

The Effect of Contextual Collaborative Learning Based Ethnoscience to Increase Student's Scientific Literacy Ability

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ABSTRACT

Scientific literacy is used as the primary goal in science education because it is considered to be used to prepare today's generation. Aspects of scientific literacy consist of the concepts, processes, and attitudes of science that can be used in people's daily lives, a picture of the success of science education carried out by each country. However, this ability has not been trained optimally through the process of learning science in Indonesia. This research aims to increase students' scientific literacy ability through contextual collaboration learning based on ethnoscience. This study used a quasi-experimental research method with a pre-experimental design that involved pretest and posttest of one group. This research has been conducted in the Chemistry Education UNDIKMA Mataram for the number of research subjects as many as 31 students. The instrument used is multiple choice tests to measure the achievement the content and process of science students while attitude scale to measure students' scientific attitudes. The results showed that the achievement of content, process, and science attitudes of students overall has increased in the medium category. This means that the effect of contextual collaborative learning based ethnoscience the capacity of scientific literacy in content, process, and attitude of students.

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Introduction

Advances in science and technology have both positive and negative impacts on human life. Positive effects arise due to various facilities that can improve the quality of human life. Ethical, moral, and global issues are negative impacts resulting from the development of science and technology (Sari et al., 2017). Therefore, students need to be equipped with the ability to care and respond to issues that develop in society, think critically and creatively to plan problem solving, and have in-depth knowledge and understanding to be applied in problem-solving (Eny & Wiyarsi, 2019). This can be achieved if students have scientific literacy.

Scientific literacy also refers to the multiplicity of literacy associated with the use of digital technology in the field of science in the form of electronic technology which includes hardware and software that support the science learning process. Therefore, important scientific literacy is

developed because (1) understanding of science can provide individual satisfaction and pleasure after studying nature; (2) to make a decision needed information and scientific thinking; (3) every public discourse and debate needed the involvement of science and technology; (4) and scientific literacy is needed in the world of work because it involves higher-order thinking skills are reasoning, creative thinking, making decisions, and solving problems (Wulandari, 2016). The above description shows the importance of someone having a literacy in science. Therefore scientific literacy is used as a benchmark in education quality.

Scientific literacy can be promoted by problem solving skill in personal and social (Lederman et al., 2013). Therefore, its development on every individual is extremely important. Every individual is demanded to have scientific literacy covering its scientific knowledge, scientific process skill, and scientific attitude. With this, scientific literacy development is important. Every individual is obligated to have scientific literacy including scientific knowledge, scientific process skill, and scientific attitude. Scientific literate society is able to use scientific knowledge, identify questions, and draw a conclusion based on the evidence, in accordance to understand as well as to generate decision related to nature and its changes done to nature through human activities. Erman et al., (2020) suggested that the development of scientific literacy was very important because it could contribute to the social and economic life, as well as to improve making decision skill at the community level and personal. It was strengthened by Wen, et al., (2020) that an individual has scientific literacy skill and technology. It is a person eligible to solve problems by using scientific concepts gained in education based on his level, recognizing product of technology around him, and its positive impact, or the use of the product and its maintenance, creative in creating simplified product technology so his learners are able to decide based on local values and custom.

The findings of this study (OECD, 2018) stated that student literacy achievement is low from all aspects (content, process and context). The 2018 PISA results for scientific competence, Indonesia ranked 62 out of 71 participating countries. In terms of the distribution of literacy itself, nationally only 25.38% of scientific literacy is considered sufficient, while 73.61% is deemed insufficient. This is confirmed by Yustin & Wiyarsi (2019) that the learning environment and climate at school influence variations in student literacy scores. Students scientific literacy is low indicate that there are still many students have not been able to measure body temperature properly, playing on the field in heavy rain, throwing garbage in the river without regard to cleanliness and disasters that can occur from his actions, likes foods that contain additives, not even a few high school students have started smoke. This condition is the causes of the low ability of students' scientific literacy. Therefore we need learning that can train students' scientific literacy skills. Learning that is considered a potential to practice students' scientific literacy skills is contextual collaborative learning based ethnosience.

Contextual collaborative learning is a method of combining two methods or modification of the contextual and the collaborative method (Rochayati et al., 2018). Collaboration learning prioritizes learning that involves several students joined together in groups that have different abilities and thoughts for each individual (Ulfiana et al., 2016). Combined with contextual learning, matrices are presented according to the student environment, so students can understand and develop their knowledge (Setiyorini, 2018). Contextual is a holistic learning process that aims to help students understand personal, social and cultural contexts in daily life so students have skills and knowledge of dynamic and flexible (Dewi et al., 2018). Contextual is a connecting learning model real world situations that aim to equip students with knowledge that can applied in concrete daily life (Yulianto & Zaini, 2019). In contextual collaboration learning involves real life contexts either incidentally or informally as an effort to create situations that give rise to specific student-centered learning outcomes. The contextual collaboration learning model is built on the basis that knowledge is a social construction which is a social effort through collaborative learning that focuses on the process and results of being important factors for monitoring and assessing the effectiveness of contextual collaborative learning (Jaimini, 2014). Furthermore, contextual collaborative learning, students are required to work together in small groups to achieve common ground academic goals, such as group assignments related to explaining observed phenomena in everyday life (Xiao, 2012). Dang (2017)

stated that collaborative learning was contextual play an important role in the environmental-based group learning experience. Contextual collaborative learning is a significant shift from a teacher-centered approach, where social interaction is emphasized so that students are able to read, respond and participate by conveying opinions and ideas to discuss and solve problems in everyday life (Haruzuan et al., 2014).

One attempt to explore the environment as a source of learning in science learning is to integrate culture as part of society which is known as ethnoscience learning. Ethnoscience is the recommended study in Indonesia today because it can grow students' awareness in rediscovering the values of local wisdom and integrating them into the learning process (Wati et al., 2021). Ethnoscience is one of them activities that turn original science into scientific science (Dewi et al., 2019). Ethnoscience can make it easier for students to dig facts and phenomena that exist in society and can be integrated with science (Khoiri et al., 2019). Ethnoscience learning can transforming teacher-centered learning into centered on students as a contextual and meaningful learning (Sumarni, 2018). Students can not only understand material but also apply it in their daily life (Sudarmin et al., 2018). This more attractive to students to learn naturally related science and apply it to living environment (Rahmawati et al., 2019). This learning is also local culture as a part of student appreciation in the form of culture (Wati et al., 2021). Ethnoscience is an interdisciplinary science that combines human and cultural anthropology with science education. The study of the scientific knowledge that is gained by examining the local knowledge that is contained in the culture of a community or ethnic group. Local awareness is derived from local communities' thought and ideas about daily life, including customs, beliefs and views on the world (Lestari & Fitriani, 2016). Ethnoscience, rooted in students' lives, is a type of contextual experience (Setiawan et al., 2017). Ethnoscience will allow students to investigate the facts and phenomena present in society and be integrated with scientific knowledge (Melyasari et al., 2018). Ethnoscience can captivate learners because it's connected to their own regional identity. Ethnoscience may also encourage knowledge and preserve local culture (Supriyadi & Nurvitasari, 2019).

Chemistry learning can be integrated into ethnoscience because it involves contextual experience in everyday life about local wisdom into learning materials and a phenomenon that exists in society (Dewi et al., 2019). Learning chemistry is theoretically teaching students to have the ability to identify chemical problems and making a conclusion based on evidence for the sake of recognizing natural changes and the effect of human interaction on nature (Gorokhov, 2010). This complex world changes quickly, which requires an understanding of chemistry to handle it (Fitriyanti et al., 2019). Because understanding chemistry literacy is highly demanded in formal education (Sumarni et al., 2017). It means that the students should not only know and memorize things related to the concepts of chemistry but also understand and implement it in their daily life (Marks & Eilks, 2009). According to Ariningtyas (2017); Ibe & Nwosu (2017) that scientific literacy can be increased through learning chemistry charge ethnoscience. Perwitasari et al. (2017) & Usman et al. (2019) showed that learning application based ethnoscience in chemistry can improve students' scientific literacy. Andriani, et al. (2019) stated that contextual based chemistry module development can build student understanding of concepts. The ethnoscience model of chemistry learning can improve scientific literacy for students (Dewi et al., 2019; Basyari et al., 2019; Fathonah & Subali, 2020).

A study showed that contextual collaboration learning can understand and develop their knowledge (Said et al., 2014; Zhong et al., 2012; Wiyarsi et al., 2020). This was confirmed by (Masfufah & Ellianawati, 2020) that the learning model using a contextual with ethnoscience can improve students' scientific literacy ability in developing local cultural values. Supriyadi & Nurvitasari (2019) founded that contextual learning based ethnoscience can inventory indigenous science that grows and develops in the Malind (Papua) tribe. Supriyadi et al., (2020) stated that malind ethnoscience has the potential to be developed in contextual learning tools. Rahmawati et al., (2019) founded that ethnoscience-based contextual learning has a significant influence on student learning outcomes and activeness.

In Indonesia, there are not many studies that examine contextual collaborative learning based ethnoscience in improving scientific literacy. Previous research studies in Indonesia only focused on collaborative learning or ethnoscience-based contextual learning. Theoretically the CCLBE model describes a new theoretical perspective that is inherited from the cognitive approach that lies, and is called 'socially shared cognition'. This theory views a study group as a distributed cognitive system individual. It does not focus on individual contributions, but on shared representations constructed by the group (Jaimini, 2014; Xiao, 2012). With this from perspective, the main reason why contextual collaborative learning based ethnoscience is efficient that members learn to think interactively: thinking not only manipulating mental objects, but also interactions with other people and with the environment as a real learning resource. Therefore, contextual collaborative learning based ethnoscience (CCLBE model) needs to be applied because understanding of content, processes, and cultural contexts in chemistry will be able to improve students scientific literacy ability. This is confirmed by Erman et al., (2020) that scientific literacy is very important because it can contribute to social and economic life, as well as improve decision-making skills at the community and personal levels.

This research aims to increase students' scientific literacy ability through contextual collaborative learning based ethnoscience. Formulation of research problem are 1) How is the difference in the significance of students' scientific literacy before and after taught the CCLBE model?, 2) How is the effectiveness of the CCLBE model in improving students' scientific literacy ability?. Therefore, it is necessary to do learning which can relate the daily lives of students with cultural environment through contextual collaborative learning based ethnoscience to improve students' literacy so learning becomes more meaningful, and can be used for introduce the local culture of the place student residence in accordance with student characteristics. So, the novelty of this research is learning chemistry in social life mostly related to maximizing context local wisdom so that it can stimulate motivation for students to build knowledge and integration of cultural competences in different professions will be decisive key in improving scientific literacy in terms of content, context and attitude.

Methods

This study used a quasi-experimental research method with a pre-experimental design that focused on contextual collaborative learning based ethnoscience implementation in studying, learning, and teaching to improve students' scientific literacy ability. This research aimed to improve students' scientific literacy ability by using the contextual collaborative learning based ethnoscience model. Data in this research is students' scientific literacy ability indicator that can be measured through a student's ability to solve the designed test. The distribution of aspects of scientific literacy is presented in Table 1.

Table 1

Aspect of Scientific Literacy

Aspects of Scientific Literacy	Indicator of Scientific Literacy	Item
Content	<ul style="list-style-type: none"> • The Formation Process of Petroleum • The Main Components of Petroleum Compilers • The Impact of Burning Oil on Water • The Impact of Combustion of Petroleum on Land • The Impact of Burning Petroleum on Health • The Impact of Burning Petroleum on the Economy 	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Process	<ul style="list-style-type: none"> • Identifying scientific issues • Explain scientific phenomena • Using scientific evidence 	10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
Attitude	<ul style="list-style-type: none"> • Responsibility for resources and the environment • Support science inquiry • Interest in science 	21, 22, 23, 24, 25, 26, 27, 28, 29, 30

The form of pre-experimental design in this study was One Group Pretest-Posttest Design (Sugiyono, 2013). The shape of the design is illustrated in Table 2.

Table 2

Pre-experimental Design

Subject	Pretest	Posttest
One Group	O ₁	O ₂

Information:

O₁ = Pretest value before CCLBE model.

O₂ = Posttest value after CCLBE model.

This research has been conducted in the Chemistry Education UNDIKMA Mataram for the number of research subjects as many as 31 students. The sampling technique is saturated sampling, namely the technique determining the sample if the population is the same as the sample (Sugiyono, 2013). The trial results of the scientific literacy instrument showed that the probabilities of all items were above 5%. Thus, it can be concluded that all items are valid, as shown in table 2.

Table 3

The Validity of Scientific Literacy Instrument

Item	1	2	3	4	5	6	7	8	9	10
Pearson Correlation	.665**	.862**	.482**	.564**	.521**	.536**	.556**	.505**	.531**	.544**
Sig. (2-tailed)	.000	.000	.008	.001	.004	.003	.002	.005	.003	.002
Criteria	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Item	11	12	13	14	15	16	17	18	19	20
Pearson Correlation	.593**	.617**	.672**	.706**	.512**	.866**	.506**	.636**	.534**	.531**
Sig. (2-tailed)	.001	.000	.000	.000	.004	.000	.005	.000	.000	.003
Criteria	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Item	21	22	23	24	25	26	27	28	29	30
Pearson Correlation	.520**	.580**	.709**	.531**	.534**	.636**	.506**	.617**	.866**	.544**
Sig. (2-tailed)	.004	.001	.000	.003	.003	.000	.005	.000	.000	.002
Criteria	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid

The reliability of scientific literacy instrument showed that value for 30 items was 0.85 with very high criteria as shown in table 4.

Table 4*The Reliability of Scientific Literacy Instrument*

Cronbach's Alpha	N of Items
0.858	30

The Increase Scientific Literacy through CCLBE Model

The instrument used was a reasonable multiple-choice question used to measure students' scientific literacy ability. The different students' scientific literacy before and after implemented CCLBE model and increase students' scientific literacy ability in this study was determined based on T-test and N-Gain. The calculation results obtained $\langle g \rangle$ value are then interpreted into three categories namely:

Table 5*Gain Value Classification*

Average Gain	Criteria
$0,00 <g \leq 0,30$	Low
$0,30 <g \leq 0,70$	Medium
$0,70 <g \leq 1,00$	High

Note. (Dewi & Mashami, 2019)

Findings and Discussion

To find out the different students' scientific literacy before and after implemented CCLBE model and increase students' scientific literacy ability were analyzed using T-test and N-gain, as seen from the table, is presented as follows.

Table 6*T-test Value of Student Scientific Literacy*

		Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Scientific Literacy	Equal variances assumed	.474	.494	2.544	62	.013	3.81250	1.49878	.81648	6.80852
	Equal variances not assumed			2.544	61.940	.013	3.81250	1.49878	.81642	6.80858

Based on table 6, the Sig. (0.013) <0.05, this indicates that there is a major gap between students scientific literacy before and after through contextual collaboration learning based ethnoscience model. The findings of these studies (Abonyi et al., 2014; Sumarni, 2018; Rahmawati et al., 2019; Adhi et al., 2018) showed that the introduction of ethnoscience-based chemistry learning will boost scientific teaching literacy.

a) The Increase scientific literacy ability of content aspects

Table 7

Student Scientific Content Achievements

Subtopics	% Pretest	% Posttest	% N-Gain
The Formation Process of Petroleum	34,5	65,5	44,9
The Main Components of Petroleum Compilers	44,5	75,7	56,2
The Impact of Burning Oil on Water	46,7	77,0	56,8
The Impact of Combustion of Petroleum on Land	52,0	78,0	54,1
The Impact of Burning Petroleum on Health	55,3	80,5	56,3
The Impact of Burning Petroleum on the Economy	56,5	80,0	54,0
Average	48,3	76,1	53,7

Student achievement in each content is shown in table 7 that there is the highest increase in the content "Impact of Burning Petroleum on the Waters" and the lowest increase occurred in the content "Process of Forming Petroleum." Students' mastery of the material "Impacts of Burning Petroleum on the Water" experienced the highest increase because the dominant activity when discussing this content was a collaboration discussion activity based on facts and experiences in daily life. Collaboration learning prioritizes learning that involves several students joined together in groups that have different abilities and thoughts for each individual (Ulfiana et al., 2016). Combined with contextual learning, matrices are presented according to the student environment so that students can understand and develop their knowledge (Setiyorini, 2018). While ethnoscience is one type of contextual learning. Ethnoscience is a cross-disciplinary science that connects the human or cultural anthropology with science learning. The study of the scientific knowledge that is gained by examining the local knowledge that is contained in the culture of a community or ethnic group. Local knowledge is derived from reasoning and ideas from local communities about everyday life, including traditional culture, values, beliefs, and world views (Lestari & Fitriani, 2016; Dewi et al. 2020; Dewi, 2019). Ethnoscience, rooted in students' lives, is a type of contextual experience (Sudarmin, 2014).

*b) The Increase scientific literacy ability of process aspects***Table 8***Student Scientific Process Achievements*

Process Indicator	% Pretest	% Posttest	% N-Gain
Identifying scientific issues	54,5	68,5	30,7
Explain scientific phenomena	64,5	78,7	40,0
Using scientific evidence	53,7	77,0	50,3
Average	57,6	74,7	40,3

Student achievement in each content is shown in table 8, showed that the highest increase in the content "Impact of Burning Petroleum on the Waters" and the lowest increase in the content "Process of Forming Petroleum." Students' mastery of the material "Impacts of Burning Petroleum on the Water" experienced the highest increase because the dominant activity when discussing this content was a collaboration discussion activity based on facts and experiences in daily life. Collaboration learning prioritizes learning that involves several students joined together in groups that have different abilities and thoughts for each individual (Ulfiana et al., 2016). Combined with contextual learning, matrices are presented according to the student environment so that students can understand and develop their knowledge (Setiyorini, 2018). While ethnoscience is one type of contextual learning. Ethnoscience is a cross-disciplinary science that connects the human or cultural anthropology with science learning. The study of the scientific knowledge that is gained by examining the local knowledge that is contained in the culture of a community or ethnic group. Local knowledge is derived from reasoning and ideas from local communities about everyday life, including traditional culture, values, beliefs, and world views (Lestari & Fitriani, 2016). Ethnoscience, which is rooted in students' lives, is a form of contextual experience (Sudarmin, 2014).

*c) The Increase Scientific Literacy Ability of Attitude Aspects***Table 9***Student Scientific Attitude Achievements*

Attitude Indicator	% Pretest	% Posttest	% N-Gain
Responsibility for resources and the environment	65,5	76,5	31,8
Support science inquiry	64,5	80,7	45,6
Interest in science	68,7	85,0	52,0
Average	66,2	80,7	43,1

The attitude aspect is the last aspect of scientific literacy. Unlike the two previous elements, this aspect of attitude looks more at students' responses to scientific issues and supports in scientific inquiry. To capture the achievements of students' scientific literacy aspects of belief used a scale instrument attitude amounting to 16 statements, where each report consists of 4 answer choices, namely strongly agree, agree, disagree, and strongly disagree. The attitude of science examined in this study includes three indicators, including (1) overall responsibility, the attainment of science attitudes of students before and after getting contextual collaboration learning-based learning ethnoscience can be seen in Table 4 illustrates that there is an increase in the attitudes of science attainment after getting contextual collaboration learning-based ethnoscience even though it is still in the moderate category. This is because learning implemented in the classroom involves phenomena that occur in everyday life so that such learning processes can have a positive impact on improving students' scientific

attitudes in resources and the environment; (2) support science inquiry; (3) interest in science. The students' scientific literacy ability in aspects of attitude begins to be grown by giving contextual problems based on ethnosience when starting learning activities. Because ethnosience is knowledge acquired based on local culture that can be innovated in science-based learning at class (Abonyi et al., 2014). Ethnosience is a learning approach that elevates local culture or wisdom to become an object of science learning. The introduction of science learning from the perspective of local culture and structured local knowledge relating to certain natural phenomena and events would increase students' scientific interests and make it easier for students to understand them (Dewi et al., 2019).

Conclusion and Implications

Based on the above definition, it can be concluded that there is a major gap between students scientific literacy before and after implemented CCLBE model and scientific literacy ability has increased in the medium category on capacity of students in content, process and attitude aspects. The uniqueness of contextual collaboration learning based ethnosience (CCLBE) model is that students can integrate their knowledge with cultural competences in a different profession so that become the key determinants in improving students' scientific literacy in terms of content, context and attitude. Recommendations for practitioner have to identify many things in the local context relevant to the concept of chemistry, not only on content, process and attitude but also in context and behavioral competencies of students in chemistry. Suggestions for future researchers to conduct similar research to demonstrate the effectiveness of the CCLBE model, especially in assessing the scientific literacy of students from other learning fields.

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Appendix

1. Lesson Plan

	RENCANA PEMBELAJARAN SEMESTER		No. Dokumen : 1
	Nama Matakuliah Kimia Umum		Revisi : Ke 1 (2019) Tanggal : 26 Oktober 2019 Halaman : 1 dari 7 halaman
Dibuat oleh:		Diperiksa oleh:	Disetujui oleh:
Citra Ayu Dewi, M.Pd		(mohon dikosongkan)	Yusran Khery, M.Pd
NIK. 201103010		NIK.	NIK.
Dosen		TPK Prodi	Ketua Prodi

RENCANA PEMBELAJARAN SEMESTER	
1. Identitas Matakuliah	
Nama Departemen/Prodi :	Pendidikan Kimia
Nama Matakuliah :	Kimia Dasar
Kode Matakuliah :	PMK1113/3(2-1)
Bobot SKS :	3 (tiga)
Jenjang :	S1
Semester :	I (Satu)
Status (Wajib/Pilihan) ¹⁾ :	Wajib
Nama dan Kode Dosen :	Citra Ayu Dewi, M.Pd & NIDN.0806068703
2. Deskripsi Matakuliah	
Matakuliah ini membahas tentang konsep dan prinsip dalam Struktur atom, Sistem periodik unsur, Ikatan kimia dan struktur molekul, Kimia unsur, Stoikiometri, Energetika kimia, Kimia koloid, Senyawa karbon dan biokimia, serta melakukan kegiatan laboratorium yang mendukung.	
3. Capaian Pembelajaran Lulusan	
S6 : Bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan.	

<p>P3 : Menguasai prinsip-prinsip K3 (Keselamatan dan Keamanan Kerja), pengelolaan laboratorium dan penggunaan peralatannya serta cara mengoperasikan instrument kimia.</p> <p>KU2 : Mampu menunjukkan kinerja mandiri, bermutu, dan terukur.</p> <p>KU7 : Mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan alternatif dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya.</p> <p>KK3 : Mampu merencanakan, melaksanakan dan mengevaluasi kegiatan praktikum dalam rangka pelaksanaan pendekatan saintifik dengan memanfaatkan potensi sumber daya yang tersedia serta memperhatikan aspek keselamatan dan keamanan kerja (K3).</p>						
<p>4. Capaian Pembelajaran Matakuliah (CPMK)</p> <p>CPMK 1 : Mahasiswa mampu bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan serta menguasai prinsip-prinsip K3 (Keselamatan dan Keamanan Kerja), pengelolaan laboratorium dan penggunaan peralatannya serta cara mengoperasikan instrument kimia (S6, P3).</p> <p>CPMK 2 : Mahasiswa mampu menunjukkan kinerja mandiri, bermutu, dan terukur serta bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan alternatif dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya dan merencanakan, melaksanakan dan mengevaluasi kegiatan praktikum dalam rangka pelaksanaan pendekatan saintifik dengan memanfaatkan potensi sumber daya yang tersedia serta memperhatikan aspek keselamatan dan keamanan kerja (KU2, KU7, KK3).</p>						
<p>5. Deskripsi Rencana Pembelajaran</p> <p>Rincian waktu setiap pertemuan yaitu:</p> <ul style="list-style-type: none"> ▪ Tatap Muka : 3 x 50" ▪ Tugas Terstruktur : 3 x 60" ▪ Tugas Mandiri : 3 x 60" 						
Pert ke-	Indikator	Bahan Kajian	Metode Pembelajaran	Waktu	Tugas dan Penilaian	Rujukan
1	<ul style="list-style-type: none"> • Dengan mengamati gambar siswa dapat menjelaskan proses pembentukan minyak bumi dan gas alam. • Diberikan data tentang komponen penyusun 	Hidrokarbon	Model CCLBE	3x50	<ul style="list-style-type: none"> - Tugas mandiri dan kelompok - Penilaian berupa tes. 	<ol style="list-style-type: none"> 1. Dewi, Citra Ayu dkk. 2015. <i>Kimia Dasar I</i>. PKPSM IKIP Mataram: Duta Pustaka Ilmu. 2. Keenan, Kleinfelter, Wood, A. Hadyana

2	<ul style="list-style-type: none"> • minyak bumi, secara mandiri siswa dapat menjelaskan komponen-komponen utama penyusun minyak bumi. • Dengan melakukan analisis siswa dapat menafsirkan bagan penyulingan bertingkat untuk menjelaskan dasar dan teknik pemisahan fraksi-fraksi minyak bumi. • Diberikan data tentang kualitas bensin, siswa dapat membedakan kualitas bensin berdasarkan bilangan oktannya. 			3x60		<p>Pudjaatmaka (alih Bahasa), 2007. <i>Kimia Untuk Universitas Jilid I Dan II</i>. Jakarta: Erlangga.</p> <p>3. Syukri, S. 2010. <i>Kimia Dasar, Jilid I – III</i>. Bandung: Penerbit ITB Press.</p>
3	<ul style="list-style-type: none"> • Dengan kegiatan membaca siswa dapat menjelaskan penggunaan residu minyak bumi dalam industri petrokimia. • Melalui diskusi dan latihan siswa dapat menganalisis dampak pembakaran hidrokarbon terhadap lingkungan dan kesehatan serta cara mengatasinya. • Mempersentasikan hasil pembelajaran tentang dampak pembakaran 			3x60		

hidrokarbon terhadap lingkungan, kesehatan dan upaya untuk mengatasinya.					
6. Daftar Rujukan 1. Brady, J.E. dan Humiston, E. (Alih Bahasa). 2008. <i>General Chemistry, 5th Edition</i> . John Willey and Sons. 2. Chang, R. 2005. <i>Kimia Dasar: Konsep-Konsep Inti, Edisi 3 Jilid 2</i> . Erlangga: PT. Gelora Aksara Pratama. 3. Dewi, Citra Ayu dkk. 2015. <i>Kimia Dasar I</i> . PKPSM IKIP Mataram: Duta Pustaka Ilmu. 4. Dewi, Citra Ayu dkk. 2017. <i>Modul Inkuiri Berorientasi CEP</i> . PKPSM IKIP Mataram: Duta Pustaka Ilmu. 5. Keenan, Kleinfelter, Wood, A. Hadyana Pudjaatmaka (alih Bahasa). 2007. <i>Kimia Untuk Universitas Jilid 1 Dan II</i> . Jakarta: Erlangga. 6. Syukri, S. 2010. <i>Kimia Dasar, Jilid 1 – III</i> . Bandung: Penerbit ITB Press.					
7. Bahan Ajar Terlampir					
8. Instrumen Penilaian Terlampir					

2. The implementation of the CCLBE model on hydrocarbon topics

Hidrokarbon


PROSES PEMBENTUKAN MINYAK BUMI DAN GAS DI ALAM

Tahap ke-1


Konstruktivisme (secara berkelompok siswa dituntut dapat membangun pengetahuan sendiri)

Pada kegiatan ini guru menjelaskan Materi dari membangun pengetahuan siswa agar siswa bisa memahami materi melalui gambar

Perhatikan gambar 21 ini Pemahkah kalian mengapa sebelumnya bahwa secara alami minyak bumi yang ada di alam ini bahan dasarnya terbuat dari ganggang???



Gambar 21 Proses pembentukan minyak bumi di



Gambar 23 Salah satu jenis dari minyak bumi yaitu

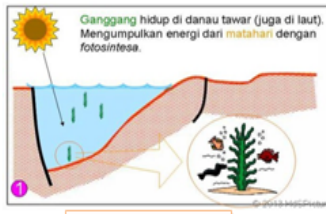
Hidrokarbon

PROSES PEMBENTUKAN MINYAK BUMI DAN GAS DI ALAM

Istilah minyak bumi diterjemahkan dari bahasa latin (artinya petro (batuan) dan oleum (minyak)). Nama petroleum diberikan kepada fosil hewan dan tumbuhan yang ditemukan dalam kulit bumi berupa gas alam, batubara dan minyak bumi.

Minyak bumi terbentuk dari fosil-fosil hewan dan tumbuhan kecil yang hidup di laut dan tertimbun selama berjuta-juta tahun lampau. Khewan dan tumbuhan laut mati, jasad mereka tertimbun oleh pasir dan lumpur di dasar laut. Setelah ribuan tahun tertimbun, akibat pengaruh tekanan dan suhu bumi yang tinggi, lapisan-lapisan lumpur dan pasir berubah menjadi batuan. Akibat tekanan dan panas bumi, fosil hewan dan tumbuhan yang terjebak di lapisan batuan secara perlahan berubah menjadi minyak mentah dan gas alam. Kedua bahan tersebut terperang di antara lapisan-lapisan batuan dan tidak dapat keluar.

1. Ganggang hidup di danau tawar (juga di laut). Mengumpulkan energi dari matahari dengan fotosintesis.



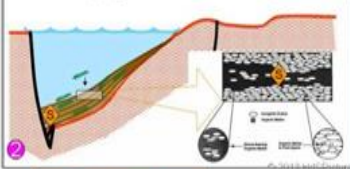
Gambar 24 Ganggang hidup

2. Setelah ganggang-ganggang ini mati, maka akan terendapkan di dasar celungan sedimen dan membentuk batuan induk (source rock). Batuan induk adalah batuan yang mengandung karbon (High Total Organic Carbon). Batuan ini bisa batuan hasil pengendapan di danau, di delta, maupun di dasar laut. Proses pembentukan karbon dari ganggang

Hidrokarbon

menjadi batuan induk ini sangat spesifik. Itulah sebabnya tidak semua cekungan sedimen akan mengandung minyak atau gas bumi. Jika karbon ini teroksidasi maka akan terurai dan bahkan menjadi rantai karbon yang tidak mungkin dimasak.

Ganggang yang mati akan terendapkan dan terkumpul dibagian dasar bercampur dengan batulempung membentuk batuan induk (source rock)




Gambar 2.5 Ganggang mati

1. Batuan induk akan terkubur di bawah batuan-batuan lainnya yang berlangsung selama jutaan tahun. Proses pengendapan ini berlangsung terus menerus. Salah satu batuan yang menimbun batuan induk adalah batuan reservoir atau batuan sarang. Batuan sarang adalah batuan pasir, batu gamping, atau batuan vulkanik yang tertimbun dan terdapat ruang berpori-pori didalamnya. Jika daerah ini terus tenggelam dan terus ditumpuki oleh batuan-batuan lain di atasnya, maka batuan yang mengandung karbon ini akan terpanaskan. Semakin kedalaman atau masuk ambias ke bumi, maka suhunya akan bertambah. Minyak terbentuk pada suhu antara 50 sampai 180 derajat Celsius. Tetapi puncak atau kematangan terbagus akan tercapai bila suhunya mencapai 100 derajat celsius. Ketika suhu terus
2. bertambah karena cekungan itu semakin turun dalam yang juga diikuti penambahan batuan penimbun, maka suhu tinggi ini akan memasak karbon yang ada menjadi gas.

Hidrokarbon

Source rock terkubur di bawah batuan-batuan lainnya. Proses penguburan berlangsung jutaan tahun, tertutup salah satunya oleh batuan **reservoir**.




Gambar 2.6 Proses Source rock

Karena adanya gradien geothermal, suhu batuan induk semakin panas Terjadi proses pemasakan

1. Karbon terkena panas dan bereaksi dengan hidrogen membentuk hidrokarbon. Minyak yang dihasilkan oleh batuan induk yang telah matang ini berupa minyak mentah. Walaupun berupa cairan, cini fasil minyak bumi mentah berbeda dengan air. Salah satunya yang terpenting adalah berat jenis dan kekentalan. Kekentalan minyak bumi mentah lebih tinggi dari air, namun berat jenis minyak bumi mentah lebih kecil dari air. Minyak bumi yang memiliki berat jenis lebih rendah dari air cenderung akan pergi ke atas. Ketika minyak tertahan oleh sebuah bentuk batuan yang menyerupai mangkok terbalik, maka minyak ini akan tertangkap dan siap ditambang.

Source rock (karbon) terkena panas dan bereaksi dengan hidrogen membentuk **hydrocarbon** (CH_4 , C_2H_6 , ...)



Gambar 2.7 Proses pembentukan hidrokarbon

Minyak (HC) bermigrasi dan batuan induk dan terperangkap dalam jebakan

Hidrokarbon

Tahap ke-2

Inkuiri (siswa secara berkelompok dituntut untuk menemukan fakta dari informasi dan menggali rasa keingintahuan)
Menunjukkan masalah membuat hipotesis, dan mengumpulkan data.

1. Merumuskan Masalah

Pada pembuatan "Lilin Aromaterapi Kulit Jeruk" ada rumusan masalah yang harus diselesaikan dengan anggota kelompok yg/bj.

1. Bagaimana proses pembuatan lilin aromaterapi dari kulit jeruk?
2. Bagaimana hasil pembuatan lilin aromaterapi dari kulit jeruk?

2. Membuat Hipotesis

Menurut Anda berdasarkan permasalahan yang di kaji di atas, buatlah hipotesis sesuai dengan permasalahan yang terjadi pada (1, dan b 2)!

Hidrokarbon

3. Mengumpulkan Data/Menguji Hipotesis

A. Tujuan Praktikum


1. siswa dapat membuat lilin aromaterapi dari kulit jeruk.
2. Siswa dapat lebih kreatif dalam pembuatan lilin aromaterapi dari kulit jeruk.

B. Prosedur kerja

- ✓ Proses pembuatan lilin aromaterapi dari kulit jeruk

1. Panaskan air dalam panci yang berdiameter 30 Cm
2. Tunggu hingga air mendidih
3. Letakkan panci kedua didalam panci pertama yang berisi air mendidih
4. Masukkan paraffin pada panci kedua 20 Cm
5. Aduk paraffin hingga mendidih menggunakan spatula kayu
6. Tambahkan pewarna
7. Setelah paraffin mencair angkat dan diamkan selama 5 menit
8. Tambahkan 2-4 tetes esensial oil dari kulit jeruk
9. Aduk hingga merata

Hasil




Hidrokarbon

✓ Menyiapkan cetakan

- Siapkan cetakan lilin gelas
- Tempatkan sumbu katun tepat di tengah cetakan
- Ikatkan sumbu bagian atas pada sebuah sumpit
- Letakkan sumpit dimulut gelas


Hasil



✓ Tahap terakhir

- Masukkan paraffin yang telah tercampur essential oil kulit jeruk ke dalam cetakan
- Diamkan hingga mengeras


Hasil



C. Hasil Pengamatan

Kelompok	Perubahan yang terjadi			
	Paraffin	Warna	Aroma	Tekstur

Hidrokarbon




Tahap ke-3

- Bertanya (Siswa secara berkelompok dituntut belajar bersama dan bekerja keras)

Apakah Anda sudah paham? untuk mengetahui kejelasan belajar Anda, cobalah menjawab pertanyaan berikut sebagai uji pemahaman.

- Apakah fungsi dari penambahan stearin pada pembuatan lilin aromaterapi?
- Kendala apa saja yang dihadapi pada saat praktikum pembuatan lilin aromaterapi?
- Sebutkan manfaat dari lilin aromaterapi.



Tahap ke-4

- Learning Community (Masyarakat Belajar)

AVO
MEMBACA

KOMPONEN-KOMPONEN PENYUSUN MINYAK BUMI

Perampakan fisik minyak bumi sangat beragam, tergantung dari komposisinya. Pada umumnya, minyak bumi yang baru dihasilkan dari sumbu pengeboran berupa lumpur berwarna hitam atau cokelat gelap, meskipun ada juga minyak bumi yang berwarna kekuningan, kemerahan, atau kehijauan. Sumur minyak sebagian besar menghasilkan minyak mentah, terkadang ada juga kandungan gas di dalamnya. Karena tekanan di permukaan Bumi lebih rendah daripada di bawah tanah, beberapa gas akan keluar dalam bentuk ampunan.

Jenis hidrokarbon yang terdapat pada minyak Bumi sebagian besar terdiri dari alkana, sikloalkana, dan berbagai macam jenis hidrokarbon aromatik, ditambah dengan sebagian kecil elemen-elemen lainnya seperti nitrogen, oksigen dan sulfur, ditambah beberapa jenis logam seperti besi, nikel, tembaga, dan vanadium. Jumlah komposisi molekul sangatlah beragam dari minyak yang satu ke minyak yang lain.

Minyak bumi tersusun dari senyawa hidrokarbon yang berbeda-beda. Perbedaan ini tergantung dari faktor umur, suhu pembentukan, dan cara pembentukan. Minyak dari Indonesia mengandung banyak senyawa aromatik seperti benzena, sedangkan minyak bumi dari Rusia mengandung banyak senyawa sikloalkana seperti sikloheksana. Berdasarkan hasil analisis yang telah dilakukan, diketahui bahwa dalam minyak bumi terdiri atas bermacam-macam senyawa hidrokarbon. Senyawa-senyawa hidrokarbon tersebut sebagai berikut.

Hidrokarbon

Berbagai Cara Menaikkan Angka Oktan Pada Bensin:

1. Salah satu cara (banyak cara yg lain) untuk menaikkan angka oktan adalah penambahan TEL (*Tetra Ethyl Lead*) kedalam bensin yg bernilai oktan rendah. Caranya sederhana, mixing saja. Namun kemudian diketahui penambahan aditif penambah nilai oktan ini berbahaya dari segi kesehatan dan lingkungan. Pada akhirnya bensin beroktan tinggi ini bisa didapatkan dengan merubah struktur molekul hidrokarbon penyusun bahan bakar. Sehingga dengan bantuan katalis pada kondisi operasi tertentu, struktur molekul parafinik (bernilai oktan rendah), bisa diubah menjadi struktur naftenik, dan naftenik menjadi aromatik. Dimana nilai oktan aromatik > naftenik > parafinik.
2. Menambahkan Naphtalene pada bensin. Naphtalene merupakan suatu larutan kimia yang memberikan pengaruh positif untuk meningkatkan angka oktan dari bensin. Biasanya angka oktan ini dapat diukur dengan mesin CFR. Dalam hal ini terlihat bahwa naphtalene merupakan bahan yang mampu meningkatkan angka oktan tetapi naphtalene sendiri bukan bahan bakar sehingga panas pembakaran campuran akan lebih rendah dari pada bensin murni. Karena bentuk struktur kimia serta sifat kearomatisan tersebut naphtalene seperti halnya benzene, mempunyai sifat antiknock yang baik. Oleh sebab penambahan naphtalene pada bensin akan meningkatkan mutu antiknock dari bensin tersebut.
3. Menambahkan MTBE (*Metil tertier-butyleter*). Bensin jenis premium menggunakan campuran MTBE tanpa TEL.

SIMPULAN

Link youtube: <https://www.youtube.com/watch>


Untuk mengetahui salah satu bentuk penyulingan minyak bumi yaitu pembuatan lilin parafin

Hidrokarbon

Tahap ke-5

• **Pemodelan (Secara berkelompok siswa dituntut untuk kerja keras)**

WACANA



Lilin aromaterapi adalah salah satu bentuk diversifikasi dari produk lilin yaitu glikolisin dari aroma litrasi atau penghirupan aromaterapi. Arom yang terdapat pada saat lilin dibakar akan memberikan rasa tenang, rileks, dan nyaman. Rangsang yang dimiliki ini sebagai produk yang diharapkan dapat diminati dan diterima oleh seluruh lapisan masyarakat.


Pembuatan lilin aromaterapi membutuhkan stearin, parafin, dan minyak atsiri. Stearin terdapat dalam lemak nabati atau hewani. Stearin juga dapat dibuat dengan cara hidroklisis asam stearat dengan gliserol pada kondisi tertentu. Stearin memiliki titik leleh yang pada kisaran 460 - 560C. Stearin merupakan gliserida yang memiliki titik cair tinggi karena mengandung asam lemak jenuh dan asam stearat dalam jumlah tinggi. Kandungan ini menyebabkan stearin berada pada kondisi padat pada suhu kamar.

Parafin merupakan suatu hidrokarbon yang bentuknya dapat berupa gas, padat, bening, atau putih abu-abu dengan titik cair rendah. Umumnya parafin berwujud dalam minyak bumi, yang struktur molekulnya terdiri dari senyawa parafin yaitu senyawa alkanana, n-alkana, isoparafin, sikloalkana, dan alicikloparafin dari senyawa aromatik. Parafin yang dipandang tidak dibedakan berdasarkan besar kerangka molekulnya. Mula-mula dengan lainnya harus memiliki jarak titik cair sebesar 20C. Parafin terdiri dari tiga jenis, yaitu soft paraffin wax (300 - 420C), medium paraffin wax (440 - 60C), dan hard paraffin wax (500 - 650C).

Pada pembuatan lilin, stearin perlu dipanaskan. Tujuan dilakukannya pemanasan pada stearin pada pembuatan lilin aromaterapi adalah untuk mencairkan stearin yang bentuknya padat pada titik lelehnya yaitu sekitar 59-62C. Rangsang dari stearin ini adalah untuk memberi bentuk pada lilin yang dibuat. Karena stearin akan menjadi padat setelah dingin. Sebelum stearin menjadi terleleh dahulu ditambah parafin dan pewarna. Fungsi parafin adalah sebagai bahan bakar untuk lilin agar dapat terbakar. Selain itu tujuan penambahan aroma parafin dan stearin ialah agar parafin yang dimasukkan dapat keras karena sifat dasar dari parafin ialah cenderung lembek dan lentur pada temperatur dibawah titik lelehnya, maka digabungkan dengan stearin. Bersama stearin, parafin menjadi bahan dasar lilin berbagai. Perambahan selanjutnya ialah penambahan zat pewarna yaitu minyak mawar dan minyak lavender.

Hidrokarbon

ETNOGRAFI (Pembuatan Lilin Aromaterapi Sereh)



> Alat dan bahan

1. Alat
 - Panci besar
 - Panci kecil
 - Kompor
 - Pengaduk / spatula kayu
 - gelas kecil bering
 - sumpit
 - Pisau
2. Bahan
 - Paraffin
 - Stearin
 - Pewarna (serbuk, batang / crayon, cat minyak)
 - Essence oil serah
 - Benang katun (sumbu)
 - White oil
 - Minyak tanah

> Cara membuat

- Panaskan parafin padat sampai
- Tambahkan stearin ke dalam cairan parafin, aduk rata. perbandingan adonan 1:2 untuk stearin dan parafin. dalam hal ini yang menentukan keras tidaknya suatu lilin adalah jumlah stearin

Hidrokarbon

- Setelah semuanya tercampur, kemudian tuang kedalam cetakan yang telah diberi sumbu dengan mengarah tegak keatas. Pada bagian bawah sumbu direkatkan dengan menggunakan lilin malam/isolasi.
- Tunggu beberapa saat hingga lilin benar-benar mengeras, baru setelah itu lilin dapat dilepas dari cetakan.

Dalam praktek pembuatan lilin aromaterapi serah ini dibuat secara kelompok/ secara bersama-sama perlu adanya kerja sama. Kerjasama merupakan kewajiban setiap orang dalam suatu kelompok tertentu pada saat melaksanakan kegiatan.

Selamat Mencoba