the formation of ionic bonds and metallic bonds. Ethnochemistry based on local Sasak knowledge should embrace this concept of collaboration, responsibility, mutual need, respect, reciprocal giving and receiving, deliberation, and consensus to achieve national educational goals. This concept is crucial for helping students see themselves as moral, social, intellectual, and spiritually intelligent human beings. Students' cognitive, emotional, and psychomotor results may be improved when an ethnochemical approach to learning is implemented.

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# 26 Ethnochemistry: Analysis Relevance Of Cultural “Pacu Jalur” In Chemical Materials As Learning Sources



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## Ethnochemistry: Analysis Relevance Of Cultural “Pacu Jalur” In Chemical Materials As Learning Sources

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### Abstract

*Explanation of chemistry that only focuses on concepts makes students have difficulty understanding the material. So there must be an integration of chemical material with the daily lives of students to better understand the material. The purpose of this study was to analyze the relationship between culture of “pacu jalur” and chemistry for learning sources. This type of research is an ethnographic research. Data collection techniques are observation, interviews, and documentation. The data obtained were analyzed using a qualitative analysis technique which is a combination of the Miles & Huberman model. Based on the results of the study, it was found that the form of cultural of “pacu jalur” relevance with chemical materials can be implemented into 4 subjects reaction rate, elemental chemistry, atomic structure of the periodic system of elements, and chemical bonds.*

*Keywords: Culture, Ethnochemistry, Pacu Jalur.*

### 1. Introduction

Facing progress in the era of globalization, graduates from a university chemistry education must develop a comprehensive attitude and psychomotor with knowledge (microscopic, macroscopic, and symbolic) [1]. Relevant research proves that many educators have difficulty integrating chemistry learning in learning so that students have difficulty understanding chemical concepts which have an impact on student learning outcomes [1][2]. Referring to these problems, lecturers are expected to be able to apply chemistry learning that is supported by chemistry learning resources that are integrated with students' daily lives and experiences so that the objectives of chemistry learning can be achieved optimally through constructivism-based learning practices.

Constructivism-based learning equipped with learning resources that are relevant to the daily lives of students will make learning more meaningful. In addition, the essence of constructivism learning theory is that the knowledge and experience gained by students is the result of construction that has been carried out through the active involvement of students, both physically and mentally to gain new knowledge and experiences [3][4][5]. This knowledge and experience is obtained through sensory experience, both listening, observing, carrying out motor activities, scientific thinking processes, and finally formulating it in the mind as knowledge [6][7][8]. The principle of learning based on constructivism is very relevant to Vygotsky's theory of cognitive development which emphasizes the organization of classroom situations, the application of strategies, and the

interaction between educators and students, as well as the importance of the influence of the social environment on the development of students' [4][9]. The intended social environment can be in the form of objects and symbols of culture, social institutions, and language. Symbols produced by culture help students to think, communicate, and solve problems to adapt their own thinking processes [4][5][10]. Therefore, through the application of constructivism-based learning (active and innovative learning models) equipped with learning resources that are integrated with local wisdom, it is hoped that it can activate students in constructing new knowledge through scientific thinking processes and involving problem solving skills so as to be able to develop aspects of cognitive, affective, and psychomotor students. However, the development of chemistry learning resources that are integrated with local wisdom is still very rarely carried out, moreover the currently available learning resources are still focused on abstract concepts without being integrated with the daily experiences of students so that chemistry material is still the most difficult material for students to understand, students at every level of education [11]. Thus, one of the efforts that can be made to make it easier for students to understand chemical material is through the availability of learning resources that are relevant to the daily lives of students, one of which is by integrating chemical material with local wisdom of an area which is the application of ethnochemistry.

The problem in learning chemistry lies not only in the low understanding of students' concepts, but also the limited resources for learning chemistry that are contextual and relevant to the daily lives of

students, one of which is ethnochemistry-based learning resources. It is possible to integrate chemical materials with local wisdom by providing examples of chemical concepts that are integrated with cultural products, as well as through the use of cultural products as natural laboratories [12][13].

Ethnochemistry is a variety of cultural practices that exist in society and are chemically related which describes the chemical practices of cultural groups that can be identified as the study of chemical ideas that can be found in any culture [14][15]. In other words, ethno refers to members of a community group in any cultural environment that can be identified through cultural traditions, codes, symbols, myths, and certain ways that are used to consider and conclude. Various previous studies that applied ethnochemistry in learning through the use of cultural products showed positive results such as the results of research conducted by using cultural products as a learning resource which had an impact on increasing students' cognitive learning outcomes, affecting students' scientific attitudes, and human rights [14][15][16]. However, based on the results of the study, it shows that the integration of culture in chemistry learning and practicum is still very rarely done [16].

Other chemistry learning problems are also reinforced by the era of globalization which greatly affects the personality of students, which is marked by the erosion of cultural values and local wisdom which is a sign of a threat to the fading of Indonesian national identity. In addition, the impact of the globalization era has also led to the emergence of behavioral deviations, as well as a lack of cultural-based learning guidance [17][18]. Therefore, it is very urgent to apply ethnochemistry in learning through the use of cultural products and the surrounding environment as learning resources and natural laboratories. However, current factual conditions show that the integration of ethnochemistry with curriculum, learning tools and in the preparation of teaching materials is still very rarely done [19], and research results show that the trend of research in the field of chemistry from 2004-2013 that raised local culture into a study was only 1.7% [5].

Moreover, the factual problem that occurs is the availability of chemistry teaching materials that are integrated with local wisdom in the Basic Chemistry course. The advantages of ethnochemical-based chemistry teaching materials can make it easier for students to understand chemical concepts because they are directly related to students' daily experiences which are the implementation of constructivism learning theory. Constructivism learning theory has the essence that

the construct of knowledge and experience obtained is a combination of the results of the construction of old knowledge and experience obtained with new knowledge that is being experienced so as to be able to develop the cognitive and psychomotor abilities of students [3][4][12]. Likewise, the results of relevant research also prove that the learning process refers to the context of students' lives with cultural heritage (local wisdom values) as a substance in understanding chemistry, a reference in developing aspects of attitudes and skills, as well as a reference in conducting laboratory-based scientific investigations. Nature can improve students' cognitive, affective, and psychomotor learning outcomes [20].

The Pacu Jalur tradition or known as a boat race is a form of tradition that has long been preserved by the people of Rantau Kuantan. Pacu Jalur is not just a speed race between one boat and another, but is also a tradition that has been ingrained and rooted among the people of Rantau Kuantan, who carry out the tradition of Rantau Kuantan Pacu Jalur, which each boat is piloted by about 60 people, is as old as other traditions of the Rantau Kuantan community such as silat, batobo, randai, rarak, and kayah, which are involved with students on a daily basis [21]. Thus, research is very urgent to be carried out to be a solution to the problem of not achieving the objectives of learning chemistry optimally because there are not enough chemistry learning resources that are relevant to the context of students' lives.

### 2. Research Methods

The approach used in this research is a naturalistic/qualitative approach with an ethnographic type of research. The research stages of ethnography consist of the description stage, the analysis stage, and the interpretation stage. Data collection techniques used in this research are observation, interview, and documentation techniques. The use of these techniques is based on the type of data taken. In analyzing the data, the researcher used qualitative data analysis techniques combined with the Miles & Huberman and Spradley models. The use of this technique is based on its suitability with the type of data to be analyzed, namely data collected by observation, interview, and documentation techniques. Techniques for analyzing ethnographic research data [22] there are four analyses, namely: (1) domain analysis; (2) taxonomic analysis; (3) componential analysis; and (4) analysis of cultural themes. Based on the analysis model that has been determined, the stages of data analysis carried out by researchers are as follows; after the data is collected, the researcher performs data reduction. At this data reduction stage, the researcher selects, simplifies, or sorts the rough data that has been

collected or recorded in observation and interview sheets, as well as discarding unnecessary data. The data is then sorted and grouped by type. After the data is reduced, the researcher then arranges the data into a systematic arrangement and then analyzes it by consulting it with relevant theories and previous research results.

### 3. Results and Discussions

#### Results

Based on the research findings, it is proven that the spur of the track consists of cultural products and local wisdom values that have a strong relevance to chemistry material that can be used as a source of chemistry learning. Chemical concepts can be integrated with track culture that is viewed from the perspective of analogy, representation, appreciation, visualization, and interpretation so that it can make it easier for students to understand chemical concepts by using culture as a learning resource. The implementation of an analogous perspective between domains in chemical learning based on boat race can be applied to chemical bonding materials. The spur culture that has relevance to the chemical bonding material is the opening of the Boat Race.



Figure 1. Boat Race Opening Ceremony

The opening of the Boat Race as shown in Figure 1 includes a carano worship dance and an umbrella dance. The cultural values of the spur of the line that underlie the concept of chemistry in this opening are the handover of betel nut to guests from the host through offering dancers. The concept of handover of betel nut is in line with the theory of ionic bonding, namely the handing over of electron pairs to achieve stability [23]. An example of an ionic bond that is easily found in the daily life of students is NaCl. The formation of NaCl compounds through the transfer of electrons, namely the sodium atom loses a valence electron to form a  $\text{Na}^+$  ion and a chlorine atom accepts an electron to form a  $\text{Cl}^-$  ion.

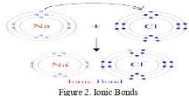


Figure 2. Ionic Bonds

The culture of boat race begins with designing the boat and then heating it over a fire. It aims to make Boat stronger, better and lighten Boat. This heating process is relevant to the chemical material, namely chemistry and its changes. Wood is an object that has a hard texture and is included as an example of an organic object. When wood is burned, there will be a chemical reaction that produces a reaction of  $\text{H}_2\text{O}$  and  $\text{CO}_2$ . The reaction will be formed if it runs perfectly. If not, it will form residual substances such as charcoal [23].

The Boat that has been completed through the heating stage will be larger than the initial state. This will make it easier for athletes to sit on the track in competition. The larger the track size, the more athletes that can participate. This is relevant to the periodic system of elements where as the atomic number increases, the size of the atomic radius also increases [23]. Some Boat sizes can be seen in Figure 3.



Figure 3. Other "Jalur" sizes

The relevance of the chemicals to this tradition of boat racing is also apparent at night after the boat race finishes. Randai art is played by the community by dancing in a circle. This is closely related to the atomic radius, where there are electrons that move around it. The relevance can be seen in Figure 4.

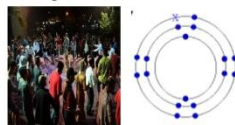


Figure 4. Relevance Of The Chemicals And Randai Art

The chemical elements involved in the implementation of spur culture are numerous. For example, in water there is a bond between the elements H and O. The bond that occurs is a covalent bond [23]. To add value to the Boat art must be added point. The carvings and Boat names used are in accordance with the results of the meeting. Don't forget to also give the Lane the name, date it was made, and the name of the village

as an identifier for the route. If the entire process has been completed, then the Boat is ready to be raced. The new painting is carried out when the motif or color of the paint after obtaining approval according to the results of the meeting, means that the value contained is the value of deliberation. The chemical elements involved include calcium carbonate ( $\text{CaCO}_3$ ), titanium dioxide ( $\text{TiO}_2$ ), PVAC (Poly Vinyl Acrylic), kaolin, pigment, and water [24]. The process of painting the boat can be seen in Figure 5.



Figure 5. painting the boat

In the competing, each athlete is given their own rower. The strength of the power and the number of paddles will determine the speed of the boat. This is in line with the concept of reaction rate where based on collision theory, the more collisions that occur, the faster the reaction rate [23]. Rower path can be seen in Figure 6.



Figure 6. The process of rowing boat

#### Discussion

The analogy approach can explain a comparative relationship which refers to the relationship between two different concepts, but has a relevant meaning. The application of an analogous approach between domains in chemistry learning can be done by integrating everyday life situations that have relevance to the concept of chemistry [25]. The results of relevant research prove that students who have high motivation will be more active in doing assignments and constructing knowledge so that it has a positive impact on learning outcomes obtained [2][14]. The motivation and high curiosity of students are one of the important factors that influence the success of science learning to be more effective and meaningful [7]. Giving real examples in everyday life makes learning more interesting and meaningful so that it can develop students' representational abilities in learning chemistry in universities [26].

The findings of the research prove that spur-of-the-moment culture has a very relevant potential to be integrated with basic chemical materials, namely matter and its changes, atomic structure, periodic system of elements, elemental chemistry and chemical bonds, motivation, and activeness of students in understanding Chemistry material that has relevance to students' daily lives so that learning becomes more meaningful. The meaning of learning is realized by integrating chemical concepts with the values of local wisdom of the community which factually in their daily activities apply chemical concepts. The constructs of new knowledge and experience gained by students will be more meaningful when associated with the old knowledge and experiences they have experienced so that they have a positive effect on increasing students' cognitive, affective, and psychomotor abilities [27][28]. One example is the formation of ionic bonds through the transfer of electron pairs between positive and negative ions to achieve a stable electron configuration or resemble the electron configuration of noble gases [29][30].

The advantages of applying analogies in learning make learning more meaningful so that learning becomes more fun and students are more motivated to be actively involved in the learning process. The application of an analogous approach in chemistry learning makes learning more interesting and meaningful so that it can improve chemistry learning outcomes [30]. The findings of this study are strengthened by previous research which proves that ethnochemistry-based learning processes or activities have an effect on improving learning outcomes, scientific attitudes, and students' science process skills [31]. Chemistry learning activities that are supported by the availability of ethnochemistry-based chemistry learning resources refer to the context of students' lives which are local wisdom values that have relevance to chemical concepts can be used as supporting learning resources and references in conducting scientific investigations. Likewise, various relevant research results also show that the implementation of ethnochemistry in learning, whether in the form of integration with learning models, integration with learning strategies, or as a source of learning and scientific investigation can develop scientific attitudes, critical thinking skills, scientific process skills, and improve cognitive learning outcomes of learners [20].

#### 4. Conclusion

The relevance of chemistry material with the culture of the "pacu jalur" is viewed from the perspective of analogy, representation, appreciation, visualization and interpretation. Culture of the "Pacu jalur" as a source of learning chemistry is found in 4 materials, including reaction



rates, elemental chemistry, atomic structure of the periodic system of elements, and chemical bonds. Teaching materials for Integrated Chemistry and culture as a source of learning chemistry based on ethnochemistry and relevant to the daily lives of students so that it affects the improvement of students' cognitive learning outcomes.

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# 27 The Relationship of Ethnochemistry Learning Experience with Students Scientific Attitudes based on Gender Perspective

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## The Relationship of Ethnochemistry Learning Experience with Students Scientific Attitudes based on Gender Perspective

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**Abstract**-This study aims to analyze the relationship between the ethnochemistry learning experience and students' scientific attitudes from a gender perspective. This quantitative research adopted a survey design. It involved 60 chemistry education students (40 female and 20 male) as the research samples and was determined through the cluster random sampling technique. The data collection instrument adopted the CAEQ questionnaire. The collected data were then analyzed by multiple regression test at a significance level of 0.05. The results presented: 1) The scientific attitude of prospective chemistry teachers was higher than the ethnochemistry-based learning experience; 2) there was a significant relationship between the ethnochemistry learning experience with the scientific attitude of students from a gender perspective

**Index Terms**- ethnochemistry, learning experience, student's scientific attitudes, gender

### I. INTRODUCTION

Chemistry learning in higher education refers to 3 main domains: cognitive, affective, and psychomotor. These aspects align with 21st-century learning objectives in the era of the industrial revolution 4.0. The 21st-century skills components cover critical thinking, communication & collaboration, problem-solving, creative thinking, and scientific attitudes (Syafrial et al., 2022; Wahyudiati, 2022). Concerning scientific attitudes, this is individual behavior that tends to solve everyday life problems through the scientific method to enhance soft skills development (Wahyudiati et al., 2019). Implementing a scientific attitude to achieve chemistry learning objectives is essential. However, its current practice focuses on mastering concepts rather than developing scientific attitudes and psychomotor aspects. It creates students' poor scientific attitudes and lack of problem-solving skills (Patonah et al., 2021; Sutrisno et al., 2020).

Scientific attitude indicators include self-efficacy, attitudes toward chemistry, and learning experiences (Dalgety et al., 2003). These three indicators influence each other. The higher attitudes toward chemistry, the higher it will impact on increasing student self-efficacy and learning experiences, and vice versa. Still, research studies that examine these three aspects are limited and concerned more with attitudes toward science (Çalik et al., 2015). It is scarce to measure the chemistry education students' scientific attitudes (Wahyudiati, 2021b; Zhou et al., 2019).

Moreover, the factual conditions of chemistry learning in Indonesian universities portray that learning concentrated on mastering concepts rather than developing attitudes, skills, or

experimental activities, and they use an unvaried learning approach (Irwanto et al., 2021; Wahyudiati, 2022; Yustina et al., 2022). Therefore, more research is expected to measure chemistry students' scientific attitudes in Indonesian universities by utilizing innovative technology and learning strategies that significantly affect the students' scientific attitudes' improvement (Osborne et al., 2003; Zhao & Wang, 2022). The quality of chemistry learning requires various innovative strategies in teaching and must be balanced with improving the lecturers' quality so that students' learning experience becomes more comprehensive.

The students learning experience will determine their learning outcomes. Its realization is by encouraging them to independently construct knowledge, skills, and scientific attitudes (Sumardi et al., 2020; Sutrisno et al., 2020; Syafril et al., 2022; Wahyudiati, 2021a). Yet, previous research showed that classroom learning tends to take place in one direction and is dominated by lecturers, which limits students' soft and hard skills (Fadli & Irwanto, 2020; Patonah et al., 2021). Thus, the learning experience is one of the critical factors influencing the achievement of chemistry learning objectives in universities.

A learning experience is vital for growing students' knowledge, attitudes, and skills. Significant learning experience could generate qualified and competent graduates in the job market qualifications. Through learning experiences—problem-solving activities, it trains students to solve a problem through scientific procedures (Edelson, 2001; Fadli & Irwanto, 2020; Patonah et al., 2021; Wahyudiati, 2022; Wahyudiati et al., 2019). In addition, to help students' concepts understanding could be through habituation of learning experiences relevant to their daily life experiences or known as local wisdom. The integration of chemistry learning with students' local wisdom is the implementation of contextual learning by combining chemistry with culture, known as the ethnochemistry approach (Sutrisno et al., 2020; Wahyudiati, 2021a). Applying the ethnochemistry approach in learning could help students formulate research problems and hypotheses and prove hypotheses so that the expected chemistry learning objectives can be accomplished optimally (Suardana et al., 2018; Wahyudiati et al., 2020). Then again, research studies that examined ethnochemistry-based learning experiences are still inadequate and more focused on cognitive learning outcomes (Dewi et al., 2017; Osborne et al., 2003).

Contextual learning experiences could develop students' scientific attitudes because of the active involvement of students in constructing knowledge and skills independently. Providing contextual learning experiences such as ethnochemistry-based learning is one solution to improve students' scientific attitudes.

However, its implementation in universities is still rare (Dewi et al., 2017; Osborne et al., 2003; Wahyudiati & Fitriani, 2021). Besides the approach and learning environment factors, various research results proved that there is a relevance between learning experiences and scientific attitudes based on gender and also between learning experiences and critical thinking skills based on grades level (Dewi et al., 2017; Osborne et al., 2003; Xu et al., 2013; Zhao & Wang, 2022). However, there has never been a study regarding the relevance of ethnochemistry-based learning experiences with scientific attitudes from a gender perspective. Therefore, research that points out the relationship between the ethnochemistry learning experience and students' scientific attitudes from a gender perspective is highly encouraged.

### II. METHOD

This quantitative survey study employed a cross-sectional survey design. A cross-sectional survey design measures the This quantitative research used a cross-sectional survey design to obtain quantitative data and a focus group interview technique to

### III. FINDINGS & DISCUSSIONS

The average value of chemistry education students' scientific attitudes (SI) and ethnochemistry-based learning practices (PBE) based on gender was determined based on the average score and standard deviation shown in Table 1. The mean of PBE was 80.40, while the mean value of SI was 85.30 (see Table 1)

Table 1. Mean SI and PBE value of Chemistry education student

Measured aspect	N	Mean	SD
PBE	60	80.40	4.90
SI	60	85.30	4.32

Before testing the hypothesis, a prerequisite test was performed through the normality and homogeneity tests. The results showed that the data were homogeneous and normally distributed because the p-value was higher than 0.05. The test continued with multiple regression tests and hypothesis testing. It indicated a significant relationship between SI and PBE for chemistry education students based on gender because the p-value was higher than 0.05, which means that the alternative hypothesis was accepted and the null hypothesis was rejected (Table 2).

Table 2. Regression analysis test of ELE and CTS based on gender

Test	df	F	Sig
Regression	2	958	.000

The average value of the ethnochemistry-based learning experience for chemistry education students (80.40) tends to be lower than their average scientific attitude (85.30). The average value of students' scientific attitude skills, including the high category (85.30), indicates that chemistry's problem-based and contextual learning experience positively impacts scientific attitudes. It is because, in learning activities, the lecturer applies a learning model that refers to problem-solving to understand concepts and develop students' scientific skills (Hair et al., 2010; Sutrisno et al., 2020; Syafril et al., 2022). This condition

confirm the data. The purpose of using a cross-sectional survey design was to measure the relationship between two or more variables in describing factual conditions (Creswell & Creswell, 2017). The research sample was determined through a cluster random sampling technique in the department of chemistry education at the Mataram State Islamic University, consisting of 60 students (40 female and 20 male).

The data were collected through surveys and interviews. The ethnochemistry-based scientific attitude and learning experience instrument adopted a CAEQ or chemistry attitudes and experiences questionnaire (Coll et al., 2002), which was transformed into an ethnochemistry-based CAEQ instrument. The instrument was tested by employing expert and empirical validation to measure the instrument's reliability level. Cronbach's alpha coefficient value was obtained at  $\alpha = .82 > .70$  and was declared reliable (Hair et al., 2010). Finally, the data were analyzed using multiple regression analysis to determine the relationship between students' scientific attitudes and ethnochemistry-based learning experiences.

supported that instilling students in learning activities to be taught using innovative learning models based on problem-solving is highly expected (Tan & Gilbert, 2014; Villafañe & Lewis, 2016; Wahyudiati, 2021b, 2022).

The development of students' positive attitudes toward chemistry learning is influenced by the development of scientific attitudes and the ethnochemistry-based learning experience. Ethnochemistry-based learning initiates students to be actively involved in constructing knowledge independently (Rahmawati, 2018; Sutrisno et al., 2020). The results of previous studies showed that the female students' scientific attitude tends to be higher than that of male students because female students have more positive interest, persistence, curiosity, and chemical attitude than male students (Villafañe et al., 2014; Villafañe & Lewis, 2016).

The current research proved a significant relationship between ethnochemistry-based learning experiences and students' scientific attitudes based on gender. The implementation of ethnochemistry in learning is reflected in integrating chemical concepts with students' daily lives, both in the form of local wisdom values and the resulting cultural products. Likewise, Rahmawati (2018) and Singh (2016) believed that integrating culture into learning will help students relate the subject matter to everyday life, and that would provide a more interesting and significant learning experience. In addition, ethnochemistry could increase male and female students' interest and learning motivation by integrating chemical concepts relevant to cultural traditions (Tan & Gilbert, 2014; Villafañe & Lewis, 2016; Wahyudiati, 2022). In the application of ethnochemistry, students' involvement in actively constructing knowledge relevant to everyday life, which is part of their culture, is believed to increase a sense of nationalism and love for their culture (Sumardi & Wahyudiati, 2021).

Ethnochemistry-based learning experiences and students' scientific attitudes positively correlate with learning outcomes. Ethnochemistry-based learning experiences enable students to be actively involved in constructing knowledge to improve chemistry education students' scientific attitudes and cognitive learning (Sumardi & Wahyudiati, 2021; Villafañe et al., 2014; Wahyudiati, 2021b; Zhao & Wang, 2022). Thus, applying approaches or

learning models that prioritize problem-solving activities based on local wisdom is crucial to creating a more significant chemistry learning experience. Therefore, educational institutions should facilitate lecturers to design and implement chemistry learning with innovative and ethnochemistry-based learning models.

#### IV. CONCLUSION

Based on the study's results, it can be concluded: 1) The chemistry education students' scientific attitude was higher than the ethnochemistry-based learning experience, and 2) there was a significant relationship between the ethnochemistry learning experience and the scientific attitude of students in terms of gender perspective.

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# 28 Pre-Service Science Teachers' Views on the Use of Indigenous Chemistry Knowledge in Chemistry Metacognition

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## Research Article

### Pre-Service Science Teachers' Views on the Use of Indigenous Chemistry Knowledge in Chemistry Metacognition\*

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#### Abstract

This study focused on the views of pre-service science teachers on the use of indigenous chemistry knowledge in chemistry metacognition. A descriptive qualitative case study design using the interpretive paradigm was employed. The social constructivist theory guided the study as cognitive functions are dependent on social interactions with other individuals and the environment. Purposively sampled 29 pre-service science teachers were the respondents who had no previous tertiary chemistry education experience. Data was collected using focus group interviews, observation and document analysis. Constant comparison analysis was used for data analysis. The study shows that: (a) pre-service science teachers know and practice indigenous chemistry knowledge in agriculture, food preservation, food processing, health-care and environmental conservation. (b) Indigenous chemistry knowledge can be effectively used in chemistry metacognition when there is an awareness of chemistry concepts / ideas in indigenous chemistry knowledge. (c) There is a positive attitude towards the use of indigenous chemistry knowledge in chemistry metacognition. The recommendation is that chemistry curriculum developers at teachers' colleges must harness the multicultural indigenous chemistry knowledge from pre-service science teachers for establishment of a course in indigenous chemistry knowledge at the tertiary institutions.

**Keywords:** Chemistry metacognition, cultural relevance, ideal chemistry education, indigenous chemistry knowledge, pre-service science teachers

## 1. INTRODUCTION

### 1.1. Indigenous Chemistry Knowledge and Chemistry Metacognition

Chemistry education is based on western and eastern oriented generation and dissemination of information that does not value indigenous chemistry knowledge (Dziva, Mpofo & Kusure 2011; Shumba, 2014). Whilst Chemistry is a subject that is abstract to both teachers and learners because it is taught in way not related to the indigenous knowledge and practices (everyday life experiences) of the learner resulting in poor academic performance (Ugwu & Diovu, 2016). Indigenous knowledge is knowledge, which has evolved in a particular society's context and is unique (Senanayake, 2006) used in that society's context daily (Austin & Hickey, 2011). Indigenous chemistry knowledge is chemistry knowledge, which has evolved in a particular society's context and is used in that society's context daily. The chemistry that is seen as abstract is actually practised using resources from the environment in the context of indigenous chemistry knowledge at levels that differ of human societies in the world unknowingly (Ugwu & Diovu 2016).

Chemistry learners are exposed to the cultural beliefs and indigenous knowledge from their culture. All learning occurs through culture in the social context (Aikenhead & Jegede, 1999). The cultural prior knowledge from the learners' culture has a significant impact on the learning of formal

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(school) chemistry concepts and this cultural prior knowledge determines the learners' preferred learning style (Baker & Taylor, 1995). Learners' construction of meaning is done through indigenous Chemistry knowledge (prior Chemistry knowledge) (Aikenhead & Jegede, 1999). Aspects of culture of non-western science learners such as indigenous knowledge (traditional and empirical knowledge), ways of knowing as well as indigenous world views should be seen and incorporated as science learning foundations (Dziva, Mpofo & Kusure 2011).

Metacognition is recognition of the value of prior knowledge with an accurate assessment of the demands of a challenging learning activity or goal and what understanding and skills are needed as well as the intelligence required to make the right deduction on how to use one's elaborate and systematic knowledge in a specific situation reliably and efficiently (Taylor, 1999). Chemistry metacognition is the recognition of the value of indigenous Chemistry knowledge (prior-knowledge) with an accurate assessment of the demands of a western Chemistry challenging learning activity and what understanding and skills are needed as well as the intelligence required to make the right deduction on how to use one's elaborate and systematic indigenous Chemistry knowledge in a specific situation reliably and efficiently. Metacognition promotes independent Chemistry knowledge, knowledge that is more permanent, motivates learners and improves educational achievement across different ages, intellectual abilities and subject areas (Louca, 2003; Somerville, 2017). Abilities of metacognition assist learners to transfer acquired Chemistry knowledge, skills and affective states to another context or learning task.

### 1.2. Research on Indigenous Knowledge and Chemistry Education

In the Asian country of Indonesia, Rahmawati and Ridwan (2017) did a study at secondary school level on the empowerment of learners' chemistry learning through an integration of learners' ethnochemistry in teaching that was culturally responsive. The results of their study were that learners developed: higher order thinking skills (creativity in problem-solving), self-confidence, stimulated responsibility and task completion, empathy for other learners, improved communication amongst themselves, curiosity and motivation. These led to the conclusion that learners were empowered in chemistry learning by the integration of ethnochemistry. Ugwu and Diovu (2016) studied the integration of indigenous practices and knowledge in chemistry teaching, learning and learners' academic achievement at senior secondary school level in the African country of Nigeria. The findings of their study were that the integration of indigenous practices and knowledge in chemistry teaching and learning improved chemistry concepts understanding and improved learners' achievement in chemistry. In Zambia, an African country that shares a border with Zimbabwe, Singh and Chibuye (2016) did a study on the effect of ethnochemistry knowledge and practices on learners' attitudes towards chemistry at secondary school level. The findings of the study showed that incorporation of ethnochemistry knowledge and practices in chemistry, improved learners' attitudes towards chemistry positively.

Most studies that have been conducted on indigenous chemistry knowledge (ethnochemistry) and chemistry education have focused on the effect of integration of indigenous chemistry knowledge on the performance of learners in chemistry and learners' attitudes towards chemistry. A study on the views of learners on the use of indigenous chemistry knowledge in chemistry metacognition has never been done before. Therefore, a gap exists in knowledge, which this study sought to fill by exploring the perceptions of pre-service science teachers on the use of indigenous chemistry knowledge on chemistry metacognition. The teaching and learning at teachers' colleges is conceptualised from the western and eastern philosophical orientations that are based on a universal approach towards knowledge generation and dissemination (Shumba, 2014). The ideal chemistry teaching and learning should be done from the African philosophical orientation that is locally contextualised and culturally

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relevant in terms of knowledge generation and dissemination that meets the needs and provides practical solutions to the everyday life chemical challenges and problems of the community.

**1.3. Research Questions**

The study is guided by the following research questions:

- Which indigenous Chemistry knowledge is known and practised by pre-service science teachers?
- How can indigenous Chemistry knowledge be effectively utilised in Chemistry metacognition?
- What are the attitudes of pre-service science teachers towards the use of indigenous Chemistry knowledge in Chemistry metacognition?

**2. METHOD**

**2.1. Research Design**

A descriptive qualitative case study design using the interpretive paradigm was employed to study the views of learners towards the use of indigenous Chemistry knowledge in Chemistry metacognition. A descriptive case study design is concerned with interpretation and description of situations, circumstances, conditions and events that are contemporary in nature and from a social constructivist perspective (Merriam, 1998). A qualitative research approach focuses on peoples' meaning systems, experiences and beliefs from their perspective. Its roots are the cultural and social anthropology, history, philosophy, sociology and psychology suggests Mohajan (2018). The interpretive paradigm was employed to study pre-service science teachers' views on the use of indigenous chemistry knowledge in chemistry metacognition. The interpretive paradigm is a constructivist paradigm that is humanistic and naturalistic which is used to interpret and understand reality in the human and social context states Shah and Al-Bargi (2013). This study was based on the subjective indigenous chemistry knowledge meanings of the pre-service science teachers' understanding and interpretation of the indigenous chemistry knowledge social and human phenomena.

**2.2. Participants**

The study was conducted at a secondary school teachers' college in Zimbabwe with the respondents being post ordinary level pre-service science teachers who had no exposure to tertiary level chemistry education before. The data collection and analysis were conducted in eight weeks in the pre-service science teachers' first term at college of 2020. The respondents were 29 pre-service science teachers from the science department of a secondary teacher training college in Zimbabwe. The demographic profiles of pre-service science teachers in that participated in the study shown in in Figure 1 to 3.

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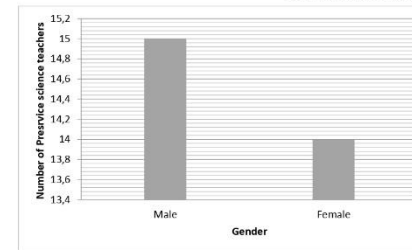


Figure 1. Gender distribution of pre-service science teachers

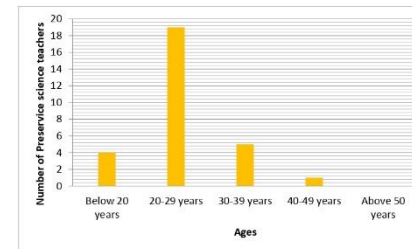


Figure 2. Age distribution of pre-service science teachers

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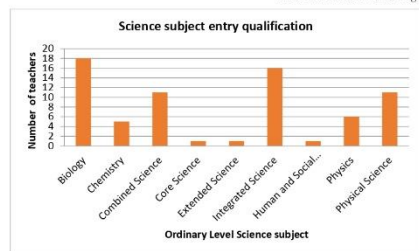


Figure 3. Science subject entry qualification of pre-service science teachers

2.3. Data Collection

The pre-service science teachers were purposively sampled who participated in the study. Focus groups, observation and document analysis were used in exploring the views of pre-service science teachers on the use of indigenous chemistry knowledge in chemistry metacognition. Focus group interviews were used for identifying the cultural indigenous chemistry knowledge held and practised by pre-service science teachers. The function of observations was to assess and find out the extent to which pre-service science teachers used cultural indigenous chemistry knowledge in the lectures. Document analysis was done using pre-service science teachers' written tests, assignments and practical write-ups at the teachers' college after marking the pieces of work. Document analysis was used for identifying the cultural indigenous chemistry knowledge held and practised by pre-service science teachers.

2.4. Data Analysis

The data was analysed using constant comparison analysis to identify the indigenous Chemistry knowledge that is known and practised by of the pre-service science teachers. Flick (2013) describes qualitative data analysis as a process whereby material that is visual or linguistic is classified and interpreted to produce statements that are explicit and implicit in dimensions as well as structures for making meaning from the material that it represents. These were done through the components of qualitative data analysis which are data collection, data reduction, data display and conclusion drawing as well as verification suggests Miles, Huberman and Saldana (2014).

The first stage of data analysis involved organizing the indigenous chemistry knowledge experiences, perceptions, behaviours and emotions of the participants into the categories (themes) of agriculture, environmental conservation, food processing, food preservation and health care. The second stage of data analysis involved the segregating and labelling (coding) of themes into those with chemistry ideas / concepts, beneficial characteristics, common characteristics with western chemistry knowledge, important uses in chemistry lectures and those with affective impacts.

3. FINDINGS

3.1. Which Indigenous Chemistry Knowledge is Known and Practised by Pre-Service Science Teachers?

Quite a large amount of Indigenous Chemistry knowledge and skills known and practised by pre-service science teachers for survival purposes. Many uses and effectiveness of indigenous Chemistry knowledge and skills were found in agriculture, environmental conservation, food processing, food preservation and health care. Indigenous environmental conservation knowledge, skills and attitudes are an area of specialisation that is known and practised by pre-service science teachers. Most of the pre-service teachers' environmental conservation majored mainly on soil, tree, plant nutrients and animal conservation.

3.2. How can Indigenous Chemistry Knowledge be Effectively Utilised in Chemistry Metacognition?

Pre-service science teachers are aware of chemistry concepts/ideas that are in some of the indigenous chemistry knowledge they know and practice as shown in Table 1.

Table 1. Indigenous Chemistry knowledge with known chemistry ideas / concepts

Use of ashes to heal wounds. Salting meat. Maize- grind using a mortar and pestle. Animal skins -clothing leather. Pumpkin seeds – processed into cooking oil (roasting, grinding, squeezing of the pumpkin seeds). Cooking sadza. Traditional medicine/herbs). Salting fish- dehydration and pH. Drying of vegetables (irradiation and evaporation). Sour milk production. Boiling water. Mango leaves plus honey and boiling and consuming the syrup (flu and colds). Applying table salt to wounds to stop bleeding. Smoking meat- no flies to the meat after smoking. Salting and drying meat. Sour milk- fresh milk placed in closed contain. Drying meat. Ashes used to kill pests. Fire making- exposure to oxygen to promote combustion. Brewing traditional beer or drink (Mahevu). Ashes as fertilizer. Cow dung fertilizer- dosage too much kills plants. Boiling-denaturing of cells and enzymes. Application of ashes in fields (neutralisation). Cooking. Fermentation of sour porridge. Mahevu. Harvesting honey from a beehive. Salting meat. Tototo (illicit brew) brewing- fermentation and fractional distillation, raw material in tototo brewing is rotten sadza/ food and rotten fruits. Cooking sadza- endothermic and exothermic reactions. Smoking food- chemical treatment. Fire exothermic and oxidation/ reduction reactions.

These Chemistry ideas/concepts are the same chemistry ideas/concepts which are found in the western Chemistry knowledge. Indigenous Chemistry knowledge is the Chemistry prior knowledge for western Chemistry knowledge. Metacognition relies heavily on subject prior knowledge for it to be learned well (Vygotksy, 1978). Pre-service science teachers gave a number of benefits associated with indigenous Chemistry knowledge and skills from their experiences in their daily lives. Table 2 gives a list of beneficial characteristics of indigenous Chemistry knowledge and skills as given by pre-service science teachers.

Table 2. Beneficial characteristics of indigenous chemistry knowledge

Quite efficient but not 100%. User friendly. Easily accessible. Rarely has side effects. Readily available. Nature derived. Help in understanding chemistry concepts. Use environmentally friendly methods. Learn as you go. Practised in everyday life. Indigenous medicines are more effective. One type of herb can be used to treat many diseases. No side effects. Environmentally friendly. Cheaper. Affordable. Passed from generation to generation (heritage). Economic. Safe. Always available. Original taste of some food stuffs not lost so much. Get money through selling processed fruits. Store of wealth. Eco-friendly. Most do not have side effects. Herbs have limited side effects. Convenient.

There are some common characteristics between indigenous Chemistry knowledge and western Chemistry knowledge that were identified by pre-service science teachers as shown in Table 3.

**Table 3. Common characteristics between indigenous and western chemistry knowledge**

*Precautions. There are stages to be followed when executing. Care. Processes are the same, for example beer brewing- fermentation and fractional distillation process. College chemistry depends on indigenous chemistry (based on), the practical part. Save the same purpose-processes. College chemistry is a modification of indigenous chemistry knowledge. Similar process. Time periods – set time for the processes. Practical application, practice, the concepts behind, putting theory into practice. Processes, they sometimes serve the same purposes e.g. heating. There are measurements that are done. Opaque beer fermentation.*

*Makes life easier. Indigenous knowledge used as assumed knowledge (indigenous chemistry knowledge the known and college chemistry the unknown).*

*School/college-theory. Home- practical. College chemistry relates to indigenous chemistry knowledge. They depend on nature. Indigenous chemistry- application (practical) and college chemistry (theoretical). College chemistry and improvement of indigenous chemistry knowledge. College chemistry is an advancement of indigenous chemistry knowledge, indigenous chemistry knowledge is the backbone of college chemistry. Practical. Indigenous chemistry knowledge is prior knowledge to the college chemistry. Theory and practice with college chemistry being theoretical whilst indigenous chemistry is practical or hands on. Similar process. Theoretical chemistry (college) makes learners realise what is done at home is exactly the same. Similar concepts between the two, at times college brings about knowledge from other places (exotic) whilst indigenous chemistry knowledge is local, relationship mutual but indigenous people won't be knowing that they are applying chemistry. Share knowledge, serve the same purpose e.g. aloe vera – used as indigenous medicines also formal chemistry uses it to make pills.*

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The importance of using indigenous chemistry knowledge in formal chemistry lectures was emphasised by pre-service science teachers because of the reasons shown in Table 4.

**Table 4. Importance of the use of indigenous chemistry knowledge in chemistry lectures.**

*School / college – theory. Home- practical. College chemistry relates to indigenous chemistry knowledge. They depend on nature. Indigenous chemistry- application (practical) and college chemistry (theoretical). College chemistry is an advancement of indigenous chemistry knowledge, indigenous chemistry knowledge is the backbone of college chemistry. Practical. Indigenous chemistry knowledge is prior knowledge to the college chemistry. Theory and practice with college chemistry being theoretical whilst indigenous chemistry is practical or hands on. Similar process. Theoretical chemistry (college) makes learners realise what is done at home is exactly the same. Similar concepts between the two, at times college brings about knowledge from other places (exotic) whilst indigenous chemistry knowledge is local, relationship mutual but indigenous people won't be knowing that they are applying chemistry. Share knowledge, serve the same purpose e.g., aloe vera – used as indigenous medicines also formal chemistry uses it to make pills.*

The use of indigenous Chemistry knowledge and skills in Chemistry lectures (western Chemistry knowledge) comes with it some advantages and disadvantages as shown in Table 5.

**Table 5. Advantages and disadvantages of using indigenous Chemistry knowledge in Chemistry lectures.**

*Advantages*

*Learners easily grasp concepts. No qualification that is needed. It can be a hub for home grown solutions. Captivate students' interest and motivation. Provides creativity. Promotes research and development. Making understanding better. Makes learning easy. Gives relevance. Information easily accessible. A lot of cultures. Raw material is local, available and cheap. Provides better understanding. Brings together the modernised learners and the sophisticated. Gives a clear picture of what is being taught. Makes it easy for learners to understand the concept as learners are well versed in indigenous Chemistry knowledge*

*Helps in following safety in a laboratory. Learners have hands-on experience. It prepares learners for after college-life. It brings reality. It promotes memory retention (empowers memory) as learners will be learning from the known to the unknown. Have an idea of what you are learning about. Common to everyone and readily available. Understand better what is being spoken/taught about them since you can relate. Learners will understand better because the concepts are being simplified. Helps to maintain the interest (motivation) of learners since they can relate.*

*Disadvantages*

*Some are out-dated. Might kill college Chemistry technical terminology among learners. Wrongly prescribe something for someone. Some of them not scientifically proven. Supports the ones in contact with the indigenous knowledge. Learners might end up dwelling much in indigenous Chemistry knowledge than on the college Chemistry concepts. Practice might be dangerous or harmful to the health of a person (Allergic to some of the indigenous Chemistry knowledge substances) There is no specificity in indigenous Chemistry. Measurements are not reliable. Some of the indigenous Chemistry knowledge method might not give enough results that can be evaluated. Reactions take a lot of time/slow. Tends to discriminate against the ones who grew up in urban areas as compared to the ones who grew up in rural areas. Dilution of cultures of other learners' cultures (cultural shock).*

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**3.3. What are the attitudes of pre-service science teachers towards the use of indigenous Chemistry knowledge in Chemistry metacognition?**

Quite a number of attitudes were exhibited by pre-service science teachers in terms of the use of indigenous Chemistry knowledge, skills and attitudes in the Chemistry lectures. Pre-service science teachers felt that it was good, acceptable, comfortable and important to use indigenous Chemistry knowledge, skills and attitudes in the Chemistry lectures. Their reasons were that the use of indigenous Chemistry knowledge, skills and attitudes in the chemistry lectures motivates learners, improves Chemistry concepts comprehension, aids memory retention and brings reality and life experiences to the classroom. Pre-service science teachers also felt that it was the best way to learn western Chemistry knowledge, as the examples used were from their daily life experiences which are known and understood. However, pre-service science teachers also felt that in the process of assisting in the learning and teaching of western Chemistry knowledge, indigenous Chemistry knowledge, skills and attitudes are standardised and preserved in the process.

**4. DISCUSSION and CONCLUSION**

The results indicate that pre-service science teachers know and practice a vast amount of indigenous chemistry knowledge in agriculture, food preservation, food processing, health-care and environmental conservation, which was complemented by indigenous chemistry knowledge in other areas. The results of this study are in agreement with Mapara's (2009) findings, which indicated that indigenous knowledge which includes the areas of medicine, agriculture, craft skills, zoology and botany among others, are still held by local people even after years of colonisation. These results are

consistent with Ugboma (2014), whose findings showed that the majority of the population possess and utilise indigenous knowledge. Senanayake's (2006) findings showed that indigenous knowledge experts are ordinary people of the society. These results are also consistent with the findings of Ugwu and Diovu (2016) and Singh and Chibuye (2016) which, showed that there are many chemistry concepts in indigenous knowledge that are known and practised by learners knowingly and unknowingly in their daily life experiences.

The findings indicate that indigenous Chemistry knowledge can be effectively used in chemistry metacognition when there is an awareness by pre-service science teachers (learners) and educators of chemistry concepts / ideas in indigenous Chemistry knowledge (Chemistry prior knowledge) that actually use chemistry concepts that are known to them in their everyday lives. This is consistent with Alshammari (2015)'s study which showed that for any learner to develop metacognitive skills, prior knowledge must be present to facilitate and help in the development of the cognitive skills.

The study's findings further show that indigenous Chemistry knowledge can be effectively used in Chemistry metacognition when indigenous Chemistry knowledge's, immerse educational value, motivating effect, importance, in-depth learning, improved academic performance, advantages, benefits, and best teaching methodologies are known and made use off in chemistry tertiary institutions involved chemistry education. Semali, Grim and Maretzki (2006)'s study showed that indigenous knowledge complements and provides relevance to science-based knowledge which supports this study's findings. The findings of a study on the incorporation of indigenous Chemistry knowledge into chemistry teaching and learning by Ugwu and Diovu (2016) showed that learners improved understanding of chemistry ideas/concepts and academic achievement. The incorporation of indigenous Chemistry knowledge into chemistry knowledge improved learners' chemistry learning through, motivation, cultural identity, engagement, collaboration and higher order thinking skills in a study by Rahimawati and Ridwan (2017).

The study's results show a positive attitude towards the use of indigenous Chemistry knowledge in chemistry metacognition by pre-service science teachers. The findings contradict Sliizha's (2007) findings, which showed a negative attitude by pre-service science teachers towards the incorporation of indigenous science into formal science. Other contradictory findings were those of Dziva, Mpofo and Kusure (2011), which showed that science teachers had a negative attitude towards the incorporation of indigenous knowledge in formal science classrooms. The pre-service science teachers were of the opinion that indigenous chemistry knowledge improves their comprehension, assists in memory retention and brings their everyday life experiences into the classroom.

Analysis of the data from the focus groups exhibited that pre-service science teachers are repositories of indigenous Chemistry knowledge, skills and attitudes. From these findings, the conclusion drawn is that chemistry educators such as teachers and lecturers have access to indigenous Chemistry knowledge that is held and practiced by chemistry learners in their everyday lives for survival. This indigenous Chemistry knowledge represents alternative chemistry concepts or chemistry misconceptions from the chemistry learners' social-cultural life which can either promote or disrupt the western chemistry teaching and learning process. It is recommended that the indigenous Chemistry knowledge of chemistry learners should be identified and applied constructively in the chemistry curriculum at teachers' colleges, thereby contextualising the western chemistry education.

Data analysis showed that there are some chemistry ideas/concepts in indigenous Chemistry knowledge that are known and practised as chemistry concepts/ideas by pre-service science teachers that are beneficial, useful, and reliable, give positive experiences and are the same with western chemistry ideas/concepts. The findings suggest that indigenous Chemistry knowledge can be utilised effectively in Chemistry metacognition as there is empirical evidence of the immerse value, importance and benefits of indigenous Chemistry knowledge ideas/concepts which can be used as

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realia since they are used for survival purposes in the everyday life experiences of pre-service science teachers. As a result, the learners' indigenous Chemistry knowledge assists in the understanding of western Chemistry concepts as it comes from learners' everyday socio-cultural life experiences. It can be concluded that indigenous Chemistry knowledge can be used successfully in Chemistry metacognition by learners in chemistry education. What is recommended is that chemistry educators should be capacitated with the knowledge, skills and attitudes for identifying learners' indigenous Chemistry knowledge that is effectively used in Chemistry metacognition.

Analysis of the data showed that pre-service science teachers felt that it was acceptable, good and comfortable to use indigenous Chemistry knowledge in Chemistry metacognition. Their reasons were that it motivated learners, improved chemistry concepts comprehension, assisted memory retention and brought realia into the chemistry classroom. The findings show very positive attitudes towards the use of indigenous Chemistry knowledge in Chemistry metacognition by pre-service science teachers in chemistry lectures. The conclusion drawn from these findings is that pre-service science teachers favour the inclusion and use of indigenous Chemistry knowledge in chemistry lectures for purposes of Chemistry metacognition. The recommendation is that chemistry curriculum developers at teachers' colleges must harness the multicultural indigenous chemistry knowledge from pre-service science teachers for establishment of a course in indigenous chemistry knowledge at the tertiary institutions.

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## 29 Local Wisdom of the Aceh Jaya Society in terms of Indigenous Cuisine that can be learned in Chemistry Learning in Schools

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### Local Wisdom of the Aceh Jaya Society in terms of Indigenous Cuisine that can be learned in Chemistry Learning in Schools

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#### Abstract

*This study aims to determine the local wisdom of the people of Aceh Jaya in terms of the indigenous cuisine of the society that can be included in learning chemistry at the school. Local wisdom is a way of living a wise life that is passed down from generation to generation through oral traditions, proverbs, or folklore. Indigenous specialties are dishes that are often or commonly consumed in an area with characters that usually reflect the character of the society and have certain local identity and characteristics. The sample in this study is the people of Aceh Jaya which is divided into three (3) districts, namely the eastern district which is in the mountainous area, the western district which is on the outskirts of the sea, and the northern district which is on the edge of the highway. The sampling technique used was the purposive sampling technique. Data collection techniques used are observations of activities carried out by society, interviews with society leaders, and documents. The data collection instruments are in the form of observation sheets, interview sheets, and document reviews. Furthermore, the research data were analyzed using the Miles and Huberman model, namely the stages of data reduction, data presentation, and conclusion. The results of the study show that the indigenous dishes of the Aceh Jaya people that are still being preserved include jruak drien (tempuyak darian), jruak kuni (tempuyak kuni), gula jruak engkot koring (curry sour fish), Pluk u, peuleumak oun murong ngon boh drien putik (coconut milk soup uses moringa leaves and young durian), peuleumak or tumis daun pakis (coconut milk / sauteed fern leaves), dam pakis tekerabe (sarap pakis). This research concludes that the typical cuisine of the Aceh Jaya society is the local wisdom of the society that can be included in learning chemistry; the chemical processes obtained in indigenous community dishes are the fermentation process, the mixture of substances, separation of mixtures, acids and bases, solutions and colloids. The chemical constituents found in these typical dishes are vitamins A and C, glucose, protein, fat, nutrition, calcium, phosphorus, iron, minerals, carotenoids, polyphenols, flavonoids, alkaloids, tannins, saponins, and oxalates.*

**Keywords:** Local Wisdom, Indigenous Cuisine, Chemistry Learning, and Chemical Compositions.

#### 1. Introduction

Local wisdom is a way of living a wise life passed down from generation to generation through oral traditions, proverbs or folklore. Aceh is a gateway for trade and cultural traffic, earning the nickname Veranda of Mecca because Islamic religion and culture have an influence on people's lives. Apriana's research (2015) is prohibited from going to sea on Fridays, because Islamic law carries out worship, those who violate it are subject to customary sanctions.

In a certain community, local wisdom can be found related to natural resource management as a local arrangement that has existed since the past with a long history and adaptation. Local wisdom does not only function as a characteristic of a community, but also functions as an effort to preserve the ecological environment of a community.

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The people of Aceh Jaya are people who are still steeped in their regional culture, which can be seen from their daily habits of mutual cooperation, weddings, funerals, or from the dishes that are typical of the region. Regional specialties are dishes that are often or commonly consumed in an area with characters that reflect the character of the people, regional specialties have certain regional characteristics and characteristics. Regional specialties or traditional dishes are passed down from generation to generation and each region has different characteristics.

Regional specialties are regional local wisdom that must be maintained, so that they are maintained and preserved. In this day and age, most people, especially students, are no longer familiar with the specialties of their own region, they are more familiar with contemporary cuisine or cuisine from outside regions. So that students are still familiar with regional specialties, what must be done is implementing local wisdom such as regional specialties into learning at school, especially chemistry learning.

What can be done regarding the implementation of ethnosience-based science learning in schools is that teachers need to identify students' prior knowledge of native science. This identification aims to explore the mindstudents' minds in order to accommodate the concepts, principles or beliefs that students have that are rooted in the culture of the society in which they live (Winarti et al, 2018).

The problem in learning chemistry does not only lie in students' low understanding of concepts, but also the limited chemistry learning resources that are contextual and relevant to students' daily lives, one of which is ethnochemistry-based chemistry learning resources (Wahyudiati, 2021). By implementing ethnochemical-based learning resources in chemistry learning at school, students understand contextually learning resources obtained from everyday life, so that students can easily understand the concepts of the material being studied and local cultural wisdom is also preserved.

Based on the problems above, this study aims to determine the local wisdom of the people of Aceh Jaya in terms of community specialties that can be included in chemistry lessons at school.

#### Theoretical Study

Aceh is a region rich in cultural potentials that have been marked by high past progress and have positioned themselves as a pedestal for admiration and role models. Call it in terms of livelihood systems: farmers, traders and fishermen for example, have standard rules and manners and have wisdom values based on the teachings and Islamic law itself.

The local wisdom of a region can not only become a policy that only applies to that area, but can also be adopted to other areas so that it becomes a cross-regional wisdom, even across ethnic groups and nations. Local wisdom can also be adopted into a nation's national policy. The local wisdom possessed by the people of Aceh can be used as a basis for living their daily social life. Local wisdom in Aceh can also be used as a tool to filter out good and bad things to deal with changing times, including in facing exposure to the mass media.

Policy(wisdom) and living wisdom, local wisdom that exists in Indonesia is not only valid in one area, but can also cross cultures or ethnicities so as to form national cultural values. For example, almost all regions in Indonesia recognize local wisdom that teaches people to work together, be tolerant, have a good work ethic, and so on. (Nucifera and Hidayat). Sibarani (2012) states that local wisdom is an original knowledge that comes from a community which is obtained through the noble values of their cultural traditions to regulate the structure of social life.

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Local wisdom is an accumulation of the results of mental activity in addressing and treating the environment which describes the way of behaving and acting in a society to respond to specific changes in the scope of the physical or cultural environment (Nuraeni and Alfian, 2013). The results of Yeny et al's research (2016), there is the existence of local wisdom in the form of *palemahan* which is knowledge, values, rules and customary law systems, which have regulated actions or actions in human relations with the environment and play a role in the development of bamboo forests and efforts to build bamboo forests by the community. Kintamani has contributed to social, economic and hydrological aspects.

According to Sibarani (2012) there are several types of local wisdom, including education, health, preservation and cultural creativity, welfare, harmony and conflict resolution, hard work, discipline, commitment, honesty, mutual cooperation, social solidarity, care for the environment, gender management, politeness, , gratitude, positive thoughts, and peace. In terms of cultural preservation and creativity, regional specialties are also cultural creativity that must be preserved so that they are not lost with the presence of foreign dishes such as pizza, kebabs, briyani rice, kebuli rice, spaghetti and so on. The regional specialties can be included in education in schools through textbooks.

Food is not only important for meeting human needs for food, but food is also closely related to culture, including technology, social organization and also people's beliefs. Food will not have any meaning unless the food is seen in its culture or social interaction network (Hardiansyah et al, 2020). Food as certain symbols will have certain meanings in many social activities. For example in food used in traditional celebrations, traditional ceremonies or wedding ceremonies. Food is also a form of ethnic identity, which can be identified from the types of dishes that have special taste characteristics (Nurti, 2017).

Indonesian traditional food is very diverse, along with the diversity of ethnic and multicultural areas. Traditional Indonesian food contains a variety of spices with different cooking techniques, made from local ingredients that are partly influenced by India, China, the Middle East and Europe (Indonesian Embassy). The diversity of traditional food is also influenced by the variety of local raw materials available in each region. According to Soh et al (2021), traditional food in each region is one of the hallmarks or identities of that area. Traditional food that has existed for a long time, is still preserved and survives until now. Food recipes and how to cook them still use old methods. Traditional food can become an icon of culinary tourism for every tourist attraction area.

Traditional food or local food is one of the identities of a community group which is very easy to find and easy to recognize. Every region in Indonesia has a culinary wealth that is the hallmark or identity of that region. One way to introduce and promote this culinary richness is through learning content in schools. Local cultural content including traditional food has begun to be inserted in textbooks used in class (Tyas, 2017).

The importance of local wisdom in our education broadly is part of efforts to increase our national resilience as a nation. The plural and dynamic culture of the archipelago is a source of local wisdom that will never die, and has local values that can be embedded in chemistry learning. This will be a challenge for teachers to integrate local wisdom into their learning programs (Sumarni 2018).

The objectives of holding local wisdom-based education in schools include: (1) Knowing the local advantages of the area where he lives; (2) Understanding various aspects related to the local advantages of the area; (3) Able to process resources; (4) Involved in services/services or other related activities with local excellence so as to earn income and preserve the culture/traditions/resources that are regional excellence; And (5) Able to compete nationally and globally (Ahmadi, et al, 2012).

Chemistry learning that is related to local wisdom is called ethnochemistry, namely regional culture in terms of regional specialties in terms of chemistry, both from its composition, chemical content and the benefits of these chemical ingredients.

## 2. Method

This research is qualitative descriptive. The research was conducted in Aceh Jaya Regency with the research sample being the people of Aceh Jaya who are in mountainous areas, on the seafloor, and on the roadside. The sampling technique used purposive sampling technique. The data collection technique used is observation of the typical dishes made by the community, interviews with community leaders, and documents about the typical dishes of the community. The data collection instruments were in the form of observation sheets, interview sheets and document reviews. Furthermore, research data analysis uses the Miles and Huberman models, namely the stages of data reduction, data presentation, and drawing conclusions.

## 3. Results and Discussion

From the results of observations and interviews with community leaders in several villages, it is clear that the community still inherits the regional specialties, whether cooked for daily use or cooked for celebrations on holidays, weddings or cooked at funeral homes. Regional specialties that are still preserved today include:

### 1. Jruék Drien(Tempuyak Durian)

Durian (*Durio zibethinus* Murr.) is an exotic tropical fruit plant that has a unique taste and aroma. Durian fruit is also called the king of fruit which is very popular with various groups of people because of its distinctive taste. Indonesia is the center of durian diversity in the world.

There is a special dish for the people of Aceh Jaya called tempuyak durian (jruék drien) which is made by fermenting durian fruit for about 1 month, and will produce jruék drien which tastes sour, with its chemical ingredients being water, lactic acid and sugar. According to (Elvira 2012), Traditional food is food that is consumed by certain people, with a distinctive taste that is accepted by that community. Traditional food products are the identity of a culture and ancestral heritage that contribute to the development and sustainability of an area in providing a variety of food choices. There are many types of traditional food in Indonesia and one of them is fermented food.

The process of making dried acid is done by separating the durian flesh from the seeds. The traditional fermented food known in Malay cuisine is tempuyak. The treatment for making jruék drien in Aceh is quite varied. The community adds certain ingredients in its manufacture. Some Acehese in the southwestern part of Aceh prefer making dried acid with the addition of salt or turmeric, but some believe that without using salt the resulting taste will be more distinctive. In general, there are several ways (methods) used to make dried acid by the people of Aceh, including adding salt, without adding salt, adding turmeric and adding salt and turmeric at the same time (Muzafar et al, 2015).

In the study of chemistry of jruék drien is a natural fermentation process, and acid-base. Fermentation is a natural process by which microorganisms such as yeast and bacteria convert carbohydrates, such as starch and sugar, into alcohol or acids.



Figure 1. Durian fruit



Figure 2. Jrucek Drien/Tempuyak durian

**2. Gule Jrucek Engkot Kerling (Tempoyak Durian Ikan Kerling).**

Kerling fish is a freshwater fish species that still lives wild in the Aceh Jaya river and has high economic value. Kerling fish or also known as golden mahseer (*Tor spp*) is the most important freshwater species for the people of Aceh. This fish inhabits watersheds (DAS) which are quite heavy in the upstream. Some researchers report that in Aceh there are 3 species of *Tor* genus fish including *Tor soro*, *Tor tambra* and *Tor tambroides*.

The results of research by Hendri and Sri (2016) showed that the kerling fish (*Tor tambroides*) found in the public waters of West Aceh can be distinguished between female and male species based on qualitative morphometric characteristics (body color, snout profile, thickness of the lower and upper lips). potential economic fish and need conservation efforts.

In recent years, this fish has become the concern of researchers and in the future it is hoped that it will become one of the commodities that contribute to increasing aquaculture production. The demand for kerling fish meat continues to increase, even though the price is very expensive. On the other hand, the aspect of cultivation has not been successful and has not even been studied much. In addition, the level of exploitation in nature continues to increase which results in increasingly critical populations in their natural habitat (Hendri et al, 2015).

Gule jrucek engkot kerling (fish durian tempoyak) contains water, lactic acid, sugar, protein, fat, calcium, phosphorus and iron, including in solution and acid-base. The results of research by Muzaifa et al (2015), the method of making jrucek drien had a very significant effect on water content, total pH, total lactic acid, total sugar and total lactic acid bacteria. Fermentation treatment without salt (regular fermentation and fermentation using turmeric) produced acid dren with higher water content, total lactic acid and total lactic acid bacteria compared to the fermentation treatment using salt. The average values of the physicochemical and microbiological characteristics of dried acid were as follows: water content 66.49%, pH 4.05, total acid 2.30%, total sugar 30.50%, total lactic acid bacteria 99-1010 CFU/g and total yeast 18x106 CFU/ g.

In learning chemistry, the chemical processes contained in gule jrucek engkot kerling are solutions in the form of suspensions, mixtures of ingredients and crumbs and natural fermentation processes.



Figure 3. Kerling Fish

**3. Jrucek Kweni (Mangifera odorata Griff)**

Kweni mango (*Mangifera odorata Griff*) is a member of the *Mangifera* genus which has a distinctive aroma of ripe fruit, so that kweni mango can be distinguished from other types of mango based on its shape and aroma. kweni mango is oval in shape with a stalk located in the middle of the base of the fruit. Pointed fruit shoots while the base is round and not indented.

According to Putri et al (2017), kuini is one of the exotic tropical fruit plants which has a unique taste and aroma that is liked by almost everyone, its unique aroma can also be used to give taste and aroma to food. Kuini fruit which is seasonal, has a high enough water content so that the fruit is easily damaged, in order to increase the selling value and extend the shelf life of the kuini fruit used as a raw material in the manufacture of fruit leather products by combining red dragon fruit in order to attract consumers' interest because dragon fruit Red has a very attractive color and has very good nutritional value for human health.

Mango fruit consists of 80% water and 15% - 20% sugar, protein, fat, minerals, dyes, tannins and various vitamins, including vitamins A, B, C and volatile substances. The content of mango kuini is water, ash, starch, crude fiber, protein, fat, sugar carbohydrates, vitamin C and calories.

Apart from being known as a durian-producing area, Aceh Jaya Regency is also known as a kuini producer. In consuming kuini, the people of Aceh Jaya usually eat the fruit immediately, make rujak, it is made dodol and can be cooked for compote to eat with sticky rice such as for compote durian, and also for making jrucek kuini. This kuini jrucek is processed/squeezed the fruit and cooked immediately without having to be fermented, and mixed with vegetables. Thus the kuini fruit can be stored and lasts a long time and can increase the selling value of the kuini fruit. Kuini oranges are also acidic and contain protein, fat, vitamin C, carbohydrates, starch and water.

This is in accordance with what was stated by Prissilia (2014), kuini is a type of mango which has a low selling value during the main harvest. One of the efforts to increase the selling value of kuini is to process kuini into a product so that its shelf life can be increased. Kuini is a fruit that is quite popular with the public because of the combination of sweet and sour taste, has a distinctive aroma similar to dumplings, but kuini fruit has a low shelf life, because it is easily spoiled caused by pests.

In learning chemistry of jrucek kweni is a natural fermentation process, a mixture of substances and acids and bases.



Figure 4. Kweini fruit

**4. Kuah Rayek Bak Pisang/Kuah Beulangong (Gravy/Meat Cooked Curry Using Banana Stems)**

Kuah Beulangong gets its name from the cooking process that uses a large pot or cauldron which the people of Aceh call beulangong. Usually in one large cauldron it can accommodate up to more than 200 servings. Apart from that, what is unique about Aceh's culinary specialties, according to tradition, can only be cooked by men. People prefer to use banana stems because they are believed to have many benefits and can also overcome stomach aches.

Kuah Beulangong Aceh Rayek (gravy with banana stems) is a mixture of various substances, such as meat, spices, water and banana stems. This dish contains fat, protein, zinc, vitamin B1, iron, saponins, triterpenoids, steroids, flavonoids and tannins. In cooking this gravy, it is done in a cooperative way, which is cooked in a large pot, and the banana stems used specifically are searched for in the forest. This banana-like gravy, if it is poured in chemistry lessons at school, is a mixed process of ingredients.



Figure 5. Banana stems gravy

Banana plants are widely used by the community to fulfill their daily needs, from fruit, midrib to plant roots. Banana plants have many uses, this is because banana plants can be used as a whole from the leaves to the roots of the plant. Stem tubers or more commonly known as banana weevils can be used as a source of carbohydrates. These tubers can also be dried into ashes. The resulting ash contains soda which can be used as an ingredient in soap and fertilizer.

##### 5. Pliek U

Pliek is the remaining coconut whose oil has been squeezed out. The naturally fermented coconut meat is then squeezed to release coconut oil and the dregs are dried in the sun called Pliek U. This coconut oil is usually used as cooking oil called "Minyeuk Reutik". Pliek u is used by the community as the basic seasoning of Kuah Pliek U. Novalia et al (2018), pThe process of making pliek u takes approximately two weeks, until then it can be used for cooking seasoning. The community has a habit of storing pliek u for long-term consumption of up to one and a half years.

Kuah Pliek U is a traditional food, a kind of coconut milk dish, which is typical of the Aceh region. At first glance, this dish is almost similar to goulash, except that the contents are vegetables and the sauce is made from selected spices. Kuah Pliek U is a traditional food that is quite famous in the Aceh region, especially in the Aceh Jaya area. Apart from being consumed daily, Kuah Pliek U is also often served on certain occasions and is a special menu that is favored by the people there. It is said that Kuah Pliek U has been a favorite food for the people of Aceh since ancient times. The name Kuah Pliek U is taken from one of the basic ingredients in making this food, namely "Pliek U" or better known as Patarana (Mariyana, 2021).

One of the uniqueness of this food is the use of pliek u in the seasoning. The use of this pliek u will give a delicious aroma and give a distinctive taste to the broth. The special sauce combined with fresh vegetables makes this one food even more delicious. The

ingredients used are young jackfruit, young papaya, long beans, peanuts, melinjo leaves, melinjo fruit, bamboo shoots and pliek u. There are also those who add ingredients such as small shrimp, papaya leaves and others. While the spices used consist of coriander, chili, garlic, shallots, and other spices. Pliek u sauce contains many nutrients that can boost immunity, so it is good for health.

The results of Fuadi and Wahyuni's research (2015), mthe people of the village of Jangka Alue U utilize coconut products by producing pliek u, and the final processed product of pliek u will produce pliek u oil and charcoal business from coconut shells. Pliek u micro business is very dependent on maximum sunlight. Pliek u will be processed when the weather is hot. Sunlight will help the maximum drying process pliek u. Pliek u is one of the typical kitchen spices of the Acehese people which is used for making vegetables. The process of processing pliek u goes through several stages, namely: (1) The coconut fruit decomposition stage; (2) The stage of milling rotten coconuts; and (3) The drying stage of dried coconuts (pliek u). During the milling process, rotten coconuts will release coconut oil or better known as pliek u oil.

The process of making pliek u, if outlined in chemistry lessons at school, includes natural fermentation processes, filtration and pliek u sauce, which is a mixture of substances.



Figure 6. Pliek U Sauce

##### 6. Peulemak Oun Murong Boh Drien Putik (Coconut Milk from Young Durian Moringa Leaves)

Peulemak oun murong boh drien putik (coconut milk from young durian and moringa leaves) is moringa leaves cooked with coconut milk and young durian added, this in chemistry studies is a heterogeneous and colloidal mixture of the coconut milk used. Moringa leaves have many benefits for the body because they contain chemical compounds that are beneficial to the health of the body such as vitamins, carotenoids, polyphenols, phenolic acids, flavonoids, alkaloids, glucosinolates, tannins, saponins and oxalates.

Saputra, et al (2020) said that Moringa leaf extract contains phytochemical compounds that have great benefits in various fields. Phytochemical compounds found in Moringa leaves include: alkaloids, terpenoids, triterpenoids, steroids, saponins, quinones, phenols, antimicrobials, antibacterials, flavonoids, and tannins. Based on the content of phytochemical compounds, Moringa leaves can be used in various fields, including: health, pharmaceuticals, preservation, food, beauty, agriculture, gelling, medicine, and others. The

results of other studies also stated that *Moringa oleifera* leaf extract contained flavonoids, tannins, terpenoids, alkaloids, and saponins. These components are considered to be used as components of herbal medicine for health (Tenri, 2020).

*Moringa leaves (Moringa oleifera)* is a plant that lives a lot in Indonesia, both growing wild in nature and being cultivated by the local community. Before there were many studies regarding the phytochemical content of moringa, the community had long used *Moringa* leaves as an herbal plant because it was believed to be able to provide many benefits. *Moringa* leaves contain various phytochemical compounds, including tannins, steroids, flavonoids, saponins, and alkaloids, all of which are antioxidants. *Moringa* leaves also contain high antioxidants in which some of the main phenolic bioactive compounds are a group of flavonoids. All antioxidant phytochemical compounds in *Moringa* leaves have free radical neutralizing activity, provide significant protection against oxidative damage, inhibit cell aging, and protect bad cells from the stress of everyday life.

Research results by Saputra et al (2020), *Moringa* leaf extract contains phytochemical compounds that have great benefits in various fields. Phytochemical compounds found in *Moringa* leaves include: alkaloids, terpenoids, triterpenoids, steroids, saponins, quinones, phenols, antimicrobials, antibacterials, flavonoids, and tannins. Based on the content of phytochemical compounds, *Moringa* leaves can be used in various fields, including: health, pharmaceuticals, preservation, food, beauty, agriculture, gelling, medicine, and others.



Figure 7. *Moringa* leaves (*Moringa oleifera*)

#### 7. Peulemak Oun Paku (Coconut Fern Leaves)

Peulemak oun paku (coconut milk from fern leaves) is a special dish that is often cooked by the people of Aceh Jaya, especially in mountainous areas, because of the many ferns that are abundant in nature. Coconut milk fern leaves with special spices to produce a distinctive aroma. Ferns are one of the most abundant natural resources in the area and contain the chemical vitamins A and C, potassium, phosphorus, magnesium, calcium and protein. Fern leaves have many benefits for the body such as being an antioxidant in the body, maintaining eye health, increasing red blood cells, preventing diabetes, preventing heart and blood vessel disease, maintaining bone health. The results of the study by Sashanita et al (6), fern vegetable filtrate can increase hemoglobin levels, increase hemoglobin levels, hematocrit values, and the number of erythrocytes is due to the fact that fern is a plant that contains lots of minerals and vitamins. Iron (Fe) contained in vegetable ferns plays a role in the formation and maturation of red blood cells, which in this process is assisted by vitamin C which functions as a trigger for this iron. So that iron and vitamin C are interconnected in the formation and maturation of red blood cells. In chemistry learning Peulemak oun paku (fern coconut milk) is a mixture of colloids. A mixture of all

ingredients and spices, while coconut milk is a type of colloid, namely an emulsion consisting of a liquid dispersed phase and a liquid dispersion medium.



Figure 8. Fern plants in Aceh Jaya

#### 8. Oun Paku Tekerabe (Urap Fern).

In addition to dipulemak, the people of Aceh Jaya also often process fern leaves by sautéing them and making them like ointment (Oun Paku Tekerabe). In chemistry, Oun Paku Tekerabe is known as a mixture, because stemmed fern leaves are mixed with grated coconut and processed with other spices.

Paku-paku is a plant that is often consumed by the public because it has the ability to cure various diseases such as coughs, asthma, fever, headaches, diarrhea, and anti-dysentery. Different cooking processes can affect the nutritional content in a food ingredient, one of which is vitamin A. Based on the results of the study, the highest vitamin A content in ferns (*Diplazium escentum* (Retz.) Sw.) was highest in the sautéing type cooking process with a vitamin A content of 0.0594 for 10 minutes (Sauhaly et al 2018).

The content of fern plants include calories, carbohydrates, potassium, vitamin A, vitamin C, fiber, iron and calcium. Research results from Zakiyyah et al (2016), after counseling on the benefits and importance of ferns, it is hoped that the community will not just eat or consume them because of their delicacy, but the community will make vegetable ferns as an alternative to certain medicines when they are sick.

Ferns also very beneficial for pregnant women including good for fetal development, Fern has a very high vitamin A content. This content plays an important role in the development of the heart, lungs, kidneys, bones and eyes of the fetus in the womb. After giving birth, intake of vitamin A is beneficial to help restore the mother's body tissue, minimize the occurrence of infection, and maintain the health of the mother's eyes. The content of vitamin C can prevent high blood pressure which can cause infection for pregnant women. Rich in potassium makes this vegetable useful in maintaining heart health and improving electrolyte function and is useful for maintaining the bone health of pregnant women and preventing cramps that are often experienced by pregnant women.

#### 4. Conclusion

From the research results, can be concluded that the community still inherits regional specialties including jneuk drien (tempuyak durian), gule jneuk kerling (tempuyak durian ikan kerling), jneuk kweni (Mangifera odorata Griff), Kuah Bak Pisang Aceh

Rayeuk/ kuwah beulangöng (pot gravy/curry cooked meat using banana stems), pliek U, peulemak oun muring boh drien putik (coconut milk from young durian leaves), peulemak oun paku (coconut fern leaves), and oun Paku Tekerabe ( fern ointment).The special cuisine of the people of Aceh Jaya is the local wisdom of the community which can be poured into learning chemistry, the chemical processes found in the special dishes of the people are fermentation processes, mixtures of substances, separation of mixtures, acids and bases, solutions and colloids. The chemical constituents contained in these special dishes are vitamins A and C, glucose, protein, fat, nutrition, calcium, phosphorus, iron, minerals, carotenoids, polyphenols, flavinoids, alkaloids, tannins, saponins and oxalates.

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# 30 Pelatihan Penyusunan Modul Kimia Berbasis Kearifan Lokal bagi Guru SMA di Sungai Penuh Jambi

## Pelatihan Penyusunan Modul Kimia Berbasis Kearifan Lokal bagi Guru SMA di Sungai Penuh Jambi

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**Abstract:** This service program is carried out with the aim of providing knowledge and increasing teacher competence in compiling teaching materials in the form of modules based on local wisdom by integrating elements of cultural habits of the local community. The method used is training with technical lectures, discussions, questions - answers and assignments. This service program was attended by 12 science teachers at SMAN 2 Sungai Penuh. The evaluation form of this program is in the form of a response to the usefulness and impact obtained from the results of the activity through the distribution of questionnaires and using a question-and-answer method with qualitative descriptive techniques to determine the strategy for implementing the edmoscience module in the classroom learning process. The results achieved in this service are that the teacher really understands and strongly agrees that if edmoscience is integrated into the lesson, the teacher is also able to draft teaching materials containing local wisdom in the form of learning modules.

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**Abstrak:** Program Pengabdian ini bertujuan untuk meningkatkan pengetahuan dan kompetensi guru dalam menyusun bahan ajar berupa modul kimia berbasis kearifan lokal dengan mengintegrasikan unsur kebiasaan budaya masyarakat setempat. Metode yang digunakan adalah pelatihan dengan teknik ceramah, diskusi, tanya-jawab dan pengisian. Pengabdian ini diikuti oleh guru-guru IPA SMAN 2 Sungai Penuh sebanyak 12 orang. Instrumen evaluasi kegiatan ini menggunakan angket yang selanjutnya dianalisis secara deskriptif. Hasil pengabdian ini adalah guru SMA Negeri 2 Sungai Penuh memiliki kemampuan untuk menulisi dan mengintegrasikan bahan lokal yang dapat dijadikan sebagai materi pembelajaran kimia dan guru juga telah memiliki kompetensi untuk menyusun perangkat pembelajaran yang berbasis kearifan lokal yang dijadikan sumber belajar kimia.

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### Pendahuluan

Pengetahuan hidup di masyarakat dapat di transformasikan dalam media pembelajaran (Sudarmim & Asyhar, 2012). Pembelajaran dapat dikembangkan guru dengan mengacu kearifan lokal suatu daerah sebagai upaya untuk mengenalkan keunikan, budaya, tradisi suatu daerah (Duanayanti et al., 2013), serta kegiatan masyarakat dalam menangani masalah lingkungan (Oluwatomi Victor, Ajay et al., 2017). Proses pembelajaran dengan mengintegrasikan unsur budaya dalam bidang pendidikan merupakan perwujudan Prakeras yang perlu diapresiasi sebagai upaya menjaga kelestarian adat istiadat dan ciri khas suatu daerah, mengingat di era pesatnya perkembangan arus modernisasi yang bisa saja tergerus dan dilupakan oleh anak bangsa. Guru dapat memanfaatkan alam dan fenomena yang terjadi

di lingkungan sekitar sebagai sumber belajar IPA dengan menyisipkan nilai-nilai budaya, salah satunya pada pembelajaran kimia.

Kimia merupakan mata pelajaran yang memfokuskan peserta didik untuk mempelajari tentang prinsip, teori, komposisi, struktur, hidam dan reaksi kimia yang dapat dikaitkan dalam kehidupan nyata (Kurnia et al., 2022). Penyampaian materi kimia dengan topik yang asing bagi peserta didik menyebabkan peserta didik mengalami keulatan dalam memahami materi kimia. Sebaliknya, jika konsep yang dipelajari berhubungan dengan kehidupan sehari-hari peserta didik maka akan menghasilkan pembelajaran yang bermakna (Asnaningrum et al., 2018). Konsep kimia sangat relevan dengan dunia nyata dalam kehidupan sehari-hari, maka diperlukan pola pikir ilmiah yang sistematis melalui tahap-tahap pemecahan masalah (Syamsurizal, 2022) dengan disertai sebuah perangkat ajar yang mendukung, sehingga memudahkan siswa dalam mengenal konsep.

Kota Sungai Penuh merupakan salah satu kota agrobotani di Provinsi Jambi. Ketersediaan tumbuhan di alam sekitarnya dapat menjadi salah satu sumber pembelajaran kimia, misalnya pada pembelajaran asam dan basa pada pokok bahasan indikator alami yang bersifat konseptual dan biasa dijumpai dalam kehidupan sehari-hari (Rahmadansah et al., 2022). Guru ditantang agar mampu mendesain proses pembelajaran menggunakan bahan-bahan alam sekitarnya, contohnya pada Proses pembelajaran seharusnya juga menerapkan penguasaan *minds-on* (kognitif), *hearts-on* (afektif), serta aspek *hands-on* (psikomotor) (Hartini et al., 2019). Untuk menjangkau hal tersebut diperlukan sarana dan prasarana pendukung, misalnya perangkat pembelajaran berupa modul. Setiap guru pada setiap satuan Pendidikan sudah sepatutnya menyusun perangkat pembelajaran yang interaktif, dapat memotivasi dan menumbuhkan minat belajar (Supentri et al., 2022). Hal ini merupakan salah satu tuntutan guru dalam mengembangkan kompetensi profesional sehingga dapat dikatakan guru yang kreatif dan inspiratif. Penggunaan media menjadikan komunikasi antara guru dan siswa berjalan lancar sehingga materi dapat tersampaikan dengan baik.

Modul merupakan salah satu media penunjang bagi peserta didik yang memiliki gaya belajar visual karena materi kimia dominan bersifat abstrak (Hutabarat et al., 2021) sehingga materi akan mudah dipelajari. Guru dapat menggunakan modul untuk memaksimalkan pemahaman peserta didik serta memfasilitasi anak untuk mau dan bisa belajar mandiri (Sanova et al., 2022). Oleh karena itu, modul harus dikemas secara menarik, efisien, inovatif, disesuaikan dengan kebutuhan dan karakteristik peserta didik (Arimadona & Silvina, 2019), serta mengenalkan kebudayaan di daerah peserta didik (Fitri et al., 2019). Modul pembelajaran dapat dikembangkan dengan memperhatikan kearifan lokal daerah sehingga membuat peserta didik dapat diarahkan sesuai tujuan pembelajaran, serta meningkatkan kesadaran peserta didik untuk menjaga, melestarikan dan mengembangkan lingkungannya.

Hasil observasi awal pada pembelajaran kimia di SMA Negeri 2 Sungai Penuh menunjukkan bahwa pembelajaran yang dilakukan guru belum memanfaatkan kearifan lokal sebagai sumber belajar. Materi yang disampaikan terbatas sesuai kurikulum. Pemanfaatan lingkungan sekitar sebagai sumber pembelajaran kurang optimal dan belum mengintegrasikan antara nilai-nilai budaya yang terkandung dengan materi yang sedang diajarkan. Fakta menunjukkan hanya 41,17% peserta didik kelas XI yang mencapai nilai KKM (Kriteria Ketuntasan Minimal) pada mata pelajaran kimia yaitu 73. Selain itu, guru juga masih menggunakan metode pembelajaran konvensional seperti ceramah, demonstrasi dan diskusi sehingga peserta didik menjadi kurang termotivasi dan cenderung pasif dalam proses pembelajaran. Dengan memberikan keterampilan kepada guru-guru untuk menulisi materi kearifan lokal yang berasal dari lingkungan dimana peserta didik berada dan di

lingkungan sekolah diharapkan menghasilkan sebuah perangkat pembelajaran dengan konten kimia itu sendiri.

#### Metode Pengabdian

Metode pengabdian ini menggunakan pelatihan untuk meningkatkan keterampilan guru SMAN 2 Sungai Penuh dalam menyusun modul kimia berbasis kearifan lokal dengan teknis ceramah, diskusi, tanya-jawab, penugasan dan workshop terhadap guru-guru IPA yang di adakan di SMA Negeri 2 Sungai Penuh. Tahapan pelaksanaannya sebagai berikut:



**Gambar 1. Tahapan Kegiatan Pengabdian Kepada Masyarakat**

Secara rinci pelaksanaan kegiatan pengabdian kepada masyarakat ini dibagi dalam empat tahapan dengan rincian sebagai berikut :

#### 1) Menetapkan Masalah

Pada tahap awal ini guru diberi kesempatan untuk menganalisis pelaksanaan pembelajaran yang pernah dilakukannya selama ini. Kemudian dilanjutkan dengan mengidentifikasi masalah-masalah apa saja yang pernah dialaminya selama mengajar.

#### 2) Menyusun Draft

Setelah diketahui permasalahan pada langkah pertama maka guru mengumpulkan bahan seperti literature yang diperlukan untuk membuat draft awal penelusuran bahan yang bersumber dari kearifan lokal yang sesuai dengan tujuan pembelajaran.

#### 3) Pelatihan Penulisan dan Pendalaman Naskah

Pada tahap ini guru dibekali teknis penulisan dan penyajian naskah pembelajaran yang baik seperti memulai dengan menelusuri sumber bahan kimia berasal dari lingkungan sekitarnya, dengan cara bagaimana bahan tersebut dapat diperoleh, bagaimana sifat dari bahan alam tersebut, dan sebagainya.

#### 4) Evaluasi

Terdapat dua bentuk evaluasi dari program pelatihan ini, yang pertama adalah mengetahui feedback terkait respon kebermanfaatannya dan dampak yang di dapat kan dari hasil kegiatan ini melalui sebaran angket dan evaluasi yang kedua adalah dengan metode tanya-jawab dalam bentuk deskriptif kualitatif mengenai strategi implementasi penerapan modul etnosains dalam proses pembelajaran dikelas. Untuk mengetahui persepsi pemahaman guru dapat dilihat dari nilai persentase dan kriteria berikut ini :

**Tabel 1. Skala Penilaian Persepsi**

Skala Presentase Nilai	Tingkat Pemahaman
81%-100%	Sangat baik
61%-80%	Baik
41%-60%	Cukup
21%-40%	Tidak baik
0%-20%	Sangat tidak baik

#### Hasil Pengabdian dan Pembahasan

Kegiatan Pengabdian diawali dengan forum sesi berbagi informasi dan pengalaman serta diskusi. Dimasa pandemik Covid-19 pembelajaran dilaksanakan secara daring, di tambah lagi dengan ketersediaan bahan praktikum serta keterbatasan waktu pembelajaran yang semakin berkurang sehingga proses pembelajaran dirasa kurang efektif, sehingga problematika ini menuntut seorang guru untuk bisa berkeaktifitas merancang perangkat bahan ajar materi kimia sesuai dengan situasi dan kondisi daerah lokal.

Berdasarkan permasalahan tersebut diatas, dalam kegiatan pengabdian ini, dilanjutkan dengan menyusun draft yang berkaitan dengan metode yang akan dilakukan, bahan lokal apa saja yang bisa digunakan sebagai bahan ajar sesuai dengan tuntutan indikator dan bagaimana cara mengumpulkannya, kemudian menyiapkan perangkat pembelajaran dalam bentuk naskah bahan lokal kimia. Naskah ini selanjutnya digunakan pada kegiatan workshop kepada guru-guru bidang studi kimia dengan tujuan untuk menambah ide atau masukan. Di akhir kegiatan, para peserta diminta respon terkait refleksi hasil kegiatan. Pendapat dari peserta menyatakan 91,82% sangat memahami dan sangat setuju jika etnosains di integrasikan dalam pelajaran karena lebih kontekstual yang dapat menghubungkan teori pengetahuan ilmiah dengan unsur kebiasaan yang terjadi di tengah-tengah masyarakat.

Secara umum kegiatan pengabdian ini memfasilitasi kompetensi guru dalam mengembangkan dan memanfaatkan bahan lokal untuk materi pembelajaran kimia. Hal ini dapat dilihat dengan antusiasnya guru mengikuti langkah-langkah pengembangan, seperti aktif bertanya mengerjakan tugas-tugas yang diberikan dan sebagainya. Secara khusus peserta workshop ini mampu menyiapkan naskah pembelajaran berupa RPP dan mendiskusikan komponen modul pembelajaran kimia dimana materinya berkaitan dengan kearifan lokal.



**Gambar 2. Pelaksanaan Pengabdian**

Ada beberapa bahan kearifan lokal yang digunakan untuk pembelajaran kimia seperti materi untuk asam basa, koloid, larutan penyangga dan sebagainya. Hingga saat ini proses pengabdian masih tetap berlangsung yaitu penugasan terhadap peserta kegiatan untuk

menyiapkan materi pembelajaran seperti tersebut di atas. Salah satu perangkat pembelajaran yang sudah ada adalah Rencana Pelaksanaan Pembelajaran untuk materi asam basa. Misalnya menguji tingkat keasaman dari berbagai larutan, seperti air teh (asam), Air Cuka (asam), Deterjen (basa), Air Jeruk (asam) dan air sabun (basa). Dengan menggunakan reagen pereaksi yang berasal dari kearifan lokal yang terdapat disekitar kita. Adapun bahan kearifan lokal tersebut yang digunakan, seperti kol ungu, kembang sepatu, kembang telang, kulit manggis, pacar, bougeville dan kunyit.



**Gambar 4. Bahan yang Berasal dari Kearifan Lokal untuk Pembelajaran Kimia**

Luaran dari kegiatan pengabdian kepada masyarakat ini adalah terwujudnya contoh perangkat pembelajaran yang siap digunakan untuk kepentingan pembelajaran, khususnya untuk pembelajaran luring. Modul yang telah di rancang diharapkan dapat berkontribusi memberikan nilai positif terhadap kemajuan hasil belajar dan membangkitkan keaktifan dan semangat peserta didik untuk mau terus belajar. Berikut tampilan modul yang dibuat oleh para peserta.



**Gambar 5. Tampilan Isi Modul Berbasis Kearifan Lokal Kota Sungai Penuh**

Modul kimia berbasis kearifan lokal Kota Sungai Penuh pada materi larutan asam dan basa telah selesai dikembangkan. Modul ini bertujuan untuk mempermudah peserta didik dalam memahami materi larutan asam dan basa. Modul ini dikembangkan dengan paradigma konstruktivisme sebagai media penyampaian pesan yang digunakan seorang kepada peserta didiknya dengan mengoptimalkan proses interaksi (Atmojo et al., 2022). Materi yang disajikan pada modul juga dikaitkan dengan kehidupan sehari-hari dan kearifan lokal Kota Sungai Penuh mengenai tumbuhan lokal yang ada dengan tujuan peserta didik memahami materi larutan asam dan basa secara menyeluruh. Proses pembelajaran berbasis kearifan lokal mampu membuat peserta didik menggunakan kemampuan literasi sainsnya untuk memahami lingkungan hidup.

Melalui pelatihan mendesain banah ajar ini di harapkan dari hasil workshop ini tidak hanya cukup untuk di ikuti saja, namun juga dapat di implementasikan di dalam kelas yang daot dipergunakan oleh guru sebagai bahan ajar. Pembelajaran IPA yang di dukung dengan konsep etnosains dapat meningkatkan pengetahuan sains, melatih kemampuan berpikir dan berliterasi kimia dalam memanfaatkan bahan alam sebagai sumber belajar (Aulia Sanova et al., 2021). Penerapan unsur etnosains dalam proses pembelajaran merupakan sebuah inovasi yang perlu dikembangkan oleh guru dalam rangka melestarikan tradisi dan budaya lokal dihadirkan dalam sebuah materi pelajaran, sehingga peserta didik memperoleh pengetahuan yang bermakna dan berkualitas.

#### Kesimpulan

Berdasarkan hasil kegiatan pelaksanaan kegiatan pengabdian ini, maka dapat disimpulkan bahwa guru SMA Negeri 2 Sungai Penuh sudah mampu menelusuri dan menginventarisasi bahan lokal yang dapat dijadikan sebagai materi pembelajaran kimia dan guru juga telah memiliki kompetensi untuk menyusun perangkat pembelajaran yang berbasis kearifan lokal yang dijadikan sumber belajar kimia.

#### Saran

Kegiatan pelatihan ini sangat bermanfaat baik guru, siswa dan sekolah. Untuk menambah pengetahuan guru, maka kegiatan selanjutnya adalah mengadakan pelatihan senpa tentang kompetensi guru dalam menyusun model pembelajaran yang berbasis etnosains kepada seluruh guru di sekolah tersebut yang tentu nya perlu juga di support dan di fasilitasi oleh pihak sekolah maupun dari instansi Dinas Pendidikan atau dari Perguruan Tinggi.

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# 31 Ethnochemistry: Exploring The Potential Of Sasak And Javanese Local Wisdom As A Source Of Chemistry Learning To Improve The Learning Outcomes Of Pre-Service Teachers

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## Ethnochemistry: Exploring the Potential of Sasak and Javanese Local Wisdom as a Source of Chemistry Learning to Improve the Learning Outcomes of Pre-Service Teachers

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**Abstract.** Learning resource availability was still focused on abstract concepts without integrating them with students' daily experiences. This appears since the ethnochemistry approach implementation in universities is still rarely conducted. The purpose of this study is to analyze the relevance of Sasak and Java local wisdom with chemistry and explore the potential of Sasak and Java local wisdom as a learning resource in basic chemistry courses. The data collection instruments were observation, interviews, and documentation. In analyzing the data, the researcher used the Spradley data analysis technique. The instruments were chosen based on their suitability with the type of data to be analyzed. Furthermore, the data analysis techniques consist of four stages, namely: (1) domain analysis; (2) taxonomic analysis; (3) componential analysis; and (4) cultural themes analysis. Based on the research findings, it proved that the local wisdom of Sasak and Java, which consists of cultural products and local wisdom values in Sasak and Java culture, has relevance to chemistry material that can be used as a learning resource. Research conclusions include: (1) The relevance of Sasak and Java local wisdom with basic chemistry material can be reviewed based on the perspective or analogy approach, representation, and visualization; and (2) the potential of Sasak and Java local wisdom as learning resources in basic chemistry courses includes three subjects, namely: material and its changes, the periodic system of elements, and chemical bonds integrated with Sasak and Java local wisdom.

**Keywords:** Ethnochemistry, local wisdom of Sasak and Java, source of learning chemistry

### Introduction

The chemistry characteristics cover three domains called the chemical triangle: the macro domain or concrete, the abstract sub-micro in atoms, ions, and molecules, and the symbolic domain in equations, formulas, mathematical equations, and graphics. Likewise, learning chemistry at the university level must generate graduates with comprehensive knowledge (microscopic, macroscopic, and symbolic) and develop affective and psychomotor aspects to compete in the globalization era (De Jong, 2013). However, various research proved that educators have difficulty integrating the chemical triangle in learning, which results in students struggling to understand chemistry concepts, especially

the microscopic and symbolic domains. These difficulties impact students' low cognitive, affective, and psychomotor learning outcomes (Wahyudiati, 2021). In this way, lecturers are expected to implement chemistry learning based on the chemistry triangle, supported by the learning resources integrated with students' daily experiences. That is to meet the chemistry learning objectives optimally through constructivism-based learning practices.

The application of constructivism-based learning equipped with relevant learning resources will make learning more significant. The essence of constructivism learning theory is the acquired students' knowledge and experience are the result of construction that has been carried out through students' active involvement, both physically and mentally (Sumardi et al., 2020; Wahyudiati et al., 2020; Laksuno & Wibowo, 2022; Widarta & Atika, 2021; Fitriyah & Fardhani, 2022). Knowledge and experience are acquired through sensory, motoric, and scientific thinking processes and finally formulated in the mind as knowledge and skills (Coll et al., 2002; Wahyudiati et al., 2019; Wwit, et al., 2013). The principle of constructivism-based learning is in line with Vygotsky's theory of cognitive development which emphasizes the organization of classroom situations, the application of strategies, and the interaction between educators and students, including the influence of the social environment on students' thinking development (Fadli, 2019; Sumardi et al., 2020). The social environment can be in the form of cultural objects and symbols, social institutions, and language. Symbols produced by culture help students to think, communicate, and solve problems to adapt their thinking processes (Ador, 2017; Hasanah et al., 2016). Hence, applying constructivism-based learning (active and innovative learning models) equipped with learning resources integrated with local wisdom will activate students in constructing new knowledge to develop students' cognitive, affective, and psychomotor aspects. Nevertheless, the development of integrated chemistry learning resources with local wisdom has not been elaborated on and is still focused on abstract concepts, making chemistry a complex subject for students to understand (Abungu, et al., 2014; Abonyi, et al., 2014; Sutrisno et al., 2020; Wahyudiati, 2016). Accordingly, one of the efforts to make students easier to understand chemistry through the availability of relevant learning resources in their daily lives is integrating the chemistry material with local wisdom or the ethnochemistry implementation.

Ethnochemistry is a variety of cultural practices that exist in society and are chemically related, which describes the chemical practices of cultural groups that can be identified as the study of chemical ideas and can be found in any culture (Ador, 2017; Rahmawati et al., 2017). In other words, *ethno* refers to members of a community group in any cultural environment that can be identified through cultural traditions, codes, symbols, myths, and specific ways to consider and conclude. Previous studies of ethnochemistry learning through cultural products showed positive results. For instance, using cultural products as a learning resource had an impact on increasing students' cognitive learning outcomes, affecting students' scientific attitudes and human rights (Abramova & Greer, 2013; Ador, 2017; Rahmawati et al., 2017; Rosa & Clark, 2011; Sumardi & Wahyudiati, 2021).

However, cultural integration in chemistry learning and practice is still scarce (Abramova & Greer, 2013; Rosa & Clark, 2011). Research trends in chemistry from 2004 to 2013, which raised local culture in a study, was only 1.7% (Wahyudiati, 2016; Wahyudiati et al., 2020). The globalization era has also led to behavioral deviations and a lack of cultural-based learning guidance (Abramova & Greer, 2013; Fadi, 2018; Fadi & Irwanto, 2020; Rosa & Clark, 2011). Moreover, the real problem is the availability of chemistry teaching materials integrated with local wisdom in the basic chemistry course. Therefore, it is crucial to instill ethnochemistry in learning through cultural products and the surrounding environment as learning resources and natural laboratories since the current factual conditions have shown the shortage of ethnochemistry integration with curriculum, learning tools, and the learning materials preparation (Sutrisno et al., 2020;

Abramova & Greer, 2013). The advantages of ethnochemistry-based chemistry teaching materials can help students easier to understand chemical concepts because they are directly related to students' daily experiences, which are the implementation of constructivism learning theory.

Referring to the theoretical and empirical studies above, the urgency of this research is to provide one of the best chemistry learning solutions by integrating ethnochemistry into the curriculum. The learning process is placed in the cultural heritage context as the substance of understanding concepts and scientific investigations based on natural laboratories based on local wisdom values (Ador, 2017; Singh, 2016; Sumardi & Wahyudiati, 2021; Fiteriani, et al., 2021; Sriyati, et al., 2021; Zuhaida & Mubtasyiroh, 2022), including Sasak and Java tribes value. The Sasak and Java tribes' values are relevant to chemistry learning, which is reflected in their traditions that come from their social system, value system, and local cultural products. Therefore, by exploring the potential of Sasak and Java local wisdom as a source of learning chemistry and natural laboratories, it is hoped it could develop students' cognitive, affective, and psychomotor aspects. All in all, this research explored the potential of Sasak and Java local wisdom that can be used as a learning resource and natural laboratory in basic chemistry courses as a form of implementing ethnochemistry in the university's curriculum. The purpose of this study is to analyze the relevance of Sasak and Java local wisdom with chemistry and explore the potential of Sasak and Java local wisdom as a learning resource in basic chemistry courses.

### Methods

This ethnographic research adopted the qualitative approach. The ethnography research consists of stages of description, analysis, and interpretation. The description stage was performed to explore the background of the problem through initial observations and interviews related to the research object. The analysis stage was completed to obtain precise data based on the formulation of the problem and research objectives. Lastly, interpreting and concluding the analyzed data was done in the interpretation stage.

The data collection instruments were observation, interviews, and documentation. In analyzing the data, the researcher used the Spradley data analysis technique. The instruments were chosen based on their suitability with the type of data to be analyzed. Furthermore, the data analysis techniques (Spradley, 2007) consist of four stages, namely; (1) domain analysis; (2) taxonomic analysis; (3) componential analysis; and (4) cultural themes analysis. In the interview activities, the informants involved consisted of community leaders, cultural leaders, and chemical content experts so that accurate data were obtained regarding the relevance of Sasak and Javanese culture to chemical materials. Furthermore, the observation and documentation activities aim to obtain primary data related to cultural products, value systems and social systems of the Sasak people that have relevance to chemical concepts so that the data obtained from this activity supports data from interviews that have been carried out previously.

Based on the analysis model, the data analysis stages of this research are elaborated as follows; After collecting the data, domain and taxonomy analyses were performed to select, simplify, or sort the data recorded in the observation sheets and interviews, including discarding unnecessary data. The data were sorted and grouped by type. After reducing and analyzing the data, they were arranged into a systematic arrangement and then analyzed by relating it with relevant theories and previous research results (componential analysis and cultural themes). After completing those processes,

conclusions were drawn based on the data analysis result, answering the research problem formulations.

### Results and Discussion

Based on the research findings, it proved that the local wisdom of Sasak and Java, which consists of cultural products and local wisdom values in Sasak and Java culture, has relevance to chemistry material that can be used as a learning resource. Chemistry concepts can be integrated with Sasak local wisdom from the analogy perspective, representation, and visualization to make students easier to understand the pictures by using culture as a learning resource and natural laboratory.

An analogy approach explains the comparative relationship by referring to the relationship between two different concepts that have relevant meanings (Samara, 2016). The application of an analogous approach between chemistry learning domains can be made by integrating students' everyday life experiences relevant to the chemistry concept (Sutrisno, et al., 2020). The analogy perspective of the implementation between domains in chemistry learning based on Sasak and Java local wisdom can be instigated in chemical bonds learning material. The relevance of Sasak and Java culture (from the perspective of analogy between domains) with chemical bonds can be seen through the tradition of *merariq* (Sasak wedding) and *manten* (Java wedding). They consist of the *nenarih* and *sorong* (proposing) process in Sasak tradition and the Java *serah-serahan* procession. The similarities between those traditions with chemistry lie in the theory or underlying concepts, meanings, and values. The values of local wisdom are based on the mutual need concepts through the handover between the male and female parties, which is legalized through marriage. The concept of needing each other through the transfer of electron pairs to achieve stability is the concept that underlies the formation of chemical bonds (Wahyudiati & Fitriani, 2021; Wahyudiati, 2021; Fadli, 2018). It is similar to the formation concept of ionic bonds through the transfer of electron pairs between positive and negative ions to achieve a stable electron configuration or resemble the electron configuration of noble gases (Prasatiawan, 2009).

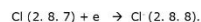
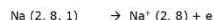


Figure 1. The *sorong serah* ceremony of Sasak tribe in *merariq* tradition



Figure 2. The tradition of *srah-srahan* of Java tribe

Ionic bonds are formed due to the attraction force between positively charged ions and negatively charged ions resulting from the transfer of electrons between the atoms that form the bond. The attraction force on these bonds is called electrostatic or Coulomb. Ionic bond results from the electrostatic attraction between a cation and an anion to achieve stability with an electron configuration resembling a noble gas. An example of an ionic bond is the formation of sodium chloride or NaCl (salt). In the formation of NaCl compounds through the transfer of electrons, the sodium atom releases a valence electron to form sodium ions or Na<sup>+</sup>. The chlorine atoms accept these electrons to form chloride or Cl<sup>-</sup> ions. Furthermore, chloride ions and sodium ions attract each other by electrostatic force resulting in an ionic bond.



The concept of ionic bonding is not only related to the Merarik tradition of the Sasak and Javanese tribesmen, but also related to the concept of metal bond formation in the chemical bond theory which is formed by the attractive force that occurs between the positive charge of metal ions and the negative charge of free moving electrons (Sukardjo, 1990). As for the relevance of the Merarik tradition, especially in Nenarih Activities, a girl is given the opportunity to make her own decisions without coercion from anyone. The submission of questions in nenarih activities can be done directly by the prospective husband or through his respected Subandar (delegation) or Jeruman (youth agency in the community) (Saito, 1996; Djelenga, 2000). The goal is to clarify the status of the girl who is currently not promising another man to marry her. Furthermore, after getting reassurance from the girl, it was determined when the girl would be brought to the groom's house. Usually in the tradition of Kawin Iari (the bride and groom eloped) in the Sasak tribe, the one who picks up the girl becomes rushed (te most) beside the groom, it is also accompanied by several men and women. Furthermore, the girl who was going to be hunted was already waiting outside the house. If the girl is retrieved without interference,

the girl is hidden in someone else's house, usually at a family member's place, not in the house of the future husband. This is known as the 'Sebo' (hiding the bride-to-be) tradition.

In addition, the interaction between two or more atoms is always accompanied by the expenditure of energy. The concept of energy expenditure in the chemical bonding theory has a strong relationship with the existence of Ajikrama tradition (amount of customary payment or related fees), in which the submission of all customary prices is carried out in a ceremony called sorong serah. The force that holds the atoms in a molecule together is called the chemical force of bonding. Chemical bonding is a force or interaction that causes atoms to bond together as molecules or causes atoms, ions, and molecules to bond together as more complex and stable bonds (Sukardjo, 1990; Achmad & Tupamahu, 2001). Using the analogy approach in chemistry learning creates more meaningful and joyful learning in which students become more motivated to be actively involved in the process. Likewise, the previous research (Lerman, 2003; Sutrisno, et al., 2020) showed that the analogous approach implementation in chemistry learning makes learning more exciting and significant; it improves learning outcomes. In addition, this ethnochemistry-based learning makes students more motivated and attracted to learning chemistry concepts associated with everyday life compared to studying chemistry abstract concepts.

The integration of basic chemistry 1 material with Sasak and Java local wisdom is also viewed from a visualization perspective or the chemical triangle concept approach consisting of microscopic, macroscopic, and symbolic components (Jhonstone, 2006)—implementing a visualization approach in chemistry learning by integrating the subject matter and its changes with local Sasak and Java wisdom. The concept of material and its changes are integrated with local Sasak and Java wisdom reflected in using chemical elements from various metals such as gold, silver, bronze, copper, and other metals of traditional ceremonial tools. For example, the jewelry of Sasak and Java brides is made of gold, silver, and bronze (Djelenga, 2000). A *keris* is an object that is considered sacred and is usually used at the wedding ceremony of the Sasak and Java tribes. The hilt of a *keris* for the nobility is usually gold (Au) and Ag (Djelenga, 2000; Wahyudiati, 2021). Gold has an atomic number of 79. The arrangement of the outermost electrons of gold is related to the yellow color of gold (Sukardjo, 1990; Saito, 1996). For the groom, the *keris* is attached to the right waist and symbolizes courage and masculinity (Figure 3). Similarly, the Java groom also wears *keris*, namely the *ronce keris melati* decorated with jasmine flowers (Figure 4).



Figure 3. The *keris* attribute on a groom



Figure 4. Keris ronce melati

Compounds and mixtures are widely used in the Sasak and Java lives, for instance, in the manufacture of traditional art tools such as *gong*, *terumpang*, *kenceng*, which are made from a combination of two or more metals. *Gong* musical instruments in the Sasak community are made of brass or copper in the shape of a large frying pan, and there is a small circle in the middle in the form of a lump, as shown in Figure 5. The Java *gong* musical instrument is a part of the traditional Java *Gamelan* art made of brass or copper, as shown in Figure 6.



Figure 5. Gong of Sasak Lombok tribe



Figure 6. Gong of Java musical instrument

The physical changes found in Sasak and Java local wisdom include the coloring of *Sesek* cloth, the manufacture of *sia* or salt, and the *belulut* tradition (covering the floor of a traditional Sasak house with cow feces). Examples of chemical changes are the manufacture of *gule beaq*, fermentation of *oncom* and *peuyeum*, *poteng reket* (fermented sticky rice), *poteng ambon* (fermented cassava), and the coloring of *Sesek* cloth. Kitchen salt in the Sasak language, known as "sia" is one of the local potentials owned by Lombok, known as a seaweed-producing area and a producer of local salt. Kitchen salt is traditionally produced by salt farmers in several areas such as East Lombok, North Lombok, and West Lombok by heating seawater with the help of sunlight, as shown in Figure 7. The principle of chemical change application can be found in the local wisdom of the Java, namely in *Oncom* manufacture. *Oncom* is a traditional food typically from West Java, as shown in Figure 8. The *oncom* fermentation process is obtained from a mixture of molds mixed with remaining peanut meal, tofu pulp, soybean pulp, or coconut pulp, which is fermented to the spore stage. There are two types of *oncom*, namely red *oncom* and black *oncom*. Usually, red *oncom* is made from tofu cake or soybeans that have been extracted for protein in the tofu manufacture. Meanwhile, black *oncom* is generally made from peanut cake mixed with cassava pulp.



Figure 7. The process of producing kitchen salt in West Lombok



Figure 8. Java special food, Oncom



Salt is an ionic compound consisting of positive ions (cations) and negative ions (anions) to form neutral compounds (without charge). The salt formation can also occur through acid-base reactions. Cation and anion components can be created from inorganic compounds such as chloride ions (Cl<sup>-</sup>) or organic compounds like acetate compounds (CH<sub>3</sub>COO<sup>-</sup>), and monatomic ions such as fluoride (F<sup>-</sup>), or can be from polyatomic ions such as sulfate (SO<sub>4</sub><sup>2-</sup>). Sodium chloride (NaCl) is the main component of kitchen salt that people widely use. Kitchen salt is obtained from processing sea water (salt solution); after being heated by sunlight, the water content will evaporate and form crystals/solids. The chemical reactions that occur in the processing of seawater into salt are:



The advantages of applying the visualization approach are essential for chemistry learning through providing examples of the existence of elements, compounds, and mixtures found in everyday life that are relevant to everyday experiences or the culture of the students themselves. These findings are also supported by previous studies, which proved that providing concrete examples in students' daily lives can make learning more exciting and meaningful. Students become more motivated to learn to develop representational skills in chemistry learning in college (Santos & Arroio, 2016; Wahyudiati, 2016). Likewise, previous studies explained that high motivation students would be more active in doing assignments and constructing knowledge that positively impacts learning outcomes obtained by Fadli, 2019; Wahyudiati, et al., 2019; Wahyudiati, 2021.

In addition, the findings also showed that the local wisdom of Sasak and Java has very relevant potential to be integrated with the subject matter of introductory chemistry courses. Those are matter and its changes, the periodic system of elements, and chemical bonds integrated with Sasak and Java local wisdom. The advantages of basic chemistry teaching materials integrated with Sasak local wisdom can increase students' interest, motivation, and activeness in understanding basic chemistry 1 material which has relevance to students' daily lives. The meaning of learning is realized by integrating chemical concepts with the values of local wisdom of the community, which is widely applied in people's daily activities, for instance, the making of *poteng* (sticky rice tape) and *oncom*, which in the process apply the concept of chemical change. Learning activities that refer to the context of students' lives are implementing constructivism learning theory. The findings of previous studies asserted that the constructs of students' new knowledge and experiences would be more meaningful if it is associated with their prior knowledge and experiences. Therefore, it will positively impact students' cognitive, affective, and psychomotor abilities (Sumardi et al., 2020; Wahyudiati et al., 2020; Fadli, 2018; Wahyudiati, 2020; Wahyudiati, 2021). Furthermore, the previous relevant studies also believed that ethnochemistry-based learning processes or activities affect learning outcomes, scientific attitudes, and students' science skills (Ango, 2002; Browman, et al., 2011; Frambach, et al., 2012; Sutrisno, et al., 2020; Wahyudiati, 2022). Chemistry learning activities supported by the availability of ethnochemistry-based learning resources refer to the context of students' lives local wisdom values relevant to chemical concepts that can be used as supporting learning resources and references in conducting scientific investigations. The implementation of

ethnochemistry in learning, whether in the form of integration with learning models, integration with learning strategies, or as a source of learning and scientific investigation, can develop scientific attitudes, critical thinking skills, scientific process skills, and improve cognitive learning outcomes of students (Ador, 2017; Wahyudiati, 2020; Wahyudiati, 2021; Wahyudiati & Fitriani, 2021). Thus, by exploring the potential of Sasak and Java local wisdom as a source of learning chemistry and natural laboratories is possible to develop knowledge, scientific attitude, and critical thinking and increase the younger generation's love for their culture.

### Conclusion

Research conclusions include: 1) the local wisdom of Sasak and Java, which consists of cultural products and local wisdom values in Sasak and Java culture, has relevance to chemistry material that can be used as a learning resource and chemistry concepts can be integrated with Sasak local wisdom from the analogy perspective, representation, and visualization to make students easier to understand the concepts by using culture as a learning resource and natural laboratory; and 2) the potential of Sasak and Java local wisdom as learning resources in basic chemistry courses includes three subjects, namely: material and its changes, the periodic system of elements, and chemical bonds integrated with Sasak and Java local wisdom.

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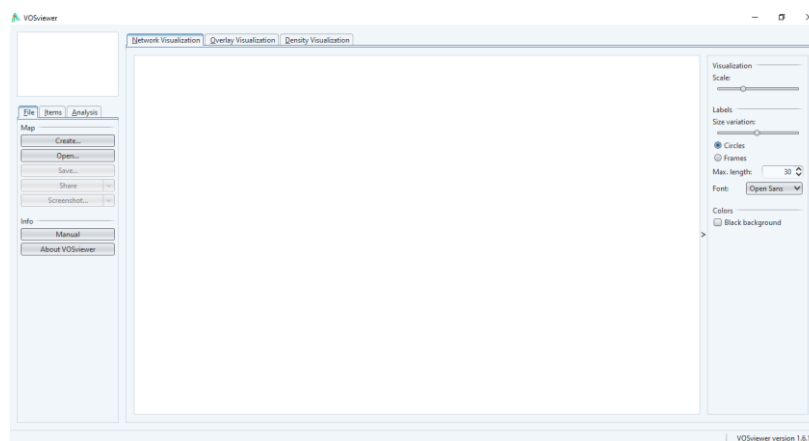
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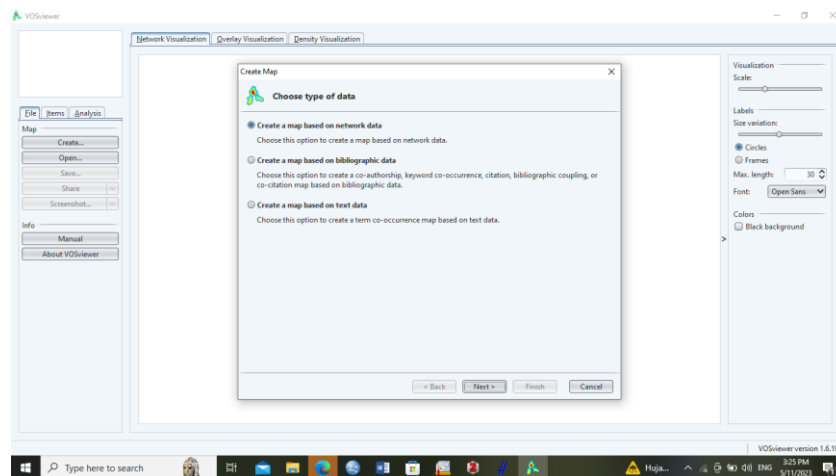
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- Wahyudiati, D. 2021. Ethnochemistry: analisis relevansi materi sistem periodik unsur dengan kearifan lokal sasak. *SPIW-Jurnal Kimia & Pendidikan Kimia*, 3(2):190-199.
- Wahyudiati, D. 2022. Implementation of Islamic education concept in ethnochemistry. *Tarbiyatuna*, 13(1):19-28.
- Widarta, F.A. & Artika, W. 2021. Analisis bentuk stimulus, dimensi kognitif, dan karakteristik hots pada instrumen evaluasi mata pelajaran ipa karya guru. *JUPI (Jurnal IPA dan Pembelajaran IPA)*, 5(3):197-208.
- Wiwit, Ginting, S.M., & Firdaus, M.L. 2013. Penerapan pembelajaran kimia dasar menggunakan media powerpoint 2010 dan phet simulation dengan pendekatan modification of reciprocal teaching berbasis konstruktivisme. *Exacta*, 11(1):29-32.
- Zuhaida, A. & Mubtasyiroh, Z. 2022. Efektivitas model project based learning dengan pendekatan berbasis lingkungan terhadap hasil belajar ipa. *JUPI (Jurnal IPA dan Pembelajaran IPA)*, 6(2):119-129.

Lampiran 6. Analisis Data Menggunakan *VOSviewer*

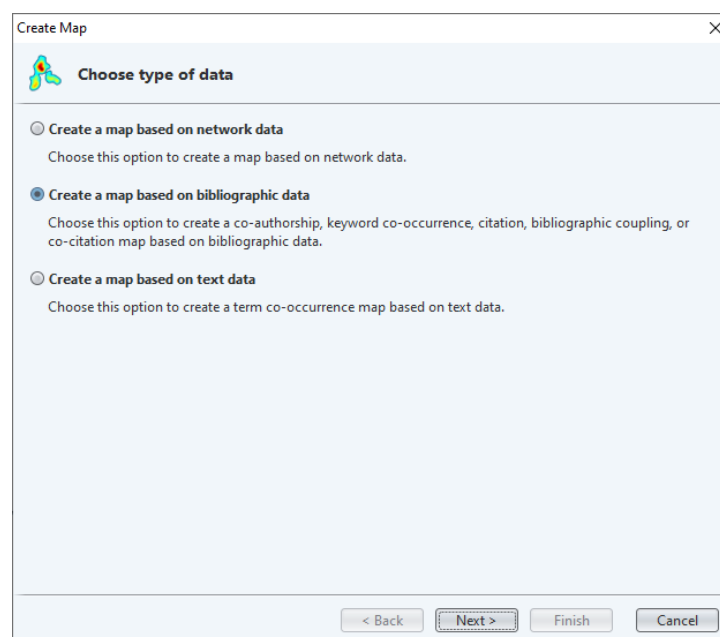
Tampilan Awal



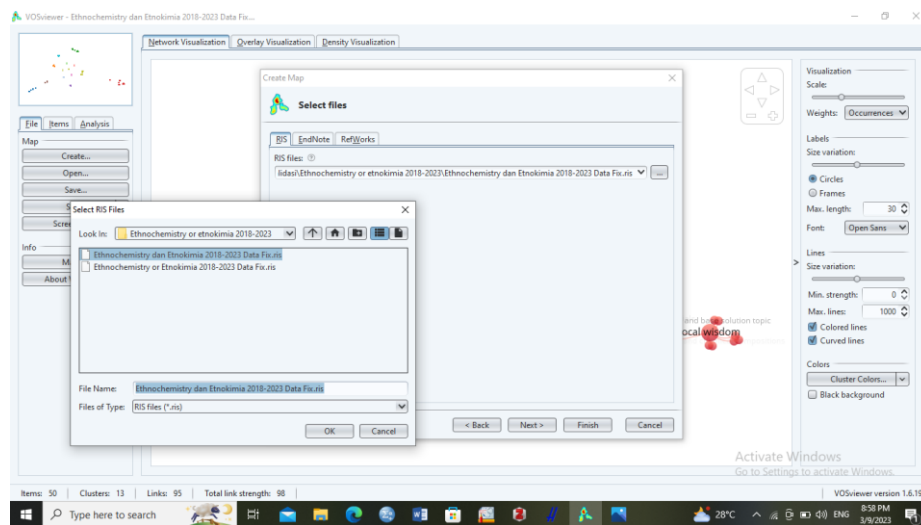
Tampilan Layar Awal aplikasi



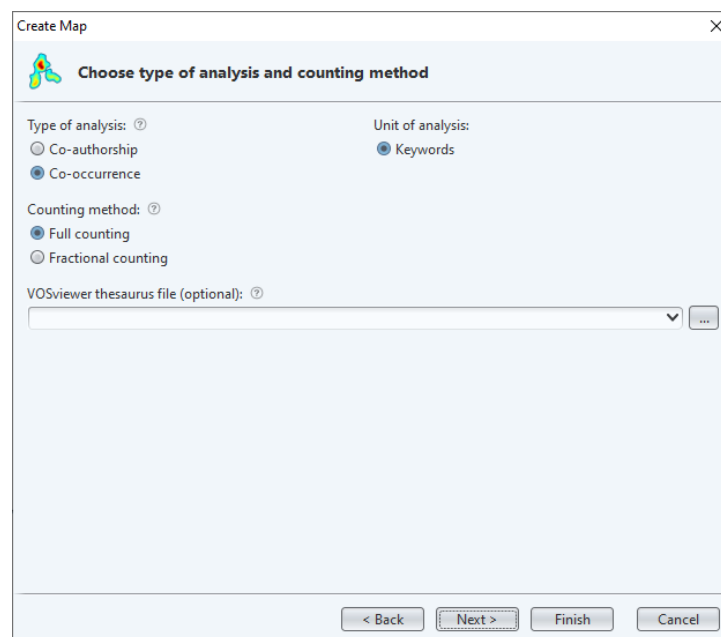
Proses Analisis Awal Dimulai dengan Klik *Create* Untuk Membuat Jenis Analisis



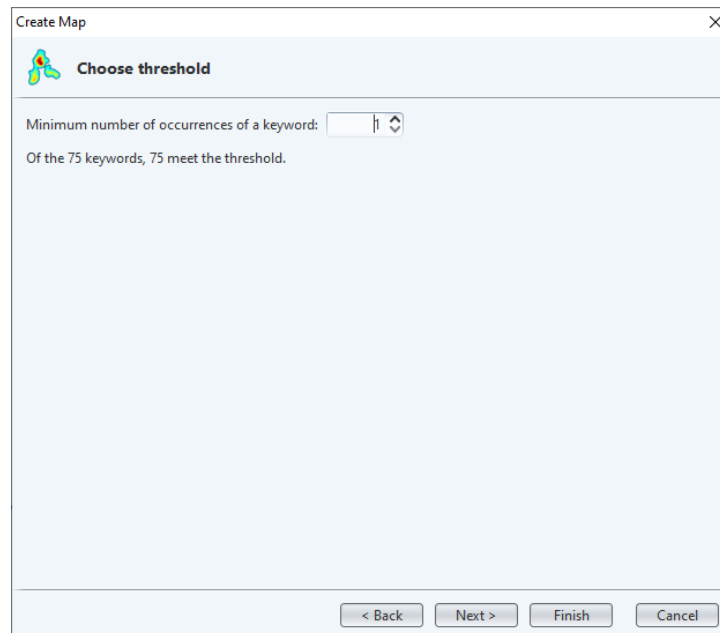
Pilih *create a map based on bibliographic data*



Menambahkan File Data dengan Format RIS untuk Dianalisis

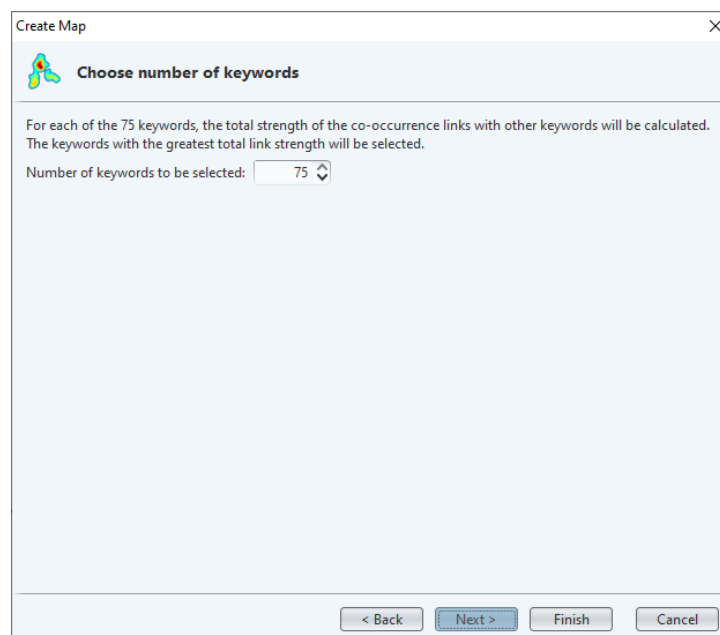


Pilih *Co-Occurrences* untuk Dapat Menganalisis Berdasarkan Kata Kunci.



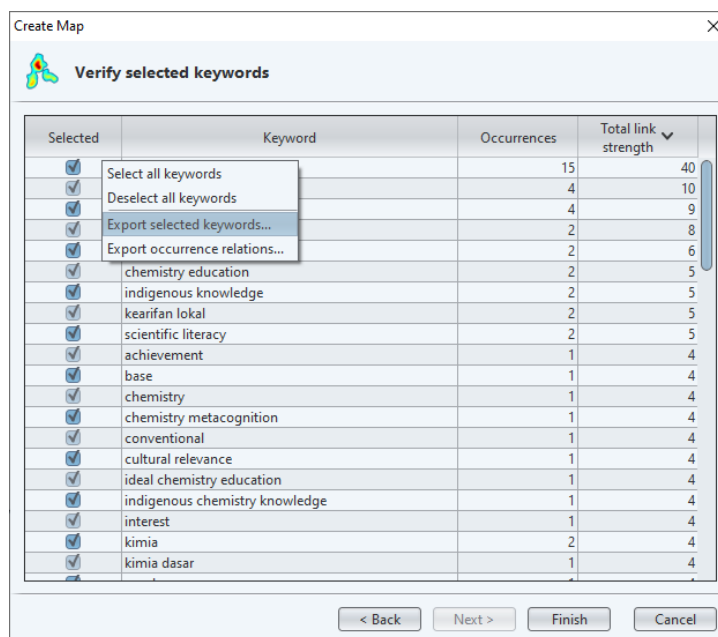
The screenshot shows a dialog box titled "Create Map" with a close button (X) in the top right corner. Below the title bar is a header area with a small icon and the text "Choose threshold". The main content area contains the text "Minimum number of occurrences of a keyword:" followed by a text input field containing the number "1" and a spinner control. Below this, it says "Of the 75 keywords, 75 meet the threshold." At the bottom of the dialog, there are four buttons: "< Back", "Next >", "Finish", and "Cancel".

Jumlah Minimum Kata Kunci Awal yang ada dalam Data Artikel Jurnal

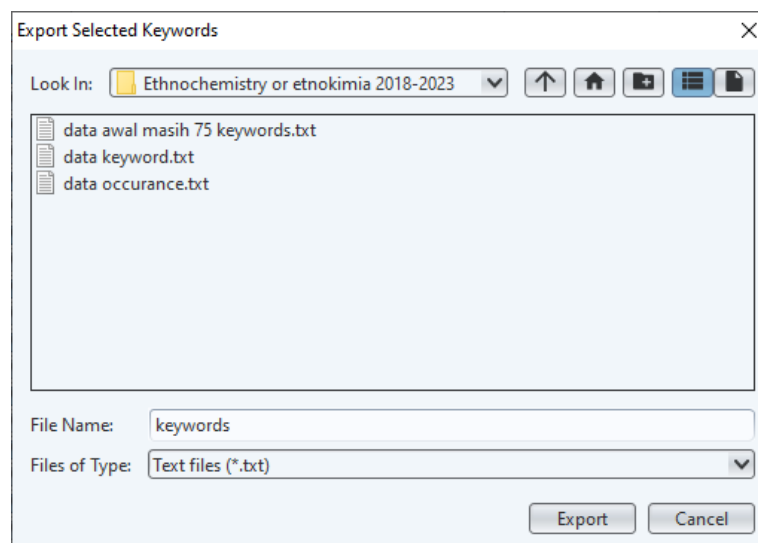


The screenshot shows a dialog box titled "Create Map" with a close button (X) in the top right corner. Below the title bar is a header area with a small icon and the text "Choose number of keywords". The main content area contains the text "For each of the 75 keywords, the total strength of the co-occurrence links with other keywords will be calculated. The keywords with the greatest total link strength will be selected." Below this, it says "Number of keywords to be selected:" followed by a text input field containing the number "75" and a spinner control. At the bottom of the dialog, there are four buttons: "< Back", "Next >", "Finish", and "Cancel".

Jumlah Kata Kunci Awal yang dapat Digunakan



Mengekstrak Kata Kunci Awal yang Dihasilkan



Mengekstrak Kata Kunci yang akan di seleksi



label	replace by
1	
2	21st century skills
3	achievement
4	acid
5	acid and chemical compositions
6	acid and base solution topic
7	acid and base solution topic
8	base
9	chemistry
10	chemistry curriculum
11	chemistry education students
12	chemistry learning
13	chemistry metacognition
14	chemistry module
15	colloid system
16	conventional
17	critical thinking skills
18	ort approach
19	culturally responsive teaching
20	cultural relevance
21	culture
22	curriculum development
23	development
24	education for sustainable development
25	development
26	electronic module
27	ethnochemistry based learning experient
28	ethnochemistry
29	ethnochemistry
30	ethnochemistry
31	ethnochemistry
32	ethnochemistry
33	ethnochemistry

### Pembuatan *Thesaurus* menggunakan MS Excel

**Create Map**

Choose type of analysis and counting method

Type of analysis:  Co-authorship  Co-occurrence

Unit of analysis:  Keywords


Counting method:  Full counting  Fractional counting

VOSviewer thesaurus file (optional):

< Back Next > Finish Cancel

### Menentukan Jenis dan Unit Analisis

Create Map ×


 **Choose threshold**

Minimum number of occurrences of a keyword:

Of the 45 keywords, 45 meet the threshold.

Jumlah Kata Kunci Minimum yang Dipilih

Create Map ×

 **Choose number of keywords**

For each of the 45 keywords, the total strength of the co-occurrence links with other keywords will be calculated. The keywords with the greatest total link strength will be selected.

Number of keywords to be selected:

Jumlah Kata Kunci yang Dipilih

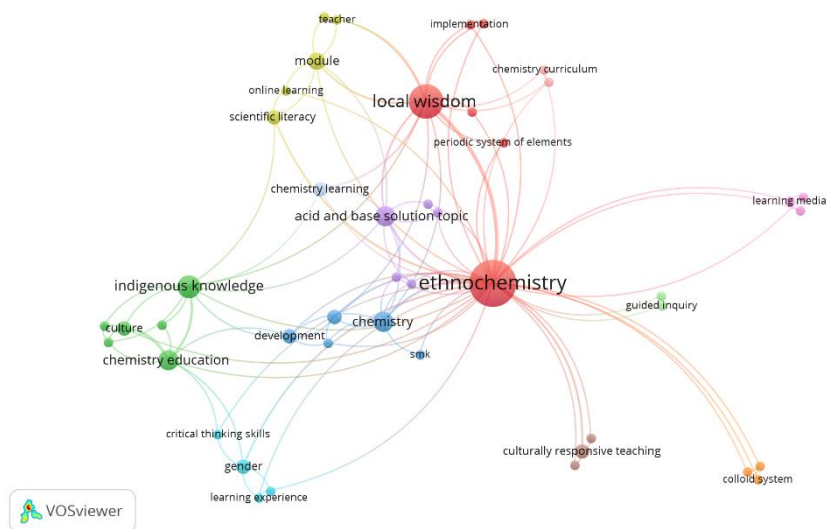
Create Map

Verify selected keywords

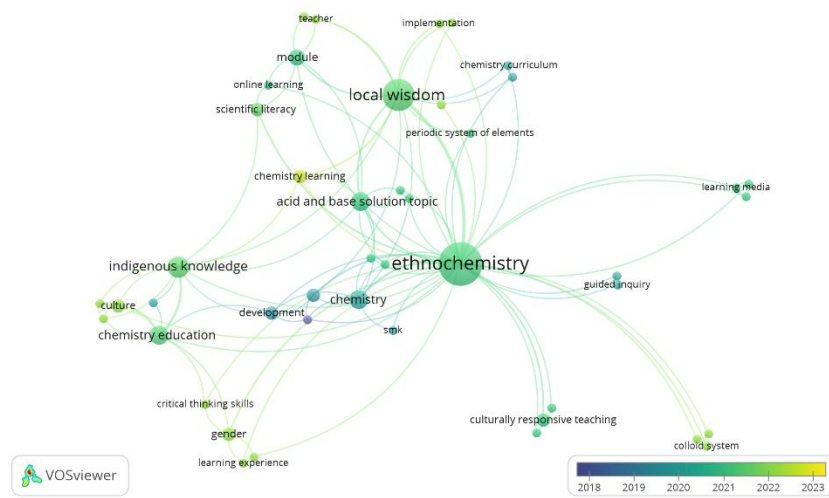
Selected	Keyword	Occurrences	Total link strength
<input checked="" type="checkbox"/>	ethnochemistry	21	52
<input checked="" type="checkbox"/>	local wisdom	11	24
<input checked="" type="checkbox"/>	indigenous knowledge	5	13
<input checked="" type="checkbox"/>	acid and base solution topic	4	12
<input checked="" type="checkbox"/>	chemistry	4	11
<input checked="" type="checkbox"/>	chemistry education	4	11
<input checked="" type="checkbox"/>	module	3	8
<input checked="" type="checkbox"/>	development	2	6
<input checked="" type="checkbox"/>	gender	2	6
<input checked="" type="checkbox"/>	practicum	2	6
<input checked="" type="checkbox"/>	chemistry learning	2	5
<input checked="" type="checkbox"/>	culture	2	5
<input checked="" type="checkbox"/>	scientific literacy	2	5
<input checked="" type="checkbox"/>	chemistry metacognition	1	4
<input checked="" type="checkbox"/>	conventional	1	4
<input checked="" type="checkbox"/>	culturally responsive teaching	2	4
<input checked="" type="checkbox"/>	guide	1	4
<input checked="" type="checkbox"/>	interest	1	4
<input checked="" type="checkbox"/>	pre- service science teachers	1	4
<input checked="" type="checkbox"/>	achievement	1	3

< Back   Next >   Finish   Cancel

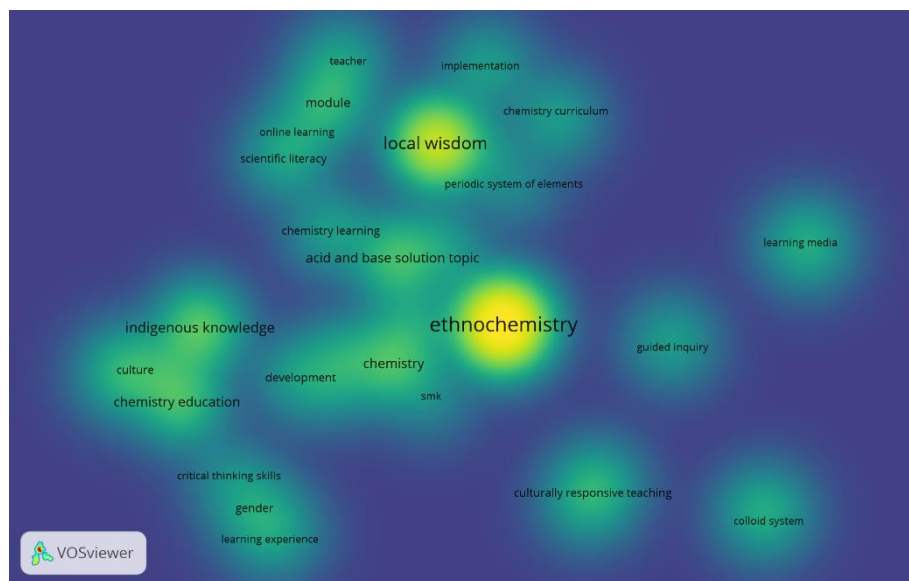
### Pemilihan Kata Kunci yang Relevan dengan Penelitian



### Network Visualization



*Overlay Visualization*



*Density Visualization*

Lampiran 7. *Thesaurus***Tabel 2** Daftar Kata/Istilah yang dibuat *Thesaurus*

<b>No</b>	<b>Label</b>	<b>Replace By</b>
1	<i>acid</i>	<i>acid and base solution topic</i>
2	<i>and chemical compositions</i>	<i>acid and base solution topic</i>
3	<i>base</i>	<i>acid and base solution topic</i>
4	<i>chemistry education students</i>	<i>chemistry education</i>
5	<i>chemistry module</i>	<i>module</i>
6	<i>crt approach</i>	<i>culturally responsive teaching</i>
7	<i>cultural relevance</i>	<i>culture</i>
8	<i>curriculum development</i>	<i>development</i>
9	<i>education for sustainable development</i>	<i>Development</i>
10	<i>ethnochemistry-based learning experience</i>	<i>ethnochemistry</i>
11	<i>etho-chemistry</i>	<i>ethnochemistry</i>
12	<i>etnokimia</i>	<i>ethnochemistry</i>
13	<i>gender differences</i>	<i>gender</i>
14	<i>guru</i>	<i>teacher</i>
15	<i>hasil belajar</i>	<i>learning outcomes</i>
16	<i>ideal chemistry education</i>	<i>chemistry education</i>
17	<i>indigenous chemistry knowledge</i>	<i>indigenous knowledge</i>
18	<i>indigenous cuisine</i>	<i>indigenous knowledge</i>
19	<i>inkuiri terbimbing</i>	<i>guided inquiry</i>
20	<i>kabupaten bantul</i>	<i>local wisdom</i>
21	<i>kearifan lokal</i>	<i>local wisdom</i>
22	<i>kearifan lokal sasak</i>	<i>local wisdom</i>
23	<i>kimia</i>	<i>chemistry</i>
24	<i>kimia dasar</i>	<i>chemistry</i>
25	<i>local wisdom of sasak and java</i>	<i>local wisdom</i>
26	<i>modul kimia</i>	<i>module</i>
27	<i>pelatihan</i>	<i>training</i>
28	<i>pengembangan</i>	<i>development</i>
29	<i>potensi budaya lokal</i>	<i>local wisdom</i>
30	<i>praktikum</i>	<i>practicum</i>
31	<i>pre- service science teachers</i>	<i>teacher</i>
32	<i>sasak</i>	<i>local wisdom</i>
33	<i>sasak local wisdom</i>	<i>local wisdom</i>
34	<i>sistem periodik unsur</i>	<i>periodic system of elements</i>
35	<i>source of learning chemistry</i>	<i>chemistry learning</i>

## Lampiran 8. Surat Keputusan tentang Penetapan Dosen Pembimbing Skripsi



KEPUTUSAN DEKAN FAKULTAS TARBIYAH DAN KEGURUAN  
UIN ANTASARI BANJARMASIN  
NOMOR 327 TAHUN 2022  
TENTANG  
PENETAPAN DOSEN PEMBIMBING SKRIPSI SEMESTER GANJIL  
TAHUN AKADEMIK 2022/2023

DEKAN FAKULTAS TARBIYAH DAN KEGURUAN UIN ANTASARI,

- Menimbang : a. bahwa untuk kelancaran mahasiswa Fakultas Tarbiyah dan Keguruan UIN Antasari Banjarmasin membuat skripsi, maka perlu menetapkan Dosen-Dosen Fakultas Tarbiyah dan Keguruan untuk menjadi pembimbing;  
b. bahwa nama-nama sebagaimana tersebut dalam Surat Keputusan ini dipandang mampu dan cakap untuk ditetapkan sebagai Dosen Pembimbing Skripsi dimaksud.
- Mengingat : 1. Undang-Undang RI No. 20 Tahun 2003 tentang Sistem Pendidikan Nasional;  
2. Peraturan Presiden RI Nomor 36 Tahun 2017 tanggal 3 April 2017 tentang Universitas Islam Negeri Antasari Banjarmasin;  
3. Peraturan Pemerintah No. 60 Tahun 1999 tentang Pendidikan Tinggi;  
4. Surat Keputusan Menteri Agama No. 30 Tahun 2017 tentang Organisasi dan Tata Kerja UIN Antasari;  
5. Surat Keputusan Menteri Agama No. 36 Tahun 2017 tentang Statuta UIN Antasari Banjarmasin;  
6. Keputusan Rektor IAIN No. 217A Tahun 2012 tentang Perubahan atas Keputusan Rektor No. 72 Tahun 2007 tentang Pedoman Penulisan Skripsi Program Strata Satu (S-1) IAIN Antasari Banjarmasin.
- Memperhatikan : Usul Ketua Program Studi Tadris Kimia Tanggal 16 Desember 2022
- MEMUTUSKAN:
- Menetapkan : KEPUTUSAN DEKAN FAKULTAS TARBIYAH DAN KEGURUAN UIN ANTASARI TENTANG PENETAPAN DOSEN PEMBIMBING SKRIPSI MAHASISWA SEMESTER GANJIL TAHUN AKADEMIK 2022/2023
- Pertama : Menunjuk dan menugaskan kepada:
- |                  |                                             |
|------------------|---------------------------------------------|
| Nama             | : Trining Puji Astutik, S.Si., S.Pd., M.Pd. |
| NIP/NUP          | : 201701030                                 |
| Pangkat/Golongan | : Penata Tk.1 /III/d                        |
| Jabatan Akademik | : Lektor                                    |
- Sebagai Pembimbing Skripsi
- Untuk membimbing mahasiswa penyusun skripsi:
- |               |                                                                                 |
|---------------|---------------------------------------------------------------------------------|
| Nama          | : Resty Utami                                                                   |
| NIM           | : 190101090092                                                                  |
| Jurusan/Prodi | : Tadris Kimia                                                                  |
| Judul Skripsi | : Analisis Bibliometrik Etnokimia pada Pembelajaran Kimia Menggunakan Vosviewer |
- Kedua : Biaya akibat dikeluarkannya keputusan ini dibebankan kepada DIPA UIN Antasari Banjarmasin.
- Ketiga : Keputusan ini berlaku sejak tanggal ditetapkan, dengan ketentuan bahwa apabila terdapat kekeliruan dalam penetapan ini, maka akan diadakan perbaikan dan perubahan sebagaimana mestinya.

Ditetapkan di Banjarmasin  
pada tanggal 16 Desember 2022  
DEKAN,



- Tembusan:
1. Rektor UIN Antasari Banjarmasin;
  2. Ketua Jurusan;
  3. Dosen Pembimbing;
  4. Arsip.

## Lampiran 9. Surat Keterangan Telah Melaksanakan Seminar Proposal Skripsi



**KEMENTERIAN AGAMA REPUBLIK INDONESIA**  
**UNIVERSITAS ISLAM NEGERI ANTASARI BANJARMASIN**  
**FAKULTAS TARBIYAH DAN KEGURUAN**  
PROGRAM STUDI TADRIS KIMIA  
Jalan Jenderal Ahmad Yani Km. 4.5 Banjarmasin 70235  
Telepon (0511) 3257627; Faksimili (0511) 3254344;  
Website: www.uin-antasari.ac.id; E-mail: info@uin-antasari.ac.id

SURAT KETERANGAN  
Nomor: B-02/Un.14/III.1.n/PP.00.9/01/2023

Yang bertanda tangan di bawah ini, menerangkan bahwa:

Nama : Resty Utami  
NIM : 190101090092  
Jurusan/Prodi : Tadris Kimia

adalah benar telah melaksanakan Seminar Proposal Skripsi yang berjudul:

Analisis Bibliometrik Etnokimia pada Pembelajaran Kimia Menggunakan VOSviewer

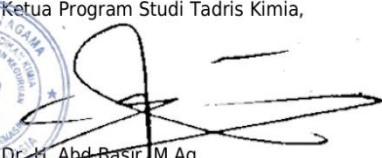
Pada Hari/ Tanggal : Senin/26 Desember 2022

Tempat : Ruang 2.1 Fakultas Sains dan Teknologi Kampus 2 UIN  
Antasari Banjarmasin

Demikian surat keterangan ini dibuat, untuk dipergunakan sebagaimana mestinya.

Banjarmasin, 09 Januari 2023  
Ketua Program Studi Tadris Kimia,



  
Dr. H. Abd Basir, M.Ag.  
NIP 196810041995031003

## Lampiran 10. Surat Riset Dekan Fakultas Tarbiyah dan Keguruan UIN Antasari Banjarmasin



**KEMENTERIAN AGAMA REPUBLIK INDONESIA  
UNIVERSITAS ISLAM NEGERI ANTASARI BANJARMASIN**

**FAKULTAS TARBIYAH DAN KEGURUAN**

Jalan Jenderal Ahmad Yani Km. 4.5 Banjarmasin 70235

Telepon: (0511) 3262426; (0511) 6783136

E-mail: ftk@uin-antasari.ac.id Website: ftk.uin-antasari.ac.id

**SURAT RISET**

Nomor : B-26/Un.14/III.1/PP.00.9/02/2023

Yang bertanda tangan tangan Wakil Dekan Bidang Akademik dan Kelembagaan Fakultas Tarbiyah dan Keguruan UIN Antasari, dengan ini menugaskan kepada :

Nama : Resty Utami  
NIM : 190101090092  
Semester : VIII (Delapan)

Alamat : Sebamban III Blok D Rt 08/Rw 04 Ds. Tri Martani, Kec. Sungai Loban, Kab. Tanah Bumbu, Prov. Kalimantan Selatan, Kode Pos 72274

Tugas : Melakukan Riset / Penelitian Ilmiah dalam rangka pengumpulan data untuk penyusunan Skripsi sarjana dengan Judul :

**ANALISIS BIBLIOMETRIK ETNOKIMIA PADA PEMBELAJARAN KIMIA MENGGUNAKAN VOSVIEWER**

Tempat Penelitian : Prodi Tadris Kimia  
Lamanya Riset : 2 (Dua) Bulan  
Dari Tanggal : 06 Februari 2023  
Sampai Tanggal : 06 April 2023


Demikian surat Riset diberikan kepada ybs, agar pihak-pihak yang berkepentingan dapat memberikan bantuan seperlunya.

Banjarmasin, 07 Februari 2023

Wakil Dekan Bidang Akademik dan Kelembagaan,

  
Dr. Ahmad Muradi, M.Ag  
NIP 197808082005011006

Mahasiswa yang bersangkutan,

  
Resty Utami  
190101090092





**KEMENTERIAN AGAMA REPUBLIK INDONESIA  
UNIVERSITAS ISLAM NEGERI ANTASARI BANJARMASIN  
FAKULTAS TARBİYAH DAN KEGURUAN**

Jalan Jenderal Ahmad Yani Km. 4.5 Banjarmasin 70235  
Telepon: (0511) 3262426; (0511) 6783136  
E-mail: ftk@uin-antasari.ac.id Website: ftk.uin-antasari.ac.id

Nomor : B-361 /Un.14/III.1/PP.00.9/02/2023 07 Februari 2023  
Sifat : Penting  
Lampiran : 1 (Satu) Berkas  
Hal : Mohon Izin Riset

Yth.Kepala Prodi Tadris Kimia  
Kota Banjarmasin

*Assalamu'alaikum Wr.Wb*

Sehubungan rencana penelitian yang akan dilaksanakan oleh mahasiswa (i) dalam rangka penyusunan skripsi, maka dengan ini kami mohon izin serta bantuan Bapak/Ibu agar kiranya berkenan memberikan informasi/data yang diperlukan oleh :

Nama : Resty Utami  
NIM : 190101090092  
Program Studi : Tadris Kimia  
Fakultas : Tarbiyah dan Keguruan  
Alamat : Sebamban III Blok D Rt 08/Rw 04 Ds. Tri Martani, Kec. Sungai Loban, Kab. Tanah Bumbu, Prov. Kalimantan Selatan, Kode Pos 72274  
No HP : 082219261482

Demikian surat keterangan ini kami sampaikan, atas perhatian dan perkenan Bapak/Ibu serta kerjasamanya yang baik kami ucapkan terimakasih.  
*Wassalamu'alaikum Wr.Wb*

Wakil Dekan Bidang Akademik dan  
Kelembagaan,



Ahmad Muradi

Tembusan :  
Dekan Fakultas Tarbiyah dan Keguruan

## Lampiran 11. Surat Keterangan Telah Selesai Melaksanakan Penelitian



**KEMENTERIAN AGAMA REPUBLIK INDONESIA**  
**UNIVERSITAS ISLAM NEGERI ANTASARI BANJARMASIN**  
**FAKULTAS TADRIH DAN KEGURUAN**  
PROGRAM STUDI TADRIH KIMIA  
Jalan Jenderal Ahmad Yani Km. 4.5 Banjarmasin 70235  
Telepon (0511) 3257627; Faksimili (0511) 3254344;  
Website: www.uin-antasari.ac.id; E-mail: info@uin-antasari.ac.id

**SURAT KETERANGAN SELESAI PENELITIAN**

Nomor: B-47/Un.14/III.1.n/PP.00.9/05/2023

Berdasarkan surat dengan Nomor: B-361/Un.14/III.1/PP.00.9/02/2023, Saya yang bertanda tangan di bawah ini Ketua Prodi Tadris Kimia Fakultas Tarbiyah dan Keguruan UIN Antasari Banjarmasin, menerangkan bahwa:

Nama : Resty Utami  
NIM : 190101090092  
Jurusan/Prodi : Prodi Tadris Kimia  
Judul Skripsi : Analisis Bibliometrik Etnokimia pada Pembelajaran Kimia Menggunakan VOSviewer

menjelaskan bahwa mahasiswa yang bersangkutan telah melakukan penelitian terhitung mulai tanggal 06 Februari 2023 sampai dengan tanggal 06 April 2023.

Demikian surat keterangan ini dibuat dan digunakan sebagaimana mestinya.

Banjarmasin, 23 Mei 2023

Ketua Prodi Tadris Kimia,



Dr. H. Abd Basir, M.Ag.

NIP 196810041995031003

## Lampiran 12. Lembar Konsultasi

**BUKU KONSULTASI  
BIMBINGAN SKRIPSI**

NAMA : RESTY UTAMI  
NIM : 190101090092  
PROGRAM STUDI : TADRIS KIMIA  
TANGGAL SURAT PENETAPAN : 16 DESEMBER 2022  
DOSEN PEMBIMBING SKRIPSI  
TANGGAL SEMINAR PROPOSAL : 26 DESEMBER 2022  
DOSEN PEMBIMBING : TRINING PUJI ASTUTIK, S.Si.,  
S.Pd., M.Pd.

## JUDUL SKRIPSI :

ANALISIS BIBLIOMETRIK ETNOKIMIA PADA PEMBELAJARAN KIMIA  
MENGUNAKAN *VOSVIEWER*



**UNIVERSITAS ISLAM NEGERI ANTASARI  
FAKULTAS TARBIYAH DAN KEGURUAN  
BANJARMASIN  
TAHUN 2023/1444 H**

**PETUNJUK PENGISIAN  
BUKU KONSULTASI BIMBINGAN SKRIPSI  
FAKULTAS TARBIYAH DAN KEGURUAN**

1. Buku ini harus selalu dibawa setiap konsultasi dengan pembimbing
2. Setiap konsultasi, mahasiswa mencatat hasil konsultasi pada buku ini, kemudian ditandatangani oleh pembimbing.
3. Buku Konsultasi Bimbingan Skripsi dilampirkan sebagai salah satu persyaratan untuk pendaftaran ujian skripsi
4. Buku Konsultasi Bimbingan Skripsi ini harus diserahkan ke program studi bersamaan dengan pengumpulan berkas lain sebagai syarat kelulusan mahasiswa.




LEMBAR KONSULTASI

**REKAPITULASI KEGIATAN KONSULTASI**

No.	Tanggal	Bab/Bagian
1	18 Januari - 06 Februari 2023	Instrumen validasi
2	10 Maret 2023	Analisis Data
3	18 - 19 Mei 2023	BAB 3
4	23 Mei 2023	BAB 4
5	30 Mei 2023	BAB 5
6	01 Juni 2023	BAB 1 dan 2
7		
8		
9		
10		

Ke-	Tanggal	Catatan Konsultasi	Tanda Tangan
1.	18/1/23	Konsultasi terkait instrumen validasi untuk lembar validasi kualitas artikel jurnal	<i>ABS</i>
2.	20/1/23	konsultasi terkait instrumen validasi kualitas artikel jurnal	<i>ABS</i>
3.	23/1/23	konsultasi terkait pemilihan data artikel jurnal yang sesuai dengan topik penelitian sebelum dilakukan validasi.	<i>ABS</i>
4.	06/2/23	konsultasi terkait revisi instrumen validasi kualitas artikel jurnal berdasarkan saran dari validator	<i>ABS</i>
5.	10/03/23	Konsultasi terkait data hasil analisis yang telah dilakukan untuk meninjau ketercapaian data	<i>ABS</i>
6.	19/03/23	konsultasi terkait kerangka penulisan Bab 3, 4 dan 5	<i>ABS</i>
7.	18/05/23	konsultasi terkait penulisan Bab 3 (metodologi penelitian) terutama penulisan isi.	<i>ABS</i>
8.	18/05/23	konsultasi terkait isi Bab 3 yang sebelumnya sudah direvisi.	<i>ABS</i>
9.	23/05/23	konsultasi terkait penulisan isi bab 4	<i>ABS</i>
10.	30/05/23	konsultasi terkait penulisan isi bab 5	<i>ABS</i>

Ke-	Tanggal	Catatan Konsultasi	Tanda Tangan
11.	01/06/23	konsultasi terkait penulisan lei Bab 1 dan 2, serta pengesahan keperluan	

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Banjarmasin, 05 Juni 2023



Resty Utami