Bioedukasi
Jurnal Biologi dan Pembelajarannya

Vol. 22 No 1, February 2024, page 1-10
e-ISSN: 2580-0094; p-ISSN:1693-3931
DOI: 10.19184/bioedu.v22i1.42022
jurnal.unej.ac.id/index.php/BIOED

Effectiveness of Transformative Green Economy in Biology (T-GEB) Learning Model on Changing Students' Conservation Perceptions about *Elaeis guineensis* Jacq. in Ecology and Socio-Economics

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Article Info

Article history:
Received July 26, 2023
Revised September 10, 2023
Accepted December 4, 2023

Keywords:
Elaeis Guineensis Jacq.
Learning Effectiveness
Perceptions of Conservation

ABSTRACT

Changing perceptions regarding the importance of conservation can be an effort to increase conservation awareness which is still low in society. This research aims to determine the effectiveness of implementing the Transformative Green Economy in Biology (T-GEB) Learning Model in changing students' perceptions of conservation. The sample for this research is class X students of State Senior High School 1 Turen for the 2022/2023 academic year. The type of quantitative research is pre-experimental using pretest-posttest and questionnaires, while qualitative data collection uses reflective essays. The application of the T-GEB Learning Model shows that learning is quite effective in improving students' cognitive learning outcomes, with an N-Gain Score of 58% on biodiversity material and 6.4% on environmental change material. the application of the T-GEB model can change students' perceptions of conservation from previously having a strong percentage of 77.7% to 91.3% which is classified as very strong based on the results of the conservation awareness questionnaire. Changes in students' perceptions of conservation are also supported by the results of reflective essays, with three themes formed, namely awareness of the important role of oil palm, perception of the impact of oil palm expansion, and awareness of conservation through oil palm expansion.

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1. INTRODUCTION

Indonesia is one of the countries which is the center of world biodiversity. Biodiversity is a natural wealth that can provide benefits both now and in the future. However, the country of Indonesia also has a high level of environmental threat, especially in species extinction and habitat destruction which causes a decrease in biodiversity (Setiawan, 2022). Efforts that can be made to reduce the decline in existing biodiversity are conservation activities. However, the majority of people do not know that conservation is important (Liauw, 2017). This is shown from the many human activities that cause problems for existing biodiversity, one of which is expanding agricultural and plantation areas, by clearing forest land which results in the threat of the preservation of species in the forest (Anggraini, 2018).

The expansion of oil palm plantations is one example of the conversion of forest land to plantations, which aims to meet the needs of the community for palm oil, improve the economic sector, as well as earn the country's foreign exchange. However, this expansion has had an impact on the environment and the existing biodiversity. Based on data from (Ditjenbun, 2021), the total plantation area of *Elaeis guineensis* Jacq. in Indonesia in 2018 it reached 14.3 million ha, while in 2021 it will be 15.1 million ha. In addition, based on research (Acin et al., 2021), there are around 1.5 million ha of forest land that has been converted into mining land and plantation land. The issue of environmental problems caused by palm oil is supported by the European Union which implemented a policy banning the import of palm oil from Indonesia (Rahayu & Sugianto, 2020). Therefore, efforts are needed to prevent the impact caused by the conversion of forest land on biodiversity, by making people aware of the importance of conservation. The importance of biodiversity conservation activities in Indonesia is regulated in Law no. 5 of 1990 journal. Based on this foundation, the obligation to conserve must be carried out by the community through a change in perception. Changes in perceptions about the importance of conservation can be

one of the efforts to raise conservation awareness. This effort can be done with conservation education in biology learning at the high school level. Biology learning materials at the senior high school level, especially class X which are closely related to conservation, namely biodiversity and the environment. Through conservation education in learning, students can build a spirit of concern for the surrounding environment (Purmadi et al., 2020).

Conservation education in biology learning at the senior high school level has previously been carried out using a problem-based learning model, which aims only to find out the level of students' desire to apply conservation after learning, not to change students' perceptions about conservation. The Transformative Green Economy in Biology (T-GEB) Learning Model can be an intermediary in increasing conservation awareness and changing students' perceptions of conservation. This is due to the integration of transformative principles and the STEAM approach into the learning model. This transformative principle focuses on changing the views of each individual that can affect values, attitudes, and behaviour. (Culture & Ages, 2018). The Transformative Green Economy in Biology (T-GEB) Learning Model acts as an intermediary in bridging students to study the impact of the existence of a commodity plant on the ecology and socio - economics of society through a problem-solving framework. In this learning model, students will be presented with problems related to environmental damage related to the expansion of commodity crops, namely oil palm. Students in groups then discuss to reach the best solution in overcoming the problems presented, so that in this case students will think about the importance of conservation efforts for the existence of a species in the environment. The application of the T-GEB learning model is compatible with the new government curriculum, namely the independent curriculum. This is because the purpose of implementing this model is to increase knowledge and awareness of conservation in students, in order to reduce environmental damage associated with the presence of commodity plants. In line with the objectives of the independent curriculum, namely to improve human resources, as well as improve the quality of education (Vhalery et al., 2022).

Based on the background above, this study aims to determine the effectiveness of the application of the Transformative Green Economy in Biology (T-GEB) Learning Model in changing students' perceptions of conservation.

2. RESEARCH METHOD

The research was carried out from August 2022 to November 2022. The place for this research was State Senior High School 1 Turen which is located on Jl. Major General Panjaitan No. 65, Sedayu, Kec. Turen, Kab. Malang, East Java. The population in this study were class X students of State Senior High School 1 Turen for the 2022/2023 academic year. The research sample taken was class X students of State Senior High School 1 Turen for the 2022/2023 academic year as many as 34 students. Samples were taken using a purposive sampling technique, namely sampling based on certain criteria (Fena Ulfa Aulia, 2021). All students in this study used pseudonyms.

This research approach is mixed method, which collaborates quantitative and qualitative approaches which allows researchers to answer research questions with sufficient depth and breadth (Dawadi et al., 2021). The type of mixed-methods used is embedded design, which gives freedom in choosing one of the approaches to prioritize (Vebrianto et al., 2020). In this study, quantitative data was prioritized as the main data , and supported by qualitative data using data triangulation techniques , which aim to dig up the truth of certain information by collecting data from various sources (Syarif et al., 2021). The embedded design used in this study is presented in Figure 1.

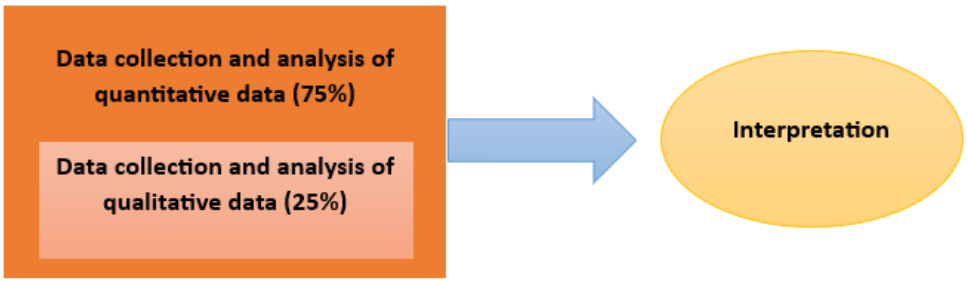

Figure 1. Embedded Design

The Transformative Green Economy in Biology (T-GEB) Learning Model is the development of transformative learning principles that are integrated with the STEAM approach and the Problem Based Learning model. There are 5 transformative learning principles in the form of self knowing, relational knowing, social knowing, visionary knowing and practical knowing (Taylor, 2013). These principles are applied to the syntax of Problem Based Learning which is integrated with science, technology, engineering, arts, and mathematics. The

T-GEB learning model is applied to material on biodiversity and environmental change, which aims to produce changes in conservation perceptions and increase students' cognitive and psychomotor learning outcomes. At the beginning of the study presented problems regarding commodity plants related to ecology and socio-economics. Furthermore, students are given dilemma questions to build the basic concept of students' perceptions of the problem. In groups students conduct an investigation, in order to find the right solution to the problem. Solutions to problems from each group are criticized to get the most effective solution. The solutions that have been made are then poured into persuasive works and disseminated through social media to attract someone to be more sensitive to these problems. The learning design in research is presented in Figure 2.

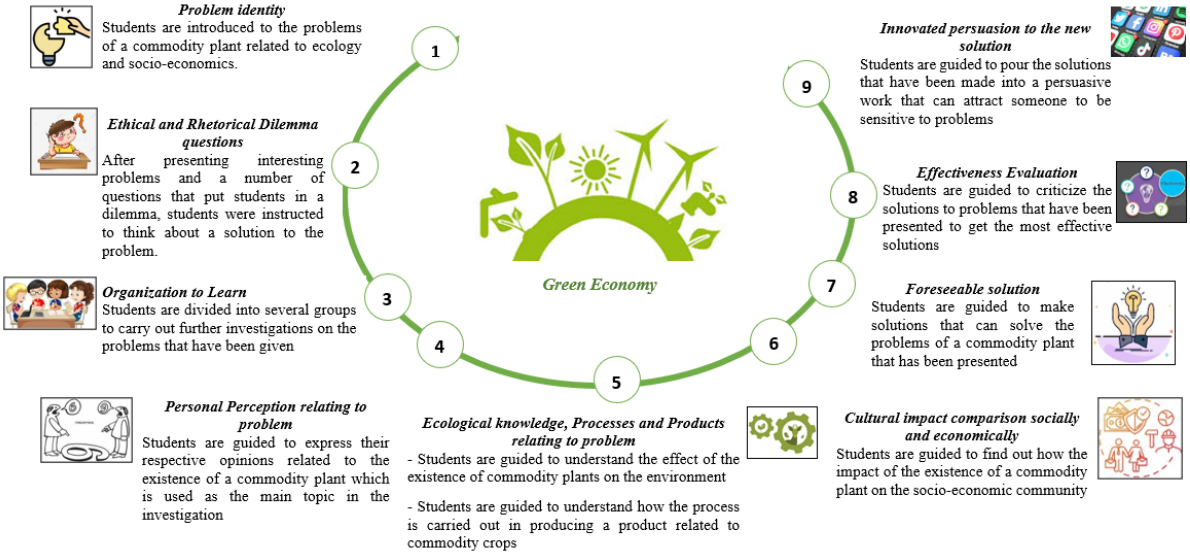

Figure 2. Design of Transformative Green Economy in Biology (T-GEB) Learning Models

Qualitative Research Instruments

The type of quantitative research used is pre-experimental , where still exists variable fixed outside follow effect on variables dependent (Maharani, et al., 2019). The research design used in the form of a one-group pretest-posttest design, which is presented in Table 1.

Table 1. One Group Pretest Posttest Design

Pretest	Treatment	Posttest
O_1	X	O_2

Source: (Hastjarjo, 2019)

Information:
O_1 : Pretest conducted before the subject is given treatment
X : Treatment Transformative Green Economy in Biology (T-GEB) Learning Model
O_2 : Posttest which is carried out after the subject is given treatment

In this type of quantitative research also uses a conservation awareness questionnaire to measure the subject's perception of conservation in the affective domain. This conservation awareness questionnaire was developed from three principles, namely the principles of protection, utilization, and preservation. The principles of protection and preservation were developed from (Westermann & von Oheimb, 2021), while the principles of utilization were developed from (Rusch et al., 2022). Each principle has 10 statement items, so that the total conservation awareness questionnaire is 30 statement items.

The pretest and posttest instruments as well as the conservation awareness questionnaire were tested for validity and reliability. The validity test aims to measure the effectiveness of an applied test (Mukholifah et al., 2020). The validity test used is the Pearson product moment test. The research instrument is said to be valid when the calculated R value > table R value (Alfian & Putra, 2017). The reliability test was carried out with the aim of measuring the stability and consistency of an instrument (Olivia & Nurfebiaraning, 2019). The reliability test used is the Alpha-Cronbach test. The instrument is declared reliable if the reliability coefficient value ranges from 0.70 to 0.90 (Yusup, 2018). The results of the validity test of the pretest and posttest instruments on biodiversity and environmental change were declared valid, with an R count > R table value, where the R table value was 0.632.

The pretest and posttest reliability tests yielded a reliability coefficient of 0.889 on biodiversity material and 0.845 on environmental change material, so that the pretest and posttest instruments for both materials were declared reliable as shown in Appendix 11.

The results of the validity test of the conservation awareness questionnaire statement items show that all statement items in the awareness questionnaire are included in the valid category. This is indicated by the value of R > R table, with an R table value of 0.361 out of 30 items and $\alpha = 0.05$. The results of the reliability test of the conservation awareness questionnaire yielded a reliability coefficient of 0.853, so that the questionnaire instrument was said to be reliable as shown in Appendix 12.

The quantitative data obtained was analyzed in the form of the Kolmogorov-Smirnov normality test, homogeneity, and difference test. The pretest and posttest data were then tested by the N-Gain score to determine the effectiveness of learning. The N-Gain test score formula is presented below.

$$N - Gain = \frac{Posttest\ Score\ - Pretest\ Score}{Max\ Score - \ Pretest\ Score}\ x\ 100$$

Source: (Archambault, 2008)

The results of the N-Gain score analysis is then interpreted based on the N-Gain grouping criteria seen in Table 2.

Table 2. N-Gain Grouping Criteria

Percentage (%)	Criteria
< 40	Ineffective
40 – 55	Less effective
56–75	Effective enough
> 76	Effective

Source: (Hake, 1999)

The results of the conservation awareness questionnaire obtained were analyzed using the Likert scale analysis technique with several questionnaire indicator criteria can be seen in Table 3.

Table 3. Questionnaire Indicator Criteria

Percentage (%)	Criteria
< 40	Very Weak
40–60	Weak
61–80	Strong
81-100	Very strong

Source: (Sugiyono, 2011)

Qualitative Research Instruments

Qualitative data collection using reflective essays. Reflective essays aim to provide an overall description of what students have learned and the experiences they have gained during the learning process (Lubis, 2019). Reflective essay data collection was carried out before learning and after learning. This reflective essay is used to support quantitative data in the form of a conservation awareness questionnaire to determine students' perceptions of conservation. This is because in embedded design reflective essays are not the main data, but as supporting data or strengthening quantitative data. The qualitative data analysis used is in the form of thematic analysis, through three stages, namely understanding the data, compiling codes, and grouping them into certain themes (Heriyanto, 2018).

3. RESULT AND DISCUSSION

Based on the results of the pretest work on biodiversity material, the average grade of class X students was 55.2, while for environmental change material it was 35.9. However, the results of posttest work on both materials experienced an increase, the average value on biodiversity material was 81.6, while on environmental change material it was 75.2 (Appendix 14). The results of the average pretest-posttest scores on both materials show that there is an increase in learning outcomes in the cognitive domain of students after the implementation of Transformative Green Economy in Biology (T-GEB) learning.

The results of the normality and homogeneity tests for the pretest-posttest data on biodiversity material show that the data obtained is not normally distributed with a value of 0.002 <0.05 and not homogeneous with a value of 0.014 <0.05, while in the environmental change material the data is normally distributed with a value 0.179 > 0.05 and homogeneous data with a value of 0.550 > 0.05 (Appendix 20).

In the material for biodiversity, because the data is not normally distributed and not homogeneous, a non-parametric difference test is used in the form of the Wilcoxon test, while in the material for environmental change using a parametric test in the form of a paired T test, because the data is normally distributed and homogeneous. The results of the different tests on the two materials showed that there were differences in the results between the pretest and posttest, with a significance value of 0.000 <0.05 (Appendix 20).

There is a significant difference in the results of the different tests on the pretest and posttest, the data is then analyzed using the N-Gain Score test. The results of the analysis using the N-Gain Score (Appendix 20), it can be seen that the difference between the pretest scores before the application of learning and the posttest scores after the implementation of learning is 58% in the material about biodiversity, and 64% in the material about environmental change. These results indicate that the application of Transformative Green Economy in Biology (T-GEB) learning in class X State Senior High School 1 Turen shows the effectiveness of learning which is quite effective. The N-Gain Score is presented in Table 4.

Table 4. N-Gain Effectiveness Score of the Transformative Green Economy in Biology (T-GEB) Learning Model on Biodiversity and Environmental Change

Material	***N-Gain***	
	Criteria Percentage	**Kriteria**
Biodiversity	58	Moderately Effective
Environmental Change	64	Moderately Effective

The Transformative Green Economy in Biology (T-GEB) Learning Model is quite effective in improving learning outcomes in the cognitive domain. This can happen because this model presents problems regarding environmental damage related to the expansion of oil palm at the beginning of learning. Increasing learning outcomes in the cognitive domain by presenting problems at the beginning of learning is in accordance with Piaget's theory of cognitive development, that intellectual development occurs in individuals when they are faced with new experiences and when they try to solve the problems presented. Piaget's theory of cognitive development is one of the theories that forms the basis for developing problem-based learning models (Ardianti et al., 2022). In addition, this research is in line with similar research conducted by (Nofri et al., 2022), regarding the application of a problem-based learning model regarding environmental damage that is currently developing in increasing knowledge of green skills related to the green economy, showing an increase in learning outcomes student. Presenting problems in the learning process will increase students' courage in expressing opinions, so that students will be more active and motivated to learn. According to (Ardianto et al., 2021), that students' activeness and greater desire to learn will have an impact on increasing student learning outcomes.

The effectiveness of the Transformative Green Economy in Biology (T-GEB) Learning Model which only achieves the criteria of being quite effective in improving student learning outcomes is related to the length of time used in learning activities. The time spent in learning the Transformative Green Economy in Biology (T-GEB) Learning Model is quite short. In addition, the material presented is still relatively new, so students have not been able to understand the material more deeply. Therefore, the effectiveness of learning only reaches the criteria of being quite effective, does not reach the criteria of being effective. In line with the results of research (Imama, 2021), it shows that the time provided by the teacher for teaching is one of the factors related to achieving effective learning.

The results of the analysis of the normality test and homogeneity of the conservation awareness questionnaire data, showed that the data obtained was not normally distributed with a value of 0.000 greater than 0.05, and not homogeneous with a value of 0.002 greater than 0.05. Therefore, a non-parametric difference test in the form of the Chi-Square test is used. The different test produces a significance value of 0.002 <0.05 (Appendix 21), indicating that there is a significant difference between the results of the questionnaire before and the questionnaire after learning.

Based on the results of a conservation awareness questionnaire, it is known that the application of Transformative Green Economy in Biology (T-GEB) learning in class X State Senior High School 1 Turen shows the results of increasing students' conservation awareness which was originally classified as strong to very strong (Appendix 21). This can be seen from the descriptive analysis of the Likert scale, the student conservation awareness questionnaire before the application of learning produces an average percentage of 77.7% which indicates that the conservation awareness of class X students is classified as strong, with a percentage of the principle of protection of 80%, the principle of preservation of 79%, and the principle of utilization of 74%. The results of the Likert scale analysis of the conservation awareness questionnaire after learning resulted in an increase in students' conservation awareness which became very strong, with an average percentage of 91.3%, with a percentage of 92% protection principle, 92% conservation principle, and 90% utilization principle presented in Table 5.

Table 5. Students' Perceptions of Conservation on Various Principles of Conservation Awareness

Principle	Previous Questionnaire Results		After Questionnaire Results	
	Percentage	Criteria	Percentage	Criteria
Protection	80	Strong	92	Very strong
Preservation	79	Strong	92	Very strong
Utilization	74	Strong	90	Very strong
Average	77,7	Strong	91.3	Very strong

The Transformative Green Economy in Biology (T-GEB) Learning Model is also able to increase students' conservation awareness which can be seen from the results of the analysis of conservation awareness questionnaires and reflective essays, that there has been a change in conservation perceptions of class X State Senior High School 1 Turen who initially had conservation awareness classified as strong becomes very strong after the application of learning. Changes in students' perceptions of conservation are caused by several factors such as new knowledge that students gain during the learning process. In line with constructivism learning theory that students will build their knowledge based on the experience they have gained (Sugrah, 2020). In this case students build different perspectives on conservation after the new knowledge they get in learning. In addition, this study is in accordance with (Herlin et al., 2018), that knowledge is a factor that can influence one's perception. Knowledge of the problem of oil palm expansion related to ecology and socio-economics in learning has raised students' awareness of the important role of conservation for biodiversity. According to (Purmadi et al., 2020), in building awareness of conservation, it must start with education and knowledge in order to be able to move one's attitude towards conservation. Awareness of the important role of conservation has led to the perception of students by continuing to maintain the existence of oil palm but still being environmentally sustainable.

On each principle of the conservation awareness questionnaire, an increase in conservation awareness is obtained which is different for each component of biodiversity which includes genetic diversity, species diversity, ecosystem diversity, functional diversity, human impact, symbols, language, norms, values, and artifacts. Functional diversity on the principle of utilization is the highest component of biodiversity that increases conservation awareness in students after the implementation of Transformative Green Economy in Biology (T-GEB) learning. Increasing awareness of conservation in each component of biodiversity from three different principles can be seen in Figure 3.

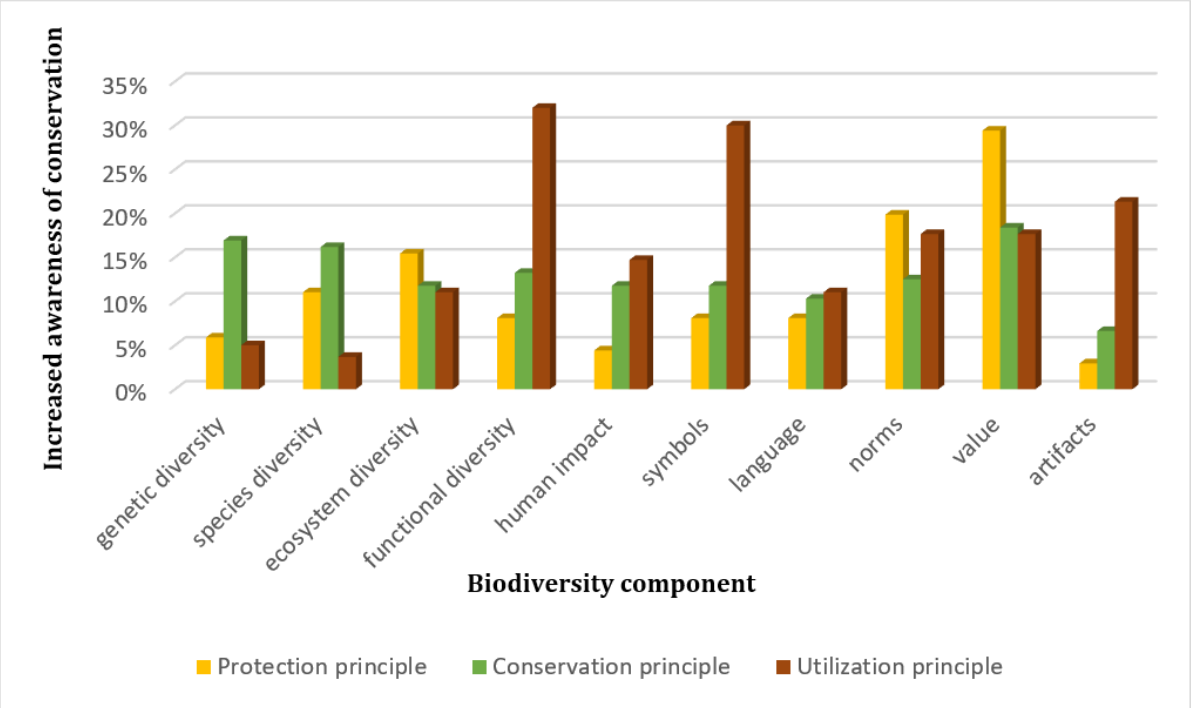

Figure 3. Increasing Conservation Awareness in Each Biodiversity Component

The highest increase in conservation awareness in the questionnaire is the principle of utilization. This is supported by the results of student reflective essays which show that one of the conservation efforts that can be done is not to overuse biodiversity. Students are aware of how the first conservation efforts they can do in utilizing existing biodiversity to meet the economic needs of the community. This is in accordance with research (Ratnasari

et al., 2022), conservation awareness possessed by students will encourage students to behave in a caring manner for the environment. Use of biodiversity in moderation is a form of caring behavior for the environment.

Based on the results of the reflective essays that have been done by students, they can be grouped into three themes, namely awareness of the important role of oil palm, perceptions of the impact of oil palm expansion, and awareness of conservation through oil palm expansion.

1) Awareness of the important role of oil palm

The majority of students in their reflective essays already know the various important roles of oil palm for humans, by writing that oil palm is the main source of meeting the needs of society for oil, as well as having a positive impact on state revenues. One student named Nadine wrote that palm oil is a raw material for producing oil.

"Palm oil is an industrial plant as a raw material for producing oil, especially cooking oil," Nadine.

In addition, one student named Sonya wrote that oil palm plays a role in increasing the country's foreign exchange.

"*Oil palm has a role in increasing foreign exchange, and can increase the income and dignity of Indonesian plantation farmers*" Sonya.

2) Perceptions of the impact of oil palm expansion

After learning the Transformative Green Economy in Biology (T-GEB) Learning Model, differences in students' perceptions of the impact of oil palm expansion emerged. Some students assume that the existence of oil palm plantations has a positive or non-harmful impact on the environment, as Ryo wrote in his reflective essay.

"*The relationship between oil palm and the environment is good, friendly and friendly. Oil palm helps in reforestation of former logged-over land*" Ryo.

On the other hand, some other students wrote in their essays that the expansion of oil palm had a negative impact on the environment, one of which was a student named Lindi who had a negative perception of oil palm expansion.

"*The case that arises in relation to oil palm is that deforestation for oil palm plantations can trigger climate change and global environmental damage*," Lindi.

3) Awareness of conservation through oil palm expansion

Students' awareness of conservation emerges through the case of oil palm expansion written in their reflective essay. The students support the conservation of an existing biodiversity, one of which is oil palm through various efforts both by the government and the people themselves. One of the students named Eka in his essay wrote about conservation related to the principle of utilization.

"*Not excessive in using*" Eka.

In addition, a student named Farrell mentioned conservation efforts related to the principle of preservation.

"*Preservation can be done through cultivation, such as oil palm plantations. Preservation by means of cultivation can provide economic benefits and be able to preserve biodiversity*" Farrell.

Conservation on the principle of protection was also written by several students, one of whom was a student named Farah.

"*The government is developing related to the palm oil industry. Starting from making efforts to protect both the environment and the oil palm itself*." Farah.

Based on the application of the Transformative Green Economy in Biology (T-GEB) Learning Model in class X State Senior High School 1 Turen, it shows that there is a link between the results of the conservation awareness questionnaire and reflective essays in increasing students' conservation awareness. In the conservation awareness questionnaire, the highest increase in conservation awareness after learning is on the principle of utilization, with statement items regarding functional diversity. The high increase in conservation awareness on the principle of utilization is supported by the results of reflective essays written by students, one of the conservation efforts that can be done is not to use oil palm or other biodiversity excessively. The functional diversity statement item in the utilization principle is the statement item with the highest increase. This is because in the results of reflective essays almost all students know that oil palm has an important role for human life, such as the main raw material for producing cooking oil which is the main need of the community, and plays a role in increasing the country's foreign exchange.

The high increase in conservation awareness on the utilization principle is due to the high increase in functional diversity statement items. Students in this case are aware that the existence of oil palm has various functions for both humans and the environment. In reflective essays, the majority of students wrote about the important role of oil palm for humans, as well as the good sides of the existence of oil palm in the environment. Student awareness of the important role of oil palm for life has influenced student perceptions. This is in accordance with research (Arifin et al., 2017), the important need for the presence of an object can influence a person's perception of the object to become more positive. Thus, the application of the Transformative Green Economy in Biology (T-GEB) Learning Model is quite effective in changing students' perceptions of conservation.

4. CONCLUSION

The application of the Transformative Green Economy in Biology (T-GEB) Learning Model is quite effective in improving student learning outcomes in the cognitive domain, this is due to the presentation of problems regarding oil palm expansion at the beginning of learning, as well as the length of time used in the learning process. In addition, the application of the Transformative Green Economy in Biology (T-GEB) Learning Model can increase students' conservation awareness from being classified as strong to very strong through a conservation awareness questionnaire supported by reflective essays. Changes in students' perceptions of conservation after learning are caused by factors such as new knowledge that students gain during the learning process, as well as students' awareness of the important role of oil palm for life.

5. ACKNOWLEDGEMENT

The author realizes that this article has been completed thanks to the help and motivation from various parties. On this occasion the author expresses respect and gratitude to: The author's parents who always provide support and motivation in compiling this article. Prof. Dr. Hadi Suwono, M.Sc. and Mrs. Rifka Fachrunnisa, S.Pd., M.Ed. as a thesis supervisor. Dr. Ibrahim, M.Sc. as a thesis examiner lecturer. Mrs. Lukie Pamularsih, S.Pd. and Drs. Idayati as a teaching assistant tutor who assisted in research data collection at State Senior High School 1 Turen. Class X students who have assisted the writer in research data collection.

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