

# Exploring Learning Obstacle of Pre-Service Chemistry Student Towards Education for Sustainability on the Topic of Biodiesel: A Preliminary Study for Developing Didactic Design

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**Abstract:** This study aims to identify the learning obstacles experienced by preservice chemistry teachers in studying the biodiesel topic in the energy section. The research method employed is qualitative descriptive, with the instrument is interview guide sheet. Participants in this study were students of the program study of Chemistry Education. The result of the interviews with prospective chemistry teachers reveals that the primary learning obstacle related to the biodiesel topic are epistemological learning obstacle, with many students struggling to understand and apply concepts in depth. While students generally grasp the basic differences between renewable and non-renewable energy and the benefits of biodiesel, they lack detailed knowledge about biodiesel production processes and potential feedstocks. Additionally, there is a reliance on provided materials and insufficient initiative in seeking additional information. To address these challenges, it is essential to design more structured in learning experiences.

**Keywords:** Biodiesel; Learning obstacle; SDGs

## Introduction

Humanity currently faces many sustainability challenges due to the complex interactions between humans and the environment. Our understanding of these challenges is still limited and hampered by uncertainty (Kioupi & Voulvoulis, 2019), therefore, to overcome sustainability challenges, it is necessary to change people's perceptions, values, attitudes, and behaviors, and create conditions that support change, this requires fundamental changes in the way they think and act. Education is considered an important tool for shaping views and values, and has great potential in addressing sustainability challenges (Yuan et al., 2022) education is both a goal and a means to achieve all other Sustainable Development Goals (SDGs) (Hoque et al., 2022; UNESCO, 2020).

Education for Sustainable Development is one of the SDG's 2030 agendas (Shulla et al., 2020). In Target 4.7 of this plan, by 2030 ensure that all learners acquire the

knowledge and skills needed to promote sustainable development, including through Education for Sustainable Development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and the contribution of culture to sustainable development (Kioupi & Voulvoulis, 2019; Shulla et al., 2020), through ESD we seek to change learner behavior to have the necessary sustainability competencies. This makes education an important strategy in achieving the SDGs (Queiruga-Dios et al., 2020).

Relationship between quality education and ESD and learning and sustainability has also been carried out. Sustainable Development and Education for Sustainable Development (ESD) have also been widely studied (Anderson et al., 2017; Kioupi & Voulvoulis, 2019; Purvis et al., 2019). To take care of the environments, it is necessary to educate values related to sustainability and relevant interests in the education system to deliver ESD.

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Sustainability has been an important agenda and is detailed as targeted Sustainable Development as listed in the 17 SDGs goals categorized into three pillars, namely social, economic, and environmental (Purvis et al., 2019).

One of the goals of the SDGs is to shift energy consumption from fossil fuels to renewable energy (RE) sources to reduce environmental damage and prevent global warming. Awareness must be instilled among the community (Hoque et al., 2022). One of the contexts that can be chosen because of its relevance to life is energy. Energy has been recognized as the main source for maintaining the economic growth of any country. The increase in the world's population, rapid industrialization, urbanization, and economic growth have caused the need for energy to continue to increase, resulting in increasing consumption of fossil fuels. The combustion of these fossil fuels produces harmful emissions, so that more environmentally friendly and sustainable alternatives are needed. Biodiesel is one good solution for diesel engines because it is renewable, non-toxic, and environmentally friendly (Jeswani et al., 2020; Mathew et al., 2021; Nazari et al., 2021).

A method to enhance student motivation and attitudes toward science education is by designing lessons that address societal issues, such as the current and potential industrial applications of science and technology (Eilks, 2002). For example, A lesson unit of biodiesel for a chemistry course designed for preservice science teachers in Indonesia as an example of SSI-based science education. Biodiesel not only is an authentic problem currently debated in the media in Indonesia but also is related to the global issue of sustainability (Nida et al., 2021). The controversy surrounding biodiesel provides a context to teach scientific concepts, learning about fats, esters, or the process of transesterification. It also gives students an opportunity to understand the societal discussions regarding how can make a biodiesel (Eilks, 2002).

However, in the learning process, problems often arise that are triggered by learning obstacle. Learning obstacle can be interpreted as a condition in the teaching and learning process that is characterized by the presence of certain obstacles to achieving optimal learning outcomes. These obstacles may or may not be felt by the students concerned. Lack of didactic preparation reflected in learning planning can result in a less effective learning process for students, resulting in various learning obstacle (Khaerudin et al., 2023). This obstacle includes ontogenetic obstacle (mental readiness to learn), didactic obstacle (the impact of teacher teaching), and epistemological obstacle (student knowledge and understanding that have limited application or narrow context). Efforts are needed to overcome these obstacle, especially epistemological

obstacle, which are individual knowledge that only applies in certain contexts (Olensia et al., 2012). Learning obstacle in chemistry education students are influenced by various factors including the capacity of lecturers in teaching, students' ability to absorb material, learning environment conditions, and the media used (Dewi, 2022; Sari et al., 2020).

This research presents novelty in the case of learning obstacles in pre-service chemistry teacher students about biodiesel. This research is important as a basis for development of a didactic design that can improve students' engagement and understanding of biodiesel. A good didactical design serves to guide learners in forming a thorough understanding and helps them overcome learning obstacles (Akbar, 2016). Learning obstacles are the primary foundation in designing Didactic Design. Researchers need to know the learning obstacles experienced by students before designing the didactical design (Nopriana et al., 2023). Therefore, the data on learning obstacles is very useful as a prediction of learners' responses and the anticipation prepared by educators, so that the material can be delivered effectively (Suryadi, 2019).

Education about renewable energy is very important in creating awareness and supporting the SDGs, especially in the sustainable management of renewable resources (Hoque et al., 2022). The existence of data on learning obstacles in biodiesel material can be the basis for designing a more effective approach according to the needs of college students, so as to increase their understanding of biodiesel as renewable energy and support the achievement of SDGs, especially in the sustainable management of renewable resources. By identifying the learning obstacles faced by students, educators can overcome these difficulties through more appropriate adjustments to materials, teaching methods, and learning strategies, so that students can more easily understand important concepts in the field of renewable energy, such as biodiesel, and contribute to environmental sustainability.

## Method

The research method used in this research is the qualitative descriptive method a research method that aims to summarize comprehensively in everyday terms about specific events experienced by individuals or groups of individuals (Sandelowski, 2000). A qualitative approach is needed for this study because this study will obtain a comprehensive summary of the learning obstacles experienced by students in studying the context of renewable energy in the MSTR course, especially in the discussion of biodiesel. The stages of

research in this study follow the stages of the qualitative approach.

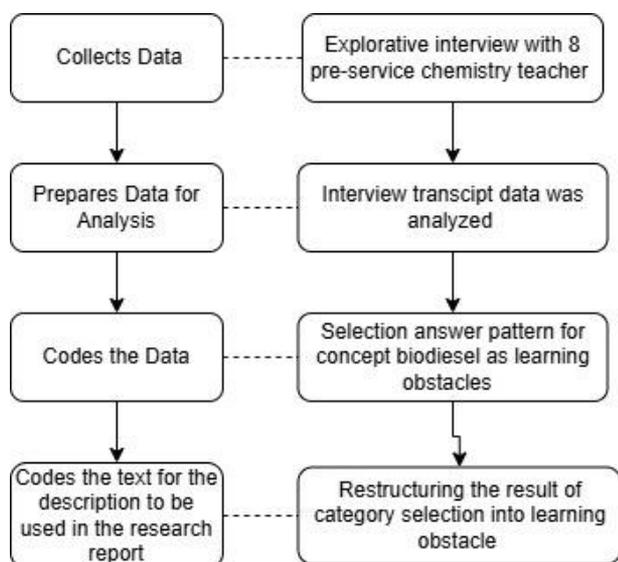


Figure 1. Research stage

The participants in this study were undergraduate students majoring in chemical education who had contracted the MSTR course (math science technology and engineering). The competencies supplied in this course are to develop science literacy, to solve sustainability problems in order to support SDGs with 2 main topics of environment and energy, and biodiesel can be used for context on the topic of energy. And knowing what learning obstacles are experienced by

## Result and Discussion

Table 2. Results of interview analysis of question category 1

Interview topics	Interview result
The energy currently used for transportation.	Most undergraduate students mentioned fossil fuels as the energy source currently used for transportation. In addition, 4 out of 8 undergraduate students added coal and alternative energy such as electricity. Then for its origin, 2 out of 8 undergraduate students mentioned the source came from oil drilling/mining.
In your opinion, is the fuel (pertamax, pertalite, solar) used renewable energy or not?	All undergraduate students answered that BBM is included in non-renewable energy sources because its availability is limited and its production takes millions of years, and if used continuously it will run out. However, 2 out of 8 undergraduate students could not explain the reason.
The difference between non-renewable and renewable energy.	6 out of 8 undergraduate students understand that the difference between renewable and non-renewable energy lies in their availability and time of formation. 2 out of 6 undergraduate students added that non-renewable energy can damage the environment. 2 out of 8 undergraduate students do not know the reason.
Examples of non-renewable and renewable energy.	All undergraduate students can cite examples of non-renewable and renewable energy.

Learning obstacle of prospective chemistry teacher students can be obtained based on an analysis of initial understanding related to biodiesel material, because if you want to understand something well, someone needs

undergraduate student as a basis for creating learning designs.

The instrument used in this research was an interview guide sheet. This research was conducted at a state university in West Java. Learning obstacles analysis was conducted on the answers given during the interview. This learning obstacle can be used as a basis for formulating didactic anticipations during learning. This learning obstacle were traced through in-depth interviews conducted to analyze the concepts and learning obstacle of students regarding the topic of biodiesel in the application of MSTR lectures. The questions given were divided into 5 categories, difference between renewable and non-renewable energy; biofuel as renewable energy; sources and processes of making biodiesel; benefits of using biodiesel; and about MSTR lectures. The question categories and question numbers on the interview sheet can be seen as follows.

Table 1. Question categories and question numbers on the interview sheet

Categories	Questions numbers
Renewable and non-renewable energy	1.2.3.4
Potential of bioenergy as renewable energy	5.6
Sources and process of making Biodiesel	7.8.9.11.12
Benefits of using biodiesel	10.13.14.15.16
MSTR Lecture	17

to connect new information with what they already know (Timilsena et al., 2022). The learning process can be built by obtaining new knowledge based on previous knowledge where a person's initial abilities can be the

main foundation that will provide instructions for integrating new knowledge with previous knowledge (Lestari et al., 2019).

The results of the interviews with undergraduate students of chemistry education were analyzed for each question. The analysis of these results was to determine what obstacles were experienced by undergraduate students. In category 1 regarding knowledge about the differences between renewable and non-renewable energy, this section consists of 4 questions. The purpose of this question is to provide an orientation that the topic of this research is related to the problem of energy that is still used for transportation and comes from non-renewable sources which if used continuously will cause an energy crisis in the future. The results of the answers from undergraduate students are shown in Table 2.

Based on the results of interview data analysis, most students have understood the difference between renewable and non-renewable energy. Some have answered correctly about renewable and non-renewable energy. Renewable energy is energy produced from

energy resources that are sustainable if managed properly (Güney, 2019; Le et al., 2020). Renewable energy can be obtained from natural resources that can be renewed or renewed naturally in a relatively short period of time, and its availability is abundant in nature. Whereas non-renewable energy is an energy source that cannot be recovered in a short time and is produced from energy resources that will run out if exploited continuously. When non-renewable energy resources are used up, it takes a very long time even millions of years to form new resources in significant quantities (Güney, 2019; Le et al., 2020). However, there are still students who are unable to explain the reasons for the difference between renewable and non-renewable energy. This can be seen from the answers to interview topics number 2 and 3. Then for its source, 2 out of 8 students mentioned that the source comes from oil drilling/mining. Even though we know that petroleum comes from fossils. The results of the analysis of specific learning obstacles can be seen in the following table.

**Table 3.** Results of learning obstacles analysis for question category 1

Interview topics	Learning obstacles
The energy currently used for transportation.	Some undergraduate students do not understand that petroleum comes from fossils and assume it comes from drilling or mining processes.
In your opinion, is the fuel (pertamax, pertalite, solar) used renewable energy or not?	There are still undergraduate students who cannot explain why fuel is included in non-renewable energy sources.
The difference between non-renewable and renewable energy.	However, there are still undergraduate students who do not know at all about the difference between renewable and non-renewable energy, even after reading the discourse, they still cannot explain the difference.
Examples of non-renewable and renewable energy.	All undergraduate students can cite examples of renewable and non-renewable energy.

**Table 3.** Results of interview analysis of category questions

Interview topics	Interview result
Renewable energy as a substitute for fuel oil.	7 out of 8 undergraduate students know that renewable energy can replace fuel. 6 out of 7 explained that types of biofuels from biomass and waste can be used as a substitute for fuel, types of renewable energy that can replace fuel oil are biofuels (bioethanol, biodiesel) by utilizing biomass whose availability will continue to exist. However, the answer only answered briefly and did not provide an explanation of the reasons.
Understanding biofuels, and types of biofuels that have the potential to replace fuels.	2 out of 8 undergraduate students know biofuel, which is a substitute for petroleum fuel derived from organic materials from renewable sources. 6 out of 8 undergraduate students do not know about biofuel, after reading the given discourse they explained that biofuel is a substitute for petroleum fuel made from natural materials that can be used as a substitute for oil and are able to explain the type of biofuel that can replace BBM, namely biodiesel derived from vegetable oil that can be used as a substitute for diesel but there is no further explanation.

In category 2 about biofuels as renewable energy which consists of 2 questions. This question is intended to determine students' understanding of the concept of biofuel as an example of biofuel that can be used as a substitute for fuel. Biofuel itself is the "biofuels" in this review are referred to the energy-enriched chemicals generated through the biological processes or derived

from the biomass of living organisms. Biofuels are a type of fuel produced from biomass or organic matter derived from plants or other living things. The process of making biofuels involves converting the chemical energy contained in biomass into a form of energy that can be used to generate power, such as for vehicle propulsion, power generation, and other energy

purposes (Ambaye et al., 2021; Anggereini et al., 2023; Guo et al., 2015; Malode et al., 2021). The types of biofuels that have the potential to replace fuel are bioethanol, biodiesel, and biogas. The results of the answers from students are shown in Table 4.

Biofuel can be used as a substitute for fuel oil because of its similarity in structure to petroleum. Long-chain carbon molecules with hydrogen atoms, similar to diesel in biodiesel (Ruhul et al., 2015). There are several types of biofuels, namely bioethanol, biodiesel, and biogas. Biodiesel or fatty acid methyl ester (FAME), which has the chemical formula RCOOCH<sub>3</sub>, is a biofuel derived from vegetable or animal oil that is used as an alternative to diesel fuel for diesel engine vehicles. Biodiesel is non-toxic and burns cleaner when compared to petroleum diesel. Biodiesel produces less emissions of carbon dioxide, sulfur dioxide, particulate matter or soot, into the air and thus reduces air pollution

compared to the use of petroleum diesel (Malode et al., 2021; Suhara et al., 2024). Bioethanol is a renewable energy that converts biomass in the form of carbohydrates into ethanol by anaerobic fermentation process utilizing microorganisms. Bioethanol is an alternative energy that is environmentally friendly, and produces low carbon emissions compared to gasoline or the like up to 85% lower (Handayani & Amrullah, 2018). Biogas is a renewable fuel gas that is an alternative to natural gas. Methane gas can be captured through anaerobic digestion in a closed system (Sing et al., 2020). Based on the results of the interview data analysis, most undergraduate students experienced the main obstacle, namely the lack of understanding of biofuels so that they did not explain in depth about the types and applications of biofuels. The results of the analysis of specific learning obstacles can be seen in Table 5.

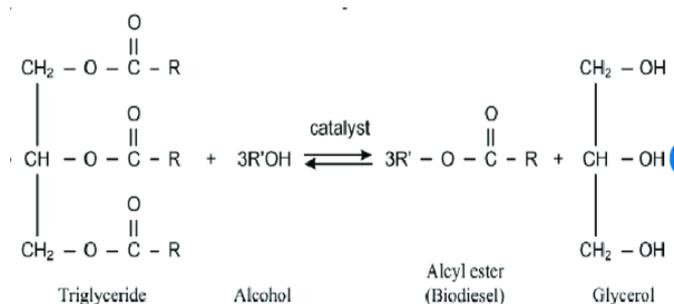
**Table 4.** Analysis interview results of question category 2

Interview topics	Interview result
Renewable energy as a substitute for fuel oil.	There are student undergraduates who don't know about energy renewable that can be replace fuel.
Understanding biofuels, and types of biofuels that have the potential to replace fuels.	Most of the undergraduate student no know about biofuels. Even after read discourse that has been given undergraduate student only mention meaning only, without accompanied with types from that biofuel.

In category 3, there are 5 questions about the source and process of making biodiesel. Giving question This intended to know understanding undergraduate student about potential source used to producing biodiesel and the chemical processes involved in the process of making biodiesel Alone.

Biodiesel can be produced from materials containing triglyceride compounds obtained from various sources, such as vegetable oil, animal fat, algae oil, or used cooking oil (Ruhul et al., 2015). Biodiesel obtained from various raw materials has different purity and composition. Considerations in choosing raw materials for biodiesel include their availability, whether or not they are used for the food sector, waste-based raw materials, the purity of the biodiesel produced, and the cost of production (Suzihaque et al., 2022). The ones that can be utilized as biodiesel are used cooking oil and castor oil. In addition to waste cooking oil, castor oil can also be used as biodiesel. *Jatropha* can grow on various types of land, including marginal land with limited availability of water and nutrients, as long as the soil drainage is good. *Jatropha* plants are resistant to acidic or alkaline soil conditions, but grow optimally at soil pH between 5.50 and 6.50. The opportunity to develop biodiesel as an alternative to diesel in Indonesia is quite large, as the use of diesel oil reaches 40% of total fuel oil consumption for transportation and 74% for industry and diesel power plants. In addition, Indonesia has

extensive marginal land and potential for crop development (Maftuchah et al., 2020).



**Figure 2.** Transesterification reaction

The formation of biodiesel is carried out through a transesterification reaction. In this process, vegetable or animal oil is reacted with an alcohol, such as methanol or ethanol, using sodium hydroxide (NaOH) or potassium hydroxide (KOH) as a catalyst. These catalysts accelerate the reaction, increase the weight of the product, and improve the final yield. After the reaction, the methyl esters or ethyl esters are separated from the glycerol. The separated biodiesel is then purified (Arachchige et al., 2021).

Biodiesel has been commercially produced and used as a substitute for diesel fuel. The chemical compounds of biodiesel are alkyl mono-esters of fatty

acids (Muhali et al., 2023; Widayat et al., 2013). The reaction equation is shown in the Figure 2. As for the

results answer from undergraduate student as following.

**Table 6.** Analysis results interview question of category 3

Topic Interview	Interview Results
Potential material nature available in Indonesia that can be utilized as biodiesel.	Entire undergraduate student knows about source material exploiting the natural resources in Indonesia as biodiesel is a oil coconut palm oil. However, only 4 of 8 students bachelor who mentioned non-food crops other that is plant distance.
Plant of "Jarak" as biodiesel source.	7 of 8 Students bachelor didn't know about "Jarak", after read they explain "Jarak" is wild plants and can grow, there is grow many in Indonesia and can utilized as biodiesel. Besides of that, plant distance useful to treatment itching and tightness breath.
Jarak converted distance become diesel oil.	7 of 8 Students bachelor didn't know about "jarak", however after read discourse all over undergraduate student mention you can get the seeds converted into biodiesel.
Stage process Biodiesel production.	Only 3 of 8 students bachelor know that the process of making biodiesel involves a reaction process so-called chemistry transesterification, however only 1 of 3 students scholar mentioned stages making it without explain more detailed. 5 of 8 students bachelor after read discourse only mention stages and reactions that occur that is reaction transesterification without explain it more carry on.
Chemical reactions in the process of making Biodiesel.	3 of 8 students bachelor No know reactions that occur during manufacture biodiesel after read discourse they explain about reaction transesterification that is reaction between oil vegetable with assisted alcohol catalyst NaOH base. However, only mention reactants and products course, explained more carry on.

Based on results analysis of interview data part big undergraduate student experience obstacle main in understand biodiesel, plants distance and manufacturing process from the biodiesel Alone Because lack knowledge beginning about plant distance, as well understanding limited regarding the transesterification process, so undergraduate student

difficulty explain details of the reaction process chemistry that occurs. Dependence on material just reading provided by educators to obtain information show lack skills in explore and filter knowledge in a way independent. As for the results analysis learning obstacle in a way specific can see in the Table 7.

**Table 7.** Analysis results learning obstacle question of category 3

Topic interview	Learning obstacle
Potential material nature available in Indonesia that can be utilized as biodiesel.	Entire undergraduate student know source Power exploiting the natural resources in Indonesia as biodiesel, however part big only mention coconut palm oil and not know potential source power another realm.
Plant of "Jarak" as biodiesel source.	Most of the undergraduate student didn't know about plant distance can utilized as biodiesel.
Plant parts converted distance become diesel oil.	Most of the undergraduate student didn't know about plant "jarak" can utilized as biodiesel.
Stage process Biodiesel production.	Most of the undergraduate student didn't know the process stages making biodiesel, even after they read discourse, they can't explain more detailed, they only mention the stages just.
Chemical Reaction in process Biodiesel production.	Entire undergraduate student are only know type reaction that occurs in the process of making biodiesel, namely transesterification reaction.

In category 4, there are 6 questions about the use of biodiesel. Giving questions are intended for evaluate understanding undergraduate student about benefit from biodiesel as energy renewable as possible replace oil earth, Biodiesel can be one of the efforts in overcoming the energy crisis and environmental problems. Biodiesel is a renewable energy source that can be produced from a variety of plants, including jatropha, helping to reduce dependence on finite and non-renewable fossil fuels, which is related to SDGs goal number 7, affordable and clean energy(UNESCO, 2020).

The use of biodiesel faces many difficulties, including the food versus fuel crisis (Suzihaque et al., 2022). To overcome this, there is another alternative, which is to utilize unused waste as biodiesel, for example from used cooking oil. This supports SDG goal 12 on sustainable consumption and production as it contributes to waste utilization. The development of biodiesel production in rural areas can open up new employment opportunities, in line with SDG goal 8 of promoting inclusive economic growth and creating decent work. This provides sustainable economic opportunities and strengthens

local economies. Access to energy services provides people with income-generating jobs, enabling them to improve their living conditions. This can support the realization of other SDGs goals including having access to health (SDGs 3) and quality education (SDGs 4), thus

leading to poverty reduction (SDGs 1) (Mazurkiewicz & Elgin, 2023). So undergraduate student understand impact to aspect environmental, economic and social. As for the results answer from undergraduate student as following.

**Table 8.** Analysis results interview of question category 4

Topic interview	Interview result
Attitude not quite enough answer in utilize potential plant distance as biodiesel. Biodiesel can as solution handle crisis energy.	By overall undergraduate students can explain and explain attitude responsible he answered to utilization plant distance This that is with ensure management good land and waste, as well using biodiesel with wise and efficient. By overall, 7 out of 8 students bachelor show that biodiesel has potential big as solution to crisis energy and environment. Although moment This its use Still in mixture with diesel. Biodiesel is looked at as source more energy friendly environmental and sustainable, which can reduce emission pollution and dependence on materials burn fossil.
Example project innovation biodiesel production.	Entire undergraduate student can give example project in material energy renewable This namely 6 out of 8 students bachelor propose project make a biodiesel prototype directly in the laboratory with utilize material nature/waste. However, 2 of 8 students bachelor propose make video content only regarding biodiesel.
Impact social, economic and environmental from biodiesel. Convey project to public.	Entire undergraduate student can explain impact use of biodiesel against aspect economy and environment. However, 2 out of 8 students bachelor can't explain impact to social aspect. Entire undergraduate student can provide deep strategy communicate projects that have been made to public general as for method delivery, that is with socialization straight away and spread it via social media with easy language understandable.

Based on results analysis of interview data part big undergraduate student show good understanding and initiative about benefits and uses of biodiesel, obstacles in apply knowledge the in a way practical, innovative in

approach project, manage impact environment in a way comprehensive, as well communicate information in a way effective to public. As for the results analysis obstacle as following.

**Table 9.** Analysis results learning obstacle question of category 4

Topic interview	Learning obstacle
Example project innovation biodiesel production.	2 out of 8 undergraduate students only propose make video content only regarding biodiesel, this reflect lack experience direct or enough information about technical and practical processes in biodiesel production from material natural or waste. As for 6 of the 8 students the undergraduate project is also limited to the process of making biodiesel at scale laboratory.
Impact social, economic and environmental from biodiesel. Convey the project idea to public.	Fraction undergraduate student not yet can explain impact use of biodiesel against aspect social. Entire undergraduate student didn't explain more carry on about challenge the possible appear in ensure that strategy effective in reach more society broad, as well as manner overcome challenge the in delivery complex message about technology and benefits from biodiesel itself.

As for parts 5<sup>th</sup> about regarding MSTR lectures. 4 out of 8 students bachelor feel difficulty with teaching materials provided lecturer, because only A little material energy renewables are discussed in a way detailed. Undergraduate students are difficulty look for source valid reading on the Internet because released by the lecturer. This matter reflects part big undergraduate student Still depending on the material readings given by the lecturer for obtain information and shows lack skills in explore and filter knowledge in a way independent.

In principle, knowledge will be obtained epistemically, epistemic Knowledge will be achieved through the stages of perception, memorial, and

introspective and ultimately formed a priori which is the knowledge itself (White, 2020). The perception phase is carried out by responding to the given didactic situation. The memorial stage is characterized by students performing mental actions to connect the results of perceptual processes with their experience, knowledge, and potential so that formulations (concepts, rules, evidence, problems, or problem solutions) are produced the introspection stage is an activity to rethink the results that have been produced. The final stage of knowledge building is a priori formation, which is the activity of concluding knowledge in general. Epistemic learning theory includes the theory of di-dactic situations (TDS). there are 4 situations in TDS, namely action,

formulation, and validation to build institutionalization (Audi, 2011). The Obstacle dominant learning identified as epistemological learning obstacle, which means difficulty study undergraduate student appear consequence understanding the concept is not complete or only based on understanding base without knowledge deep (Nopriana et al., 2023; Sukri et al., 2023). As for the general outline obstacle students' learning bachelor namely, lack understanding regarding biofuels so they didn't explain in a way deep related biofuel applications, difficulties in understand biodiesel and the process of making biodiesel, they didn't know source oil other vegetables that can made as biodiesel, difficulties apply knowledge theoretical about biodiesel in context practical and project real, and depends on the material given reading lecturer or not active look for source addition or verify information in a way independent. This data can used to diagnose learning obstacle student undergraduate and as base for designing design effective learning as well as facilitate achievement objective learning.

A teacher must have didactic skills to create effective learning situations, which involve thinking processes in three phases: before learning, during learning, and after learning (Khaerudin et al., 2023). Identification of learning obstacle in topic biodiesel that arise can be the basis for anticipating didactically in learning design. If students' responses to the didactic situations developed are beyond the reach of the teacher's thinking or are not explored properly, then the various learning barriers may not be responded to appropriately, or even not responded to at all, so that it can hinder the overall learning process.

## Conclusion

The analysis of interviews with undergraduate student of chemistry teachers about learning obstacle related to the biodiesel topic. This learning obstacle were traced through in-depth interviews conducted to analyze the concepts and learning obstacle of students regarding the topic of biodiesel in the application of MSTR lectures. The questions given were divided into 5 categories, difference between renewable and non-renewable energy; biofuel as renewable energy; sources and processes of making biodiesel; benefits of using biodiesel; and about MSTR lectures. The Obstacle dominant learning identified as epistemological learning obstacle, which means difficulty study undergraduate student appear consequence understanding the concept is not complete or only based on understanding base without knowledge deep. As for the general outline obstacle students learning bachelor namely, lack understanding regarding biofuels so they

didn't explain in a way deep related biofuel applications, difficulties in understand biodiesel and the process of making biodiesel, they didn't know source oil other vegetables that can made as biodiesel, difficulties apply knowledge theoretical about biodiesel in context practical and project real, and depends on the material given reading lecturer or not active look for source addition or verify information in a way independent. This data can used to diagnose learning obstacle student undergraduate and as base for designing design effective learning as well as facilitate achievement objective learning.

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## Author Contributions

A.A. conceptualized the research idea, carried out data collection and analysis, management and coordination responsibilities, analyzed data, carried out the research process. H. and A.S. guided in the development of interview instruments, preparation of data collection and data analysis, and provided critical feedback on the manuscript.

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## Conflicts of Interest

The authors declare no conflict of interest.

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