JURNAL GEOGRAFI
Geografi dan Pengajarannya
ISSN : 1412 - 6982
e-ISSN : 2443-3977
Volume 23, Number 2, December 2025
https://journal.unesa.ac.id/index.php/jg
DOI : https://doi.org/10.26740/jggp.v23n2.p353-372

THE INFLUENCE OF GEOGRAPHY EDUCATION ON STUDENTS' UNDERSTANDING OF THE ROLE OF TOLI-TOLI COASTAL VEGETATION IN MAINTAINING SOIL STABILITY

Wilda Ismiatus Sholihah*[1], Bambang Syaeful Hadi[2]
[1]Geography Education Master Program, Universitas Negeri Yogyakarta, Indonesia
[2]Department of Geography Education, Universitas Negeri Yogyakarta, Indonesia

ARTICLE INFO

Article history:
Received 04 Sept 2025
Revised 16 October 2025
Accepted 11 Nov 2025

***Keywords*:**
Geography Education,
Ecological Awareness,
Coastal Vegetation

ABSTRACT

Geography education is crucial in fostering students' ecological awareness, particularly regarding coastal ecosystems. This study examined the effect of geography education on students' understanding of coastal vegetation functions in maintaining soil stability in Toli-Toli. Using a quantitative explanatory design and simple linear regression, data were collected via a 4-point Likert scale questionnaire covering geography education and ecological understanding indicators. The analysis showed a significant effect of geography education, with a partial t-test ($t = 11.979 > 1.983$; $p = 0.001$) and F-test ($F = 143.492 > 3.09$; $p < 0.001$). The determination coefficient ($R^2 = 0.589$) revealed that geography education accounts for 58.9% of the variance in students' understanding. These results highlight the importance of contextual and applied geography learning to strengthen ecological literacy, enabling students to appreciate the ecological and socio-economic roles of coastal vegetation, particularly mangroves, in protecting coastlines and maintaining environmental sustainability.

A. INTRODUCTION

Education is one of the main instruments in shaping public awareness of the environment. Through education, individuals not only acquire knowledge and skills, but also develop an attitude of caring for nature conservation. Geography education, as one of the subjects in secondary school, has a strategic role in providing an understanding of natural phenomena, human interaction with the environment, and the interrelationship between spaces (Urbańska et al., 2022). Thus, geography learning can be a means of instilling ecological awareness and environmental analysis skills in students. (Kurniawan et al., 2025). One important element in maintaining the balance of coastal ecosystems is coastal vegetation, including mangrove forests and other types of coastal vegetation. This vegetation has vital ecological functions, including preventing erosion, binding sediment, protecting coastal areas from damage caused by ocean waves, and supporting biodiversity. The functions of coastal vegetation are not only ecological

*Correspondence address: wildaismiatus.2023@student.uny.ac.id

but also have an impact on the socio-economic aspects of local communities, such as fisheries, tourism, and land use. Students' understanding of the role of coastal vegetation is very important so that they are able to apply geography in the context of environmental sustainability and become individuals who care about nature conservation.

However, various studies show that students' understanding of the function of coastal vegetation is still limited. Several factors that influence this include a theoretical approach to learning, limited field experience, a lack of contextual learning resources, and a lack of integration of local environmental issues into the curriculum. This condition poses a challenge for geography education to not only transfer knowledge, but also build ecological awareness, spatial analysis skills, and students' critical thinking abilities regarding real environmental issues (Rosviani et al., 2022).

Coastal erosion in Toli-Toli, Central Sulawesi, poses a serious threat that erodes coastal habitats and disrupts the welfare of local communities. Data from Statistics Indonesia (2025) reveals 14 significant erosion points in seven coastal villages, indicating an urgent need for effective mitigation efforts. Although physical intervention is important, ecological education is crucial in building awareness of sustainable conservation. A study by Kurniawan et al. (2025) shows that contextual geography education significantly improves students' understanding of the function of coastal vegetation, such as mangroves, which play an important role in maintaining soil stability and preventing erosion. The integration of spatial and socio-cultural approaches in education opens up opportunities for strategies to involve the younger generation as agents of change in erosion mitigation. This study aims to fill the knowledge gap regarding the impact of erosion with a multidimensional approach that combines spatial data and environmental education, contributing to adaptive and sustainable coastal management.

The purpose of this study was to determine the extent of students' understanding of the function of coastal vegetation, particularly mangrove forests, in the context of coastal ecosystems in the Toli-Toli region and to analyse the relationship between students' ecological understanding and their actual behaviour in protecting and preserving the coastal environment in the community around the school. Students' understanding of the functions of this ecosystem still needs to be improved so that they can play an active role in environmental conservation. Therefore, this study is important to provide a clear picture of the effectiveness of Geography

education in shaping students' ecological awareness and positive behaviour towards the preservation of coastal ecosystems in the Toli-Toli region. This study is expected to provide recommendations that support mangrove conservation efforts through improved education and the involvement of the younger generation in preserving the coastal environment.

The importance of students' understanding of the function of coastal vegetation also has an impact on disaster mitigation efforts in coastal areas. Coastal vegetation plays a role in reducing the risk of damage caused by sea waves, tidal floods, and erosion, so that students who understand this role not only gain academic knowledge but also absorb the values of environmental sustainability (Ribeiro, et al., 2020). Thus, geography education becomes a strategic means of instilling ecological awareness and encouraging students to become agents of change in coastal ecosystem conservation.

For the application of this study, a number of quantitatively measurable indicators were used. The variable of geography education as an independent variable was measured through five main dimensions, namely: (1) the suitability of learning materials with the topic of coastal vegetation, (2) interactive and contextual learning methods, (3) the availability of learning resources, (4) active student involvement in discussions and field activities, and (5) the learning evaluation process. Meanwhile, the variable of students' ecological understanding was measured through five indicators, namely: (1) conceptual understanding, (2) understanding of ecological functions, (3) environmental awareness, (4) application of knowledge, and (5) behaviour and attitudes towards conservation. These indicators were developed based on the theory of environmental literacy and ecological awareness (Maridi et al., 2015; Wulandari, 2023; Ulyah et al., 2022) and are described in detail in Tables 1 and 2.

Based on the background and objectives of the study, the main question to be answered in this study is the extent to which geography education influences students' ecological understanding of the function of coastal vegetation in maintaining soil stability. This question forms the basis for directing the focus of the study on the relationship between the quality of geography learning and the level of students' ecological understanding of coastal ecosystems.

In line with this research question, this study establishes a hypothesis as the basis for empirical testing. The alternative hypothesis (H_1) states that geography education has a significant effect on students' understanding of the function of coastal vegetation in maintaining soil stability. Conversely,

the null hypothesis (H_0) states that geography education does not have a significant effect on students' understanding of the function of coastal vegetation in maintaining soil stability.

B. METHOD

This research was conducted in the coastal area of Toli-Toli, Central Sulawesi, which has a strategic coastal ecosystem, including mangrove forests and coastal vegetation that play an important role in maintaining soil stability. The location was selected purposively because the area has well-preserved coastal vegetation, but students' understanding of the role of this ecosystem is still low. The research was conducted over two months, from June to July 2025, and included the stages of preparation, data collection, analysis, and report writing.

This study used a quantitative approach with an explanatory research design to explain the causal relationship between geography education (X) and students' understanding of the role of coastal vegetation in maintaining soil stability (Y). The analysis was conducted using a linear regression model to determine the significant influence between variables. The research population consisted of 137 students from three social studies classes at MAS Al-Khairaat Kalangkangan. The sample was determined using stratified random sampling so that the sample represented the variation in infrastructure conditions at each research location. The sample size was determined using the Slovin formula with a 5% margin of error, resulting in approximately 102 samples from the school. Prior to the main data collection, an instrument trial (pilot test) was conducted on 30 students outside the research sample who had similar characteristics to the main respondents. The results of the trial were used to refine the instrument items.

This study used a questionnaire to measure respondents' perceptions. Responses were given on a Likert scale. This Likert scale consists of four responses representing the level of agreement or satisfaction of respondents to the statements in the questionnaire. The four-point Likert scale questionnaire includes: (1) Strongly Disagree, (2) Disagree, (3) Agree, (4) Strongly Agree. This strategy is expected to yield more in-depth and quantitative data on respondents' views regarding the conditions and challenges faced by the fisheries sector in Bitung, as well as its contribution to the regional economy. The reason for using a 4-point scale is to make it easier for respondents to give an assessment without a neutral option, thus forcing respondents to choose either agree or disagree. The instrument uses 20 questions, with 10 questions per indicator.

The content validity of the instrument was tested using Aiken's V, involving three experts in geography and environmental education. The calculation results showed an Aiken's V value of 0.804, which means that all items were declared valid because they exceeded the minimum limit of 0.80. Construct validity was tested through Corrected Item-Total Correlation analysis, with the results showing that all items had a correlation value > 0.30. The reliability test using Cronbach's Alpha resulted in α = 0.850 for the geography education variable and α = 0.880 for the student understanding variable, indicating high reliability.The data were analysed using simple linear regression with the equation:

$$Y = a+bX+e \text{..... (1)}$$

where Y = student understanding, X = geography education, a = constant, b = regression coefficient, and e = error.

The analysis was performed using IBM SPSS Statistics version 27, after the data met the classical assumptions of normality, linearity, and homoscedasticity. The model was deemed suitable for testing the effect of geography education on students' understanding of coastal vegetation functions in the Toli-Toli coastal region. Before performing regression analysis, classical assumption tests are first conducted to ensure that the data meets statistical requirements and that the regression model used is analytically valid.

One-Sample Kolmogorov-Smirnov Test

			Unstandardized Residual
N			102
Normal Parameters[a,b]	Mean		.0000000
	Std. Deviation		2.29474842
Most Extreme Differences	Absolute		.083
	Positive		.056
	Negative		-.083
Test Statistic			.083
Asymp. Sig. (2-tailed)[c]			.082
Monte Carlo Sig. (2-tailed)[d]	Sig.		.085
	99% Confidence Interval	Lower Bound	.078
		Upper Bound	.092

Figure 1. Normality Test
(Source: SPSS 27 Processing, 2025)

The results of the normality test using the One-Sample Kolmogorov–Smirnov Test show a significance value (Asymp. Sig. 2-tailed) of 0.082, which is greater than the significance level of 0.05. This means that the residual data is normally distributed and meets the assumption of normality. Thus, the regression model used in this study is suitable for proceeding to the next stage of analysis.

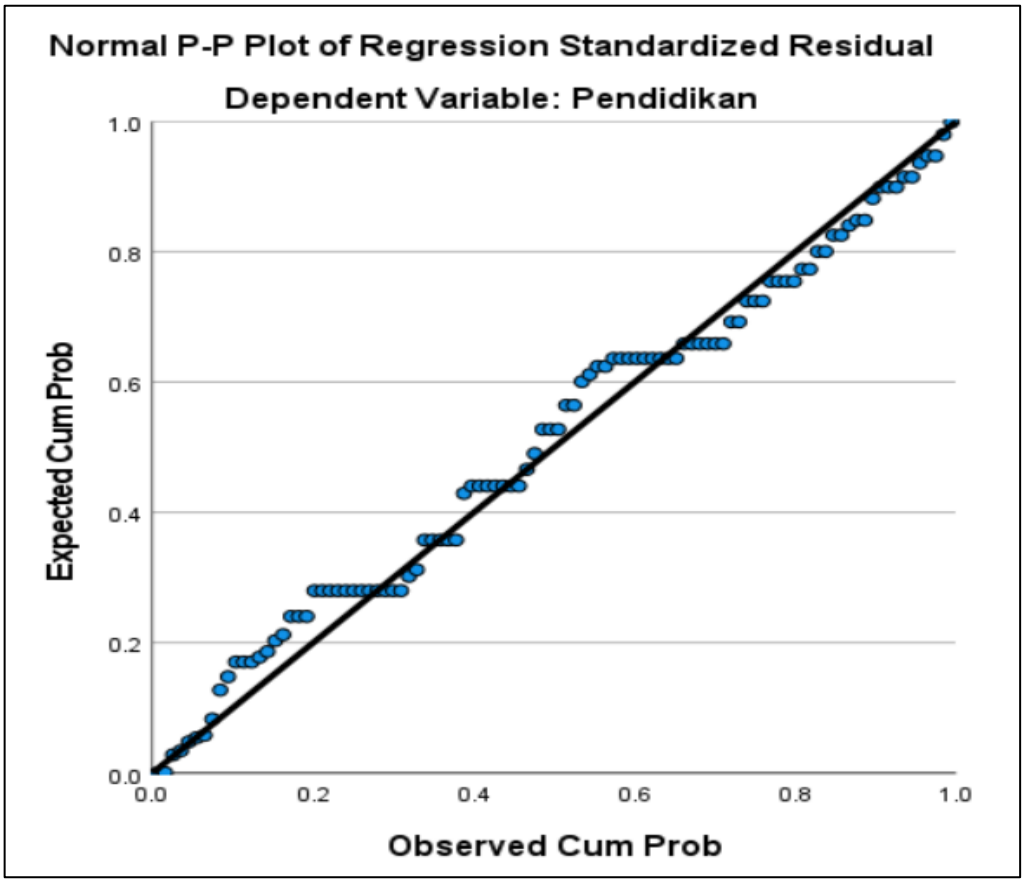

Figure 2. Homogeneity Test
(Source: SPSS 27 Processing, 2025)

The results of the variance homogeneity test can also be observed through a scatterplot between the Standardised Predicted Value and Standardised Residual values. The data points appear to be scattered randomly above and below the zero line without forming any particular pattern. This scatter pattern indicates that the residual variance is constant for each predicted value, so it can be concluded that the data meets the assumption of homoscedasticity or variance homogeneity. The results of the heteroscedasticity test on the scatterplot graph show points scattered randomly above and below the zero line without any particular pattern. This condition indicates the absence of heteroscedasticity.

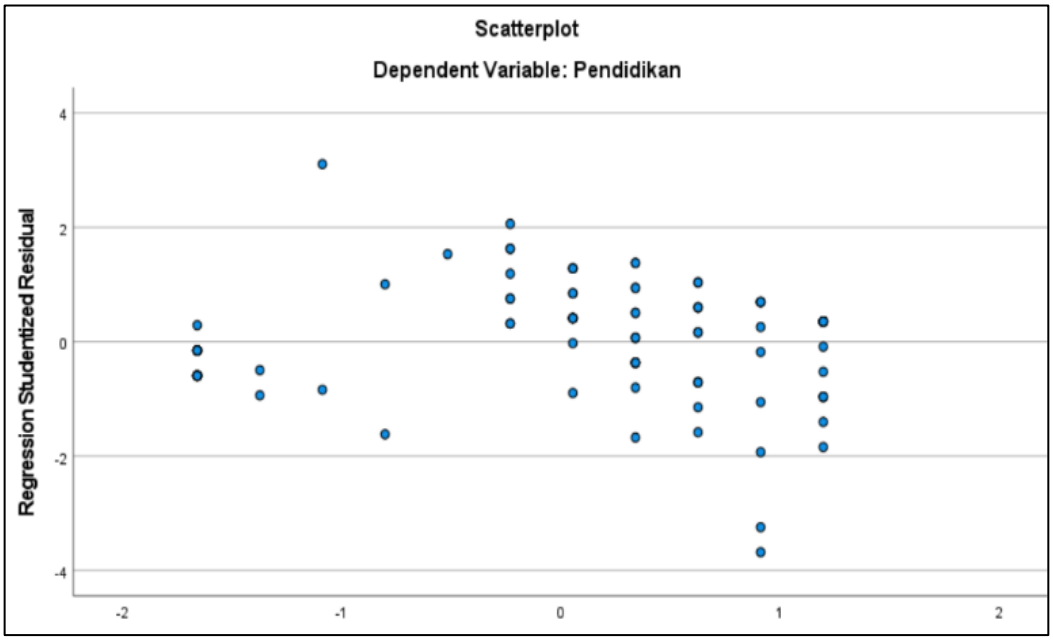

Figure 3. Heteroscedasticity Test
(Source: SPSS 27 Processing, 2025)

The Geography Education variable in this study was measured through five main indicators. First, Learning Materials, which emphasised the suitability of geography content with the topics of coastal vegetation and soil stability, where relevant and contextual materials could improve students' understanding of the ecological function of coastal vegetation (Ulyah, Hastuti, and Prihastanti, 2022). Second, Learning Methods, which include the use of interactive, contextual, and problem-based learning strategies, aim to engage students actively in the learning process and enable them to relate theoretical concepts to real phenomena (Priandeni et al., 2025). Third, Learning Resources, which include media, books, or field learning materials, provide additional support for students in understanding the material, so that their understanding of the concepts becomes more comprehensive. Fourth, Student Engagement, which assesses students' active participation in discussions, practical work, and field activities, shows students' motivation and enthusiasm in learning about coastal vegetation (Nasution, Adlika, and Tampubolon 2022).

Finally, Learning Evaluation, which measures the effectiveness of assessment through relevant questions or assignments, reflects the extent to which the material, methods, and learning resources are able to shape students' understanding of the function and role of coastal vegetation in maintaining soil stability.

Table 1. Geography Education Dimension and Indicators

Dimensions	Indicators
Learning Materials	The suitability of geography material with the topics of coastal vegetation and soil stability
Learning Methods	The use of interactive, contextual, and problem-based learning methods
Learning Resources	Availability of media, books, or field learning resources related to coastal vegetation
Student Engagement	Active participation in discussions, practicals, or field activities about the coastal environment
Learning Assessment	Active participation in discussions, practicals, or field activities about the coastal environment

(Source: Data processed in 2025)

The dependent variable in this study was Students' Understanding of the Role of Coastal Vegetation in Maintaining Soil Stability, which was measured through five dimensions (Maridi, Saputra, and Agustina, 2015). First, Conceptual Understanding, which assesses the extent to which students know the definitions and types of coastal vegetation, such as mangroves and casuarina trees, as the basis for ecological understanding (Wulandari, 2023). Second, Ecological Function, which measures students' ability to understand the role of coastal vegetation in resisting erosion, binding sediments, and maintaining soil stability, so that students can relate the concept to the real impact on the coastal environment. Third, Environmental Awareness, which assesses the extent to which students recognise the importance of coastal vegetation for the preservation of ecosystems and the lives of surrounding communities (Wulandari, 2023). Fourth, Knowledge Application, which assesses students' ability to explain or predict the impact of reduced coastal vegetation on the environment, demonstrating their level of understanding in a practical context. Finally, Behaviour and Attitude, which measures student involvement in conservation or environmental education activities, reflecting the internalisation of knowledge into concrete actions that support the sustainability of coastal ecosystems.

Table 2. Students' Understanding of the Role of Coastal Vegetation

Dimensions	Indicators
Conceptual Understanding	Knowing the definitions and types of coastal vegetation (e.g. mangroves, sea pines)
Ecological Function	Understanding the role of coastal vegetation in preventing erosion, binding sediment, and maintaining soil stability
Environmental Awareness	Recognising the importance of coastal vegetation for ecosystem conservation and community life
Application of Knowledge	Being able to explain or predict the impact of coastal vegetation reduction on the environment
Behaviour and Attitude	Demonstrating a caring attitude towards coastal vegetation, e.g. participating in conservation activities through environmental education

(Source: Data processed in 2025)

C. RESULT AND DISCUSSION

C.1. RESULT

The results of this study present empirical findings on the influence of geography education on student's understanding of the role of coastal vegetation in maintaining soil stability in Toli-Toli**.** After going through the data collection and analysis stages, the results of the study were obtained, describing how geography education contributes significantly to shaping students' understanding of the ecological function of coastal vegetation, particularly mangrove forests. coastal vegetation, particularly mangrove forests.

Table 3. Results of the Geography Education Indicator Survey

Class	Total Value	Number of Students	Average Total Score per Student
IPA 1	908	26	34,92
IPS 1	961	26	36,96
IPA 2	918	25	36,72
IPS 2	869	25	35,00

(Source: Data processed in 2025)

Based on the results of the Geography Education indicator survey described in Table 1, data on student achievement from the four sample classes in the study are presented in Table 3. IPS 1 lass ranked highest with an

average score of 36.96, followed by IPA 2 with a score of 36.72, then Social IPS 2 with 35.00, and finally IPA 1 with a score of 34.92. The difference in achievement between classes of 2.04 points indicates that there is variation in the level of students' understanding of the role of coastal vegetation in maintaining soil stability. The achievements of students majoring in Science (IPA 2 and IPA 1) showed inconsistent results, IPA 2 obtained the highest score, while IPA 1 ranked lowest. These findings suggest that internal class factors, such as student motivation, the quality of teacher-student interaction, and the teaching methods used, play a significant role in determining students' level of understanding, even though the curriculum taught in both classes is the same. Therefore, efforts to improve the quality of learning need to consider these aspects in order to optimise students' understanding evenly.

Table 4. Results of the Student Ecological Role Understanding Survey

Class	Total Value	Number of Students	Average Total Score per Student
IPA 1	901	26	34,65
IPS 1	952	26	36,62
IPA 2	930	25	37,20
IPS 2	869	25	34,76

(Source: Data processed in 2025)

The survey results regarding students' understanding of the ecological role of coastal vegetation in maintaining soil stability show variations in achievement between classes. IPA 2 recorded the highest average score of 37.20, followed by IPS 1 with a score of 36.62. Meanwhile, IPA 1 and IPS 2 scored lower, at 34.65 and 34.76, respectively. Despite the differences between classes, the achievements of students from both majors, Science and Social Studies, were relatively balanced overall. The high achievements in IPA 2 and IPS 1 indicate the effectiveness of geography learning in improving the ecological understanding of students in these groups. Conversely, the lower results in IPA 1 and IPA 2 classes indicate the need to strengthen learning strategies, particularly through a contextual approach that links the material to the actual conditions of the coastal environment. This approach is expected to increase the relevance of learning and deepen students' understanding of the role of coastal vegetation in maintaining soil stability.

Table 5. Reliability Test

	Cronbach's Alpha Value
X	0.850
Y	0.880

(Source: Data processed in 2025)

Based on the reliability test results, Cronbach's Alpha value for the Geography Education variable (X) was 0.850, while for the Student Understanding variable (Y) it was 0.880. Both values were above the minimum threshold of 0.70, which is generally used as the standard for assessing the reliability of research instruments. This indicates that the instruments used for both variables have good internal consistency and are reliable for measuring the intended constructs.

Table 6. Partial T-test

	T_{count}	T_{table}	Sig
X-Y	11.979	1,983	.001

(Source: Data processed in 2025)

Based on the partial t-test results presented in Table 7, a t-value of 11.979 was obtained with a t-table value of 1.983 at a significance level of 0.001. The calculated t-value, which is much greater than the table t-value, indicates that the variable of Geography Education (X) has a significant effect on Students' Understanding of the Role of Coastal Vegetation in Maintaining Soil Stability (Y). Furthermore, the significance value of 0.001, which is smaller than 0.05, reinforces the conclusion that this effect is statistically significant. Thus, it can be concluded that Geography Education partially contributes significantly to improving students' understanding of the role of coastal vegetation in maintaining soil stability.

Table 7. Simultaneous F-test

Variable	F_{count}	F_{table}	Sig
X1-Y	143.492	3.09	< .001

(Source: Data processed in 2025)

Based on the results of the simultaneous F-test, a calculated F value of 143.492 was obtained with a table F value of 3.09 at a significance level of less than 0.001. This calculated F value, which is much higher than the table F value, indicates that geography education simultaneously has a significant effect on students' understanding of the role of coastal vegetation in maintaining soil stability in the Toli-Toli region. Furthermore, the very small significance value indicates that this effect is not merely coincidental, but rather a statistically significant relationship. Thus, it can be concluded that geography education plays an important role in improving students' understanding of the importance of coastal vegetation in maintaining soil stability in the region.

Table 8. Coefficient of Determination Test

Variable	R-Square
X1-Y	0.589

(Source: Data processed in 2025)

Based on the results of the coefficient of determination test, an R-Square value of 0.589 indicates that the Geography Education variable (X1) is able to explain approximately 58.9% of the variation in students' understanding (Y) of the role of coastal vegetation in maintaining soil stability. This figure indicates a substantial contribution of geography education to student understanding, but there is still approximately 41.1% of variation influenced by other factors outside the model that have not been identified or measured in this study. Therefore, although geography education has been proven to be significant and play an important role, these results also emphasise the need for further research to identify other variables that influence student understanding, such as environmental factors, field experience, teaching methods, or individual student characteristics. Thus, the interpretation of these results must be done carefully, considering that the model used does not fully explain the overall variability in student understanding.

C.2. DISCUSSION

Students' Understanding of the Functions of Coastal Vegetation and Mangrove Forests

Students' understanding of the function of coastal vegetation, particularly mangrove forests, is an important aspect in preserving coastal

ecosystems. The results of the study indicate that students have a good understanding of the ecological functions of coastal vegetation and mangrove forests, particularly in preventing abrasion, maintaining soil stability, and supporting biodiversity. This shows that geography education plays an effective role in improving students' environmental literacy through material that is contextual to their surrounding environment.

In line with (Lagbas & Dl. Habito, 2016), mangrove forests act as protectors of the coast from erosion and abrasion, absorb carbon dioxide and produce oxygen, and provide a habitat for various marine and terrestrial biota. In addition, mangroves also support the socio-economic aspects of coastal communities, such as food sources and ecotourism. In a study by Salampessy et al. (2021), mangroves provide ecosystem services such as food supplies through fisheries and forest products that are utilised by the surrounding community. Furthermore, mangroves also support ecotourism activities, which are an alternative source of income for coastal communities. Students' understanding of these functions can be developed through adequate education, enabling them to apply this knowledge in environmental conservation practices**.**

Conceptually, the results of this study can be explained through the Knowledge–Attitude–Behaviour model, which explains that good environmental knowledge will form positive attitudes and subsequently encourage environmentally friendly behaviour. Students' understanding of the functions of coastal vegetation and mangrove forests can be seen as the first step in forming ecological responsibility. In the context of geography education, this emphasises the importance of a place-based learning approach that connects the subject matter with the real environmental conditions surrounding students.

The results in Table 3 and Table 4 show that students' understanding of the functions of coastal vegetation and mangrove forests varies between classes. In terms of geography education indicators, IPS 1 recorded the highest score (36.96), while IPA 2 ranked highest in terms of ecological understanding indicators (37.20). These differences in achievement indicate that mastery of geography material and ecological understanding are not always linear, but are greatly influenced by learning approaches, motivation, and student involvement in classroom and field activities.

The results of the second table show that students have a fairly good understanding of the function of coastal vegetation, especially mangroves, in maintaining soil stability, preventing

abrasion, and supporting biodiversity. The high achievement in certain classes shows that when geography is taught contextually for example, by linking theory to the actual conditions of the mangrove ecosystem in Toli-Toli students' ecological understanding becomes more profound. Conversely, classes with lower achievements reflect the need for more interactive and project-based learning strategies so that students not only understand concepts theoretically but are also able to internalise them in a conservative attitude towards the environment.

Students' level of understanding is also influenced by external factors such as teacher support, the availability of environment-based learning resources, and the intensity of students' direct interaction with coastal areas. These factors reinforce the regression results that geography learning depends not only on the material, but also on the social and learning environment context. As proposed by Digamon & Cinches (2017), variations in student achievement can be explained through Schlechty's continuum of student engagement.

In this study, the level of engagement in teamwork was greatly influenced by the teacher: how activities were structured and experienced. In the context of Tables 3 and 4 in this study, classes with high scores (IPA 2 and IPS 1) may have achieved a level of authentic engagement through the use of contextual learning methods, real-world tasks, group work, and feedback from teachers. Conversely, classes with low scores may have been at a level of strategic compliance or ritual compliance, where student engagement was less than optimal.

The fact that social studies students can exceed science students' achievements on several indicators confirms that subject choice does not entirely determine students' level of ecological understanding. Other factors such as the teaching methods used by teachers, learning motivation, and student involvement in discussions and fieldwork play a greater role in improving understanding. This is consistent with the principle of contextual education, where learning that is relevant to the students' environment, in this case the Toli-Toli coastal ecosystem, is easier to understand and internalise.

These findings are in line with the results of research (Tagulao et al., 2022) that environmental education through exhibitions and field trips to mangrove ecosystems significantly increases students' pro-environmental orientation, knowledge, and values towards conservation. Direct experience-based learning has a positive impact on the formation of students' conservation attitudes, although the effect is not only

determined by the formal curriculum but also by non-formal activities relevant to the local context.

Geography education has a real contribution in improving students' understanding of the functions of coastal vegetation and mangroves. However, in order for this knowledge to be internalised into conservation attitudes and behaviours, more participatory, project-based learning strategies are needed, as well as more field experiences in coastal ecosystems.

The Role of Geography Education in Raising Students' Ecological Awareness

The results of the study indicate that geography education plays an important role in increasing students' ecological awareness, particularly in understanding the role of coastal vegetation and mangrove ecosystems in maintaining environmental balance. These findings reinforce the position of geography education as a strategic tool in developing environmental literacy in formal education.

The results of this study are in line with the findings of Kurniawan et al. (2025), which show that geography education plays an important role in increasing students' ecological awareness, particularly in understanding the function of coastal vegetation and mangrove ecosystems in maintaining environmental balance.

The results of the study indicate that classes with better Geography education indicators, particularly in terms of teaching methods and student engagement, achieved higher levels of ecological understanding. In line with the findings (Sever et al., 2025), the use of Project-Based Learning (PBL) and Service-Learning (SL) not only improves students' conceptual understanding of environmental issues, but also enables them to internalise knowledge into real attitudes and behaviours. Students who are actively involved in field projects, such as assessing regional sustainability or designing conservation strategies, are more likely to have high ecological awareness and consistent pro-environmental behaviour.

This shows that the quality of the learning process greatly influences the formation of students' ecological awareness. This increased ecological awareness becomes the main capital for students to behave positively in protecting and preserving coastal ecosystems in their communities. Table 8 reinforces the role of geography education in increasing students' ecological awareness, namely the coefficient of determination (R-squared) value of 0.589 in Table 8 shows that the geography education variable is able to explain almost 58,9% of the variation in

students' understanding. This is a significant contribution, although there are still other factors outside of geography education that influence student awareness, such as the social environment and direct experience. and the individual characteristics of students.

The results of this study provide a deeper understanding of the influence of geography learning on students' ecological awareness. Unlike Tagulao et al. (2022), who emphasised field-based learning, this study shows that ecological awareness is also influenced by external factors such as teacher support, local learning resources, and student interaction with the coastal environment. This confirms that ecological awareness is formed through the integration of curriculum content and real-life experiences, so that geography education needs to combine scientific knowledge with local ecological wisdom in order to be more meaningful for students.

Theoretically, increasing students' ecological awareness is in line with the Knowledge Attitude Behaviour model, in which cognitive understanding shapes positive attitudes and environmentally conscious behaviour.

The Relationship Between Ecological Understanding and Students' Conservation Behaviour

Research findings showing a positive and significant relationship between students' ecological understanding and environmental conservation behaviour are supported by various previous studies of a similar nature. Hasanah et al. (2022) found that environmental knowledge has a significant influence on environmental behaviour among students at Islamic boarding schools. Furthermore, Utina's (2008) research shows that students' knowledge, attitudes, and behaviour towards forest conservation are interdependent and influence each other in the formation of environmentally friendly behaviour.

Purnomo's (2024) research also confirms that outdoor learning can increase knowledge and attitudes towards environmental conservation, which in turn has a positive impact on environmental behaviour. Thus, these findings are consistent with the Knowledge Attitude Behaviour model, which states that knowledge forms the basis for attitudes that then encourage concrete actions to protect the environment (Hasanah et al., 2022; Utina, 2008; Purnomo, 2024).

The survey results presented in Table 3 show variations in students' understanding of geography education material related to the role of coastal vegetation in maintaining soil stability. It can be seen that IPS 1 class has the highest average score compared to other

classes, followed by IPA 2, IPS 2, and IPA 1. The difference in achievement between classes, which reaches 2.04 points, shows that even though performance is the same, internal class factors such as student motivation, the quality of teacher-student interaction, and learning methods have a significant influence on learning success. This emphasises the importance of interactive, contextual, and participatory learning methods to improve the effectiveness of geography education in shaping students' ecological awareness.

Table 4, which measures students' understanding of the ecological function of coastal vegetation, also shows varied results between classes, with IPA 2 and IPS 1 classes achieving the highest scores. This data reinforces the finding that contextual learning factors and active student involvement in fieldwork activities can promote better ecological understanding.

Conversely, lower achievements in some classes indicate the need to improve learning strategies so that the material is not only understood theoretically but also relevant to the real environmental conditions in the Toli-Toli coastal area. This is in line with the findings (Restović & Bulic, 2024) that active involvement in research-based learning in a real natural environment can improve both students' knowledge and attitudes towards conservation.

They noted a significant increase in the number of correct answers on knowledge tests after participating in activities in the national park, followed by more positive attitudes towards ecological conservation. This confirms that direct learning experiences in nature play an important role in strengthening ecological literacy.

Survey results show that classes with higher levels of ecological understanding tend to have better conservation attitudes and behaviours. However, this relationship is not always linear, as other factors such as motivation, support from the school and family environment, and field experience also influence the application of knowledge into real behaviour. This is in line with Simpao & Yabut (2022), who found that environmental knowledge does have a positive effect on conservation behaviour, but attitudes play a strong moderating role.

This means that students who have positive attitudes towards conservation are more likely to translate their ecological knowledge into concrete actions to protect the environment.

D. CONCLUSION

The study found that geography education has a significant and positive effect on students' understanding of the role of coastal vegetation in maintaining soil stability, as indicated by a regression

coefficient of b = 0.674 and a significance value of $p < 0.05$. These results confirm that geography learning contributes substantially to improving students' ecological understanding and conservation behavior. Theoretically, this research reinforces the Knowledge–Attitude–Behavior (KAB) model, demonstrating that cognitive knowledge gained through contextual geography learning can foster positive environmental attitudes and promote responsible ecological actions.

Empirically, this study provides new insights into place-based geography education within the socio-ecological context of Toli-Toli, a coastal area facing environmental challenges such as erosion and mangrove degradation. The findings highlight the importance of integrating scientific concepts with local ecological wisdom. Practically, the study implies that geography education should implement contextual and experiential learning strategies to enhance students' ecological literacy and prepare them to become active agents in sustainable coastal management.

BIBLIOGRAPHY

Badan Pusat Statistik Kabupaten Toli-Toli. (2025). Kabupaten Toli-Toli dalam angka 2025 . https://tolitolikab.bps.go.id

Cahyo, W. (2023). Potensi ekosistem mangrove untuk mewujudkan kawasan pesisir berkelanjutan di Desa Wedung, Kecamatan Wedung, Kabupaten Demak, Jawa Tengah. Jurnal Pengabdian, Riset, Kreativitas, Inovasi, dan Teknologi Tepat Guna, 1(2), 81–92. https://doi.org/10.22146/parikesit.v1i2.9562

Digamon, J. S., & Cinches, M. F. C. (2017). Schlechty's student engagement continuum in the work team experience: A pilot study. Journal of Institutional Research in South East Asia, 15(3), 49–68. https://www.seaairweb.info/journal/JIRSEA_v15_n3_2017.pdf

Hasanah, N. dkk. (2022). Hubungan pengetahuan lingkungan dan sikap konservasi terhadap perilaku lingkungan santri di Pondok Pesantren Darut Tafsir. Jurnal Pendidikan Lingkungan dan Budaya Lokal , 6(3), 194-204. https://doi.org/10.36813/jplb.6.3.194-204

Kurniawan, N., Yuliani, S., Scorviana, N., Hidayaht, A. N., & Kholik, A. (2025). Pemberdayaan remaja dalam konservasi mangrove dan inovasi produk olahan mangrove di Pulau Harapan Kabupaten Kepulauan Seribu. Jurnal Pengabdian Kepada Masyarakat, 9(2).

Lagbas, A. J., & Dl. Habito, C. (2016). Ecosystem services of coastal and fisheries resources: Perspectives of high school students in municipality of Panukulan, Polillo Island, Quezon, Philippines. Journal of Marine and Island Cultures, 5(2), 145–158. https://doi.org/10.1016/j.imic.2016.09.005

Maridi, Saputra, A., & Agustina, P. (2015). Kajian potensi vegetasi dalam konservasi air dan tanah di daerah aliran sungai (DAS): Studi kasus di 3 sub DAS Bengawan Solo (Keduang, Dengkeng, dan Samin). Prosiding Seminar Nasional Konservasi dan Pemanfaatan Sumber Daya Alam, 65–68.

Nasution, F. R., Adlika, N. M., & Tampubolon, B. (2022). Analisis perhatian dan keterlibatan siswa pada pembelajaran secara daring. Jurnal Pendidikan Sosiologi dan Humaniora, 13(1), 91. https://doi.org/10.26418/j-psh.v13i1.52321

Purnomo, A. (2024). Pengaruh pembelajaran outdoor terhadap pengetahuan, sikap, dan pelestarian lingkungan mahasiswa S1 Pendidikan Geografi. Jurnal Pendidikan Geografi , 15(1).

Priandeni, F. N., Prasetya, J. D., Kristanto, W. A. D., Suharwanto, S., & Lukito, H. (2025). Analisis vegetasi dan kualitas lingkungan ekosistem mangrove di ekowisata tracking mangrove Taman Nasional Karimunjawa. Prosiding Seminar Nasional Teknik Lingkungan Kebumian SATU BUMI, 6(1), 251–259.https://doi.org/10.31315/psb.v6i1.14481

Restović, I., & Bulic, M. (2024). Research-based learning about nature conservation influences students' attitudes and knowledge. Education Sciences, 14(12). https://doi.org/10.3390/educsci14121410

Ribeiro, L. F. Q., de Oliveira Côrtes, L. H., & Di Beneditto, A. P. M. (2020). The perceptions of high school students on the habitat of the crab Ucides cordatus (Linnaeus, 1763) (Crustacea: Decapoda: Ucididae) in northern Rio de Janeiro state, southeastern Brazil. Journal of Threatened Taxa, 12(9), 16043–16047. https://doi.org/10.11609/jott.5951.12.9.16043-16047

Rosviani, L., Kusmana, C., Rachmawati, E., & Gunawan, H. (2022). Evaluation of the implementation of mangrove thematic environmental education in Indramayu, West Java. IOP Conference Series: Earth and Environmental Science, 1109(1). https://doi.org/10.1088/1755-1315/1109/1/012038

Sever, S. D., Amin, H., & Tok, E. (2025). The evolution and future of education for sustainable development in Qatar. In Gulf Studies (p. 345–365). https://doi.org/10.1007/978-981-97-9667-0_18

Simpao, A. C., & Yabut, H. (2022). Conservation behavior among students in a university in Metro Manila: The moderating role of attitudes on the impact of environmental knowledge. Asia-Pacific Social Science Review, 22(3), 95–108. https://doi.org/10.59588/2350-8329.1466

Tagulao, K. A., Bernardo, A. B. I., Kei, L. H., & Calheiros, C. S. C. (2022).

Mangrove conservation in Macao SAR, China: The role of environmental education among school students. International Journal of Environmental Research and Public Health, 19(6). https://doi.org/10.3390/ijerph19063147

Ulyah, F., Hastuti, E. D., & Prihastanti, E. (2022). Struktur komunitas vegetasi mangrove di pesisir pantai Kepulauan Karimunjawa. Jurnal Ilmu Lingkungan, 20(1), 176–186. https://doi.org/10.14710/jil.20.1.176-186

Urbańska, M., Charzyński, P., Gadsby, H., Novák, T. J., Şahin, S., & Yilmaz, M. D. (2022). Environmental threats and geographical education: Students' sustainability awareness—evaluation. Education Sciences, 12(1).https://doi.org/10.3390/educsci12010001

Utina, S. (2008). Pengetahuan, sikap dan perilaku konservasi hutan pada siswa sekolah dasar. Jurnal Pendidikan Lingkungan Hidup , 10(1).