



Development Of Project-Based Teaching Modules To Improve Students' Spatial Thinking Skills In Geography Learning

Endang Sutiah, Sunarty Suli Eraku, Nurfaika

^{1,2,3} Master of Geography Education Study Program, Universitas Negeri Gorontalo, Indonesia

Corresponding author: endangsutia7@gmail.com

Abstract

This study aims to develop, validate, and evaluate the practicality and effectiveness of a Geography teaching module based on Project-Based Learning (PjBL) for Remote Sensing material to enhance students' spatial thinking skills at SMAN 4 Gorontalo. The research employed a Research and Development (R&D) design using the 4D development model, consisting of Define, Design, Develop, and Disseminate stages. Research subjects included students from classes X.7 and X.8, as well as Geography teachers from seven public senior high schools in Gorontalo City. Expert validation results indicate that the module is "highly feasible," receiving an average feasibility score of 94% from module experts and 91% from material experts. The practicality level is classified as very good based on classroom observations of teacher activity (97%) and student responses (92%). The module's effectiveness is demonstrated by significant improvements in learning outcomes, with N-Gain scores of 0.68 for class X.7 and 0.69 for class X.8—both categorized as moderate improvement. These findings reveal that the PjBL-based module successfully enhances spatial thinking skills, increases student engagement, and effectively supports the implementation of the Merdeka Curriculum. The module is recommended as an applicable and contextual learning resource for Geography teachers.

Keywords: Teaching Module, Project-Based Learning, Remote Sensing, Spatial Thinking, Merdeka Curriculum, Geography

INTRODUCTION

Education according to Sudjana (2021) is an effort that is carried out consciously and systematically to create learning conditions and processes that encourage students to play an active role in developing their full potential. This opinion is in line with Mulyasa (2022) who

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emphasizes that educator competence has a strategic role in creating a conducive learning environment and being able to adapt to the times. In addition, education is also closely related to character building efforts. Zubaedi (2021) stated that character education is the main basis for forming a person who is responsible, honest, and with integrity. Therefore, the role of teachers is not only limited to delivering learning materials, but also as a guide and role model for students.

In the digital era, the use of technology is an inseparable element in the implementation of education. Munir (2021) stated that the integration of technology in learning activities can increase the effectiveness and efficiency of the teaching and learning process, especially in the application of online and hybrid learning. Nevertheless, this situation requires the readiness of educators and students to be able to utilize digital-based learning media appropriately, wisely, and productively.

Based on this presentation, the theoretical basis in this study is based on the view that education is a comprehensive process, covering the cognitive, affective, and psychomotor domains. Technological integration, strengthening character values, and improving the quality of educators are the main components that play a role in supporting the success of education both now and in the future.

The curriculum is a fundamental element in the implementation of the education system. The existence of the curriculum acts as a guideline in the learning process, both in determining teaching materials and competencies that must be achieved by students. Along with the development of time, the curriculum in Indonesia has undergone a number of updates as a form of adjustment to the demands and dynamics of the times. These change efforts aim to improve the quality of education and the relevance of learning content. However, the implementation of the curriculum often faces various obstacles, especially related to the readiness of educators and implementation in the field. An effective curriculum should be able to accommodate the diversity of student characteristics and foster critical and creative thinking skills. Therefore, curriculum development needs to be based on a thorough scientific study and involve various related parties (Majid, 2022).

The Independent Learning Curriculum is based on four main principles that are manifested through the latest education policies. First, the implementation of the National Standard School Exam (USBN) is replaced with an assessment system that assesses the competence of students through written tests and comprehensive assessment forms. Second, the National Examination (UN) was transformed into a Minimum Competency Assessment (AKM) and a Character Survey which aims to improve the quality of learning and map the





achievement of students' abilities, without making it a determinant of graduation. Third, the implementation of AKM is focused on measuring literacy, numeracy, and character skills. Fourth, educators are given flexibility in designing and developing Learning Implementation Plans (RPP) with main components in the form of learning objectives, learning activities, and assessments which are then known as teaching modules (Maulida Utami, 2022).

Learning planning in the Independent Curriculum provides greater flexibility for educators to design and develop teaching modules that include learning objectives, learning activities, and assessments as the main elements (Utami, 2022). Teaching modules act as learning tools that are compiled based on the applicable curriculum and are used to help teachers design the learning process in a structured and systematic manner. Through the development of teaching modules, teachers are required to improve critical thinking skills, creativity, and innovation in designing learning activities. Thus, strengthening educators' pedagogic competence is a very crucial aspect so that the resulting teaching modules are able to support effective, efficient, and aligned learning with learning achievement indicators (Irmaliya Izzah Salsabilla, 2023).

However, the implementation of the Independent Curriculum, which is still relatively new, including at SMA Negeri 4 Gorontalo, poses a number of obstacles in the process of preparing teaching modules. Some educators still rely on the 2013 Curriculum learning tool in the form of a Learning Implementation Plan (RPP), so the use of teaching modules has not been utilized optimally. This situation shows the need for the development of teaching modules that are more interactive and contextual. In addition, the Independent Curriculum requires teachers to have a higher level of creativity in presenting learning materials by adjusting the characteristics of the curriculum, educational units, students, and the substance of the teaching materials. Therefore, the development of quality teaching modules is expected to be able to support the achievement of learning objectives optimally, especially in Geography learning in Gorontalo City.

METHOD

The limited trial research was carried out at SMA Negeri 4 Gorontalo which is located on Jalan Brigjen Piola Isa, Wongkaditi Village, North Kota District, Gorontalo City, Gorontalo Province. The subjects of this study are students of classes X.7 and X.8.

This research applies the Research and Development (R&D) method, which is a research approach that aims to produce a product while testing the level of effectiveness of the product developed. The R&D method not only focuses on the development of knowledge, but also



emphasizes the process of designing, testing, and refining products that can be used to solve real problems, especially in the context of education (Sugiyono, 2021). In line with this view, Gall, Gall, and Borg (2020) stated that R&D research in the field of education is directed to develop and validate various learning products, such as teaching modules, learning media, software, and learning strategies.

Development Design

Types of Research

This research uses a type of Research and Development (R&D) research that aims to develop learning products and test the level of effectiveness in the context of education. Sugiyono (2021) explained that R&D research is carried out through systematic stages to produce products as well as assess the feasibility and effectiveness of their use. In this study, the product developed is in the form of a Project Based Learning (PjBL)-based Geography teaching module which is designed to improve students' spatial thinking skills in remote sensing materials in class X.

The development model applied in this study is the 4D (Four-D) model developed by Thiagarajan, Semmel, and Semmel. The model is still relevant and widely used in research in the field of education. The 4D model includes four main stages, namely Define (definition), Design (design), Develop (development), and Disseminate (Wulandari & Suparno, 2021).

RESULTS AND DISCUSSION

Define Stage

Results of the analysis of observation of teacher activities in the learning process

Table 1 Results of the observation analysis of teachers' activities in the learning process

NO	TEACHER ACTIVITIES	PRESENTATION SCORE		TOTAL	SCORE PERCENTAGE		PERCENTAGE
		OBSERVER 1	OBSERVE 2		OBSERVER 1	OBSERVER 2	
1	MEETING 1	73	72	145	96%	95%	95%
2	MEETING 2	62	63	125	98%	98%	98%
3	MEETING 3	69	70	139	98%	98%	98%
AVERAGE		68	68,33333333	136,333	97%	97%	97%

Source: 2024 primary data

The table above shows the results of observations on the implementation of teachers'

activities during three learning meetings. The assessment is carried out by two observers to ensure the objectivity and consistency of the assessment. Assessments are carried out on indicators of teacher activity during the learning process, which are converted into scores and percentages. The following is a detailed explanation of the data based on the table.

1. Meeting 1

Observer score 1: 73, Observer score 2: 72, Total score: 145, Score percentage: 96% (Observer 1), 95% (Observer 2), with an average percentage of 95%. Interpretation: Teachers show excellent performance in managing learning, from planning, implementation, to assessment. Almost maximum scores reflect teacher readiness, mastery of material, conducive classroom management, and skills in guiding students.

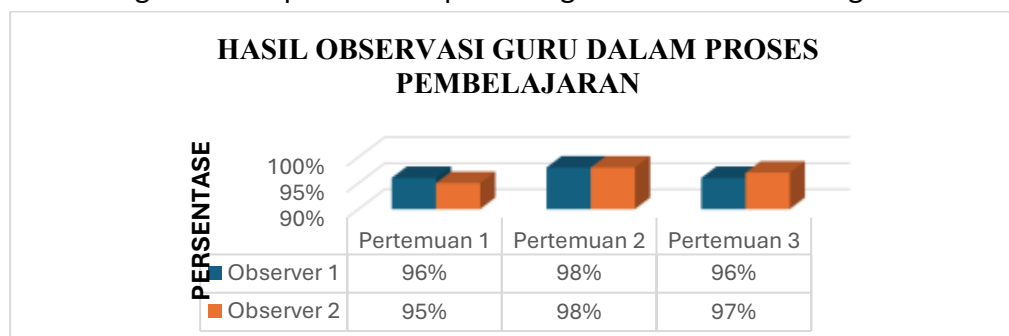
2. Meeting 2

Observer Score 1: 62, Observer Score 2: 63, Total Score: 125 Score percentage: 98% (Observer 1 & 2). Interpretation: Although the absolute score was slightly lower than in meeting 1, the percentage showed that the teacher's achievement remained at a very good level. This can mean that there are different technical adjustments or learning contexts, but the quality of learning remains optimal. Most likely the teacher is very adaptive to the methods and materials presented.

3. Meeting 3

Score from Observer 1: 69, Score from Observer 2: 70, Total Score: 139, Percentage of score: 98% (Observer 1 & 2). Interpretation: The consistency of teacher performance is maintained. This score shows that teachers have maintained the quality of learning at an excellent level. In the third meeting, students usually start to be more active because they are used to the process, and the teacher can focus more on strengthening or deepening the material.

The following is a description of the percentages outlined in the diagram below.



Source: 2024 primary data

Figure 1 results of teachers' observations in the learning process

- 1) Analysis of the effectiveness of the geography teaching module
 - Pretest and posttest results of group A

table. 2 Results of Pre-test and Post-test recapitulation of SMAN 4 Gorontalo Group A (X7) students

Yes	Students	Total Score	Ket.	Total Score	Ket.
1	PD. 1	34	Incomplete	88	Completed
2	PD. 2	32	Incomplete	91	Completed
3	PD. 3	51	Incomplete	88	Completed
4	PD. 4	45	Incomplete	84	Completed
5	PD. 5	42	Incomplete	80	Completed
6	PD. 6	74	Completed	98	Completed
7	PD. 7	36	Incomplete	93	Completed
8	PD. 8	34	Incomplete	78	Completed
9	PD. 9	25	Incomplete	88	Completed
10	PD. 10	47	Incomplete	84	Completed
11	PD. 11	48	Incomplete	64	Incomplete
12	PD. 12	14	Incomplete	64	Incomplete
13	PD. 13	24	Incomplete	76	Completed
14	PD. 14	30	Incomplete	79	Completed
15	PD. 15	74	Completed	86	Completed
16	PD. 16	33	Incomplete	80	Completed
17	PD. 17	43	Incomplete	94	Completed
18	PD. 18	78	Completed	80	Completed
19	PD. 19	18	Incomplete	76	Completed
20	PD. 20	26	Incomplete	84	Completed
21	PD. 21	18	Incomplete	58	Incomplete

22	PD. 22	18	Incomplete	80	Completed
23	PD. 23	37	Incomplete	76	Completed
24	PD. 24	68	Completed	67	Completed
25	PD. 25	48	Incomplete	84	Completed
TOTAL NUMBER		997	Incomplete	2020	Completed
AVERAGE		39,88		80,8	

Source: 2024 primary data

The table of the results of the recapitulation of *pre-test* and *post-test* scores in Group A (X.7) shows a very significant increase in student learning outcomes. The number of participants in this group is 25 people. The learning process aims to measure the effectiveness of certain teaching methods through two main indicators, namely average scores and completeness levels. Before learning, students are given a pre-test to measure their initial abilities. The average pre-test score was 39.88, with only 4 people (16%) having reached the set completion limit. This indicates that the majority of students have not mastered the subject matter adequately. After learning, a *post-test* is carried out to find out the improvement in their understanding. The results showed that the average score increased to 80.8, and as many as 23 people (92%) were declared complete.



Source: 2024 primary data

Figure 2 of the results of the x7 class pretest at SMAN 4 Gorontalo



Source: 2024 primary data

Figure 3 posttest results of class x7 at SMAN 4 Gorontalo

Pretest and posttest results of group B

Table 3 Results of Pre-test and Post-test Recapitulation of SMAN 4 Gorontalo Group B (X8)

No .	Students	Total Score	Ket.	Total Score	Ket.
1	PD. 1	28	Incomplete	80	Completed
2	PD. 2	63	Incomplete	92	Completed
3	PD. 3	77	Completed	98	Completed
4	PD. 4	19	Incomplete	95	Completed
5	PD. 5	76	Completed	80	Completed
6	PD. 6	34	Incomplete	68	Completed
7	PD. 7	26	Incomplete	74	Completed
8	PD. 8	76	Completed	87	Completed
9	PD. 9	18	Incomplete	74	Completed
10	PD. 10	12	Incomplete	90	Completed
11	PD. 11	46	Incomplete	58	Incomplete
12	PD. 12	56	Incomplete	89	Completed
13	PD. 13	32	Incomplete	68	Completed
14	PD. 14	10	Incomplete	71	Completed
15	PD. 15	34	Incomplete	90	Completed

16	PD. 16	24	Incomplete	64	Completed
17	PD. 17	41	Incomplete	80	Completed
18	PD. 18	35	Incomplete	84	Completed
19	PD. 19	18	Incomplete	74	Completed
20	PD. 20	54	Incomplete	89	Completed
21	PD. 21	28	Incomplete	79	Completed
22	PD. 22	42	Incomplete	80	Completed
23	PD. 23	42	Incomplete	90	Completed
24	PD. 24	48	Incomplete	80	Completed
25	PD. 25	61	Incomplete	95	Completed
TOTAL NUMBER		1000	Incomplete	2029	Completed
AVERAGE		40		81,16	

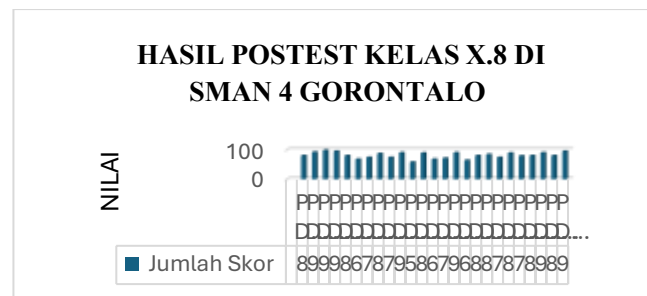
Source: 2024 primary data

Group B (class X.8) consists of 25 students who have participated in the evaluation of learning outcomes through two stages, namely pre-test before learning starts and post-test after learning ends. The purpose of this evaluation is to measure the effectiveness of the learning approach applied in improving students' understanding of the subject matter. Based on the results of the recapitulation, the total score in the pre-test was 1000, with an average of 40, and only 3 students (12%) had reached the limit of completeness. After the learning process, the total score increased drastically to 2029, with an average of 81.16, and 23 students (92%) achieved completion. This data shows a significant increase both in terms of average scores and the number of students who have successfully completed their studies.



Primary :D ata 2024 Source

Figure 4 results of class x8 pretest at SMAN 4 Gorontalo



Primary :D ata 2024 Source

Figure 5 results of class x8 pretest at SMAN 4 Gorontalo

Table 4 Determination of N-Gain improvement of spatial thinking ability

CLASS	AVERAGE LOANS	AVERAGE POSTS	MAXIMUM SCORE	N.GAIN	PERCENTAGE (N.GAIN)	CRITERIA
GROUP A (X7)	39,88	80,8	100	0,68	68%	Medium (0.3 $\leq g < 0.7$)
GROUP B (X8)	40	81,16	100	0,69	68,6%	Medium (0.3 $\leq g < 0.7$)

Primary :D ata 2024 Source

The N-Gain calculation was carried out to determine the improvement of students' spatial thinking skills after using the project-based Geography teaching module. N-Gain is calculated based on a comparison between pretest and posttest scores obtained before and after learning.

The results of the calculation show that:

1. Class Group A (X7)

The average pretest score was 39.88, while the average posttest score increased to 80.8 from a maximum score of 100. The N-Gain value obtained was 0.68 or 68%, which falls into the "moderate" category ($0.3 \leq g < 0.7$). This shows that there is a significant increase in students' spatial thinking skills after using project-based teaching modules.

2. Class B (X8)

The average pretest score was 40, and the posttest score increased to 81.16 from a maximum score of 100. The N-Gain value of 0.69 or 68.6%, is also in the "medium" category. These results indicate that the use of project-based teaching modules is effective in improving students' abilities, although they have not reached the high category ($g \geq 0.7$).

Overall, the results of N-Gain in both groups showed that the project-based Geography teaching module was able to improve students' spatial thinking skills with a

moderate improvement category. This improvement shows that the implementation of a project-based learning model provides a more active, contextual, and meaningful learning experience for learners.

Disseminate Stage

Results of analysis of student responses

Table 5 percentage of student responses to project-based learning-based geography teaching modules

No	RESPONDENTS	SCORE/ASPECT VALUE												TOTAL SCORE	SCORE PERCENTAGE (%)
		1	2	3	4	5	6	7	8	9	10	11	12		
1	R.PD.1	4	3	4	3	4	3	4	4	3	4	3	4	43	90%
2	R.PD.2	3	4	3	3	4	4	4	3	4	3	3	4	42	88%
3	R.PD.3	4	3	4	3	3	4	4	3	3	3	4	3	41	85%
4	R.PD.4	3	4	3	4	3	4	4	3	4	3	4	3	42	88%
5	R.PD.5	3	4	4	4	4	4	4	4	4	4	3	4	46	96%
6	R.PD.6	4	4	4	3	4	3	3	4	4	3	4	4	44	92%
7	R.PD.7	4	3	4	4	3	4	3	3	4	3	4	3	42	88%
8	R.PD.8	4	4	4	3	4	4	3	4	3	4	3	4	44	92%
9	R.PD.9	3	4	3	4	3	4	4	4	3	3	4	4	43	90%
10	R.PD.10	4	4	4	4	4	4	3	4	4	4	4	3	46	96%
11	R.PD.11	4	4	3	3	4	4	3	3	4	4	4	4	44	92%
12	R.PD.12	4	4	3	4	3	3	4	4	3	4	3	4	43	90%
13	R.PD.13	3	3	4	4	4	4	3	4	4	3	4	3	43	90%
14	R.PD.14	4	4	3	4	4	3	4	3	4	4	4	4	45	94%
15	R.PD.15	4	4	3	4	3	4	3	4	3	4	4	4	44	92%
16	R.PD.16	3	4	3	4	3	4	3	4	4	3	4	3	42	88%
17	R.PD.17	4	4	3	4	4	4	3	4	3	4	4	4	45	94%
18	R.PD.18	3	4	3	4	4	3	4	4	4	4	4	4	45	94%
19	R.PD.19	3	4	4	4	3	4	4	3	4	4	4	4	45	94%
20	R.PD.20	3	4	4	4	4	4	4	4	4	4	4	4	47	98%
21	R.PD.21	4	4	4	4	4	3	4	4	4	4	3	4	46	96%
22	R.PD.22	3	4	3	3	4	4	3	4	4	3	3	4	42	88%
23	R.PD.23	4	4	4	4	4	3	4	4	4	4	4	4	47	98%

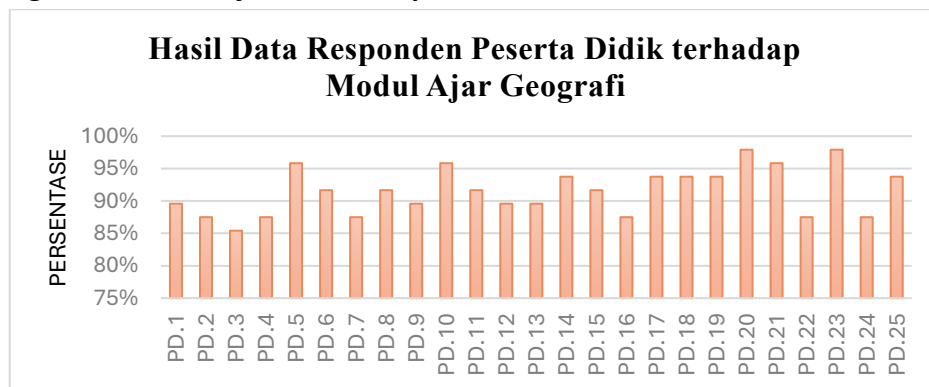
24	R.PD.24	4	3	4	3	4	4	3	4	3	4	3	3	42	88%
25	R.PD.25	4	4	3	4	4	3	4	4	3	4	4	4	45	94%

Primary Data Sources 2024

This table displays the response data of 25 students to the Project-Based Learning (PjBL) Geography learning module used in learning activities. The assessment is conducted based on 12 aspects of indicators, which include various elements of module quality, such as clarity of content, display, ease of use, learning effectiveness, and support for group work and critical thinking skills. Each aspect is graded on a scale of 1–4, so the maximum total score that can be obtained per student is 48 points. The actual total score is then converted into a percentage score (%), which indicates the student's acceptance rate or satisfaction with the module.

Primary :D ata 2024 Source

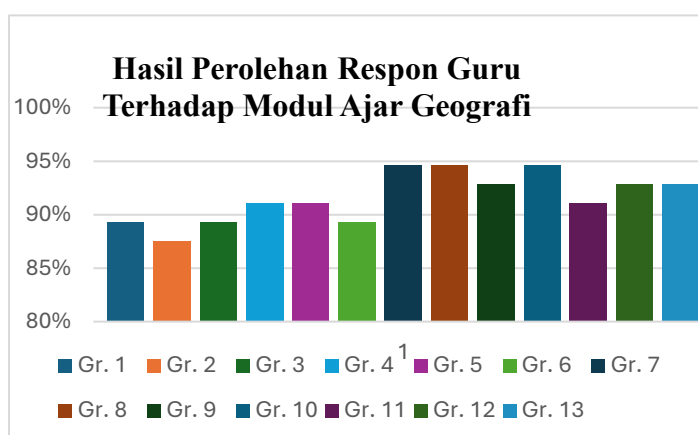
Figure 6 Results of Student Respondents at SMAN 4 Gorontalo



This table presents the responses of 13 teachers (respondents) to the project-based Geography teaching module. The assessment was carried out based on 14 aspects of indicators that reflect the quality of the module from various perspectives, such as clarity of content, linkage with the curriculum, attractiveness of presentation, and effectiveness in supporting project-based learning. Each indicator was assessed using a Likert scale of 1–4, with a maximum total score per respondent of 56 points (14 aspects × a maximum score of 4). The actual score given by the teacher is then converted into a percentage score (%) to facilitate the interpretation of the acceptance rate and satisfaction with the module.

This table presents the results of the recapitulation of the responses of Geography teachers from 7 State High Schools throughout Gorontalo City, starting from SMAN 1 to SMAN

7 Gorontalo, to the project-based Geography teaching module (PjBL) that is being developed and tested. There were a total of 13 teachers as respondents, representing one or more teachers from each school. The purpose of this data collection is to obtain empirical and objective feedback from educators in the field regarding the quality of modules used in the project-based Geography learning process, especially in the context of the implementation of the Independent Curriculum.



Primary :D ata 2024 Source

Figure 7 Student Respondent Results at SMAN 4 Gorontalo

Based on the graph above, it can be seen that the teacher's response rate to the developed Geography teaching module is in the range of 88% to 95%. In general, all teachers gave a positive response to the project-based teaching modules implemented. The 4th, 5th, and 10th teachers showed the highest response rate, reaching around 95%, which shows that they rated this module as very good in terms of material integration, clarity of learning steps, and relevance to basic competencies and learning outcomes. Meanwhile, the 2nd teacher showed the lowest response of around 87%, but this figure is still included in the very good category. This indicates that although there are several aspects that need to be improved. For example, the attractiveness of the appearance or completeness of the overall project activities of the teaching module is considered effective and relevant to the needs of geography learning.

Overall, these results show that the project-based teaching modules developed have managed to obtain a high acceptance rate from teachers, with an average of over 90%. These findings reinforce that the use of a project-based approach is not only able to improve student learning activities, but is also appreciated by teachers as a learning innovation that supports the formation of spatial thinking skills and mastery of contextual geographical concepts.

DISCUSSION

Eligibility of Geography Teaching Module

The feasibility of the teaching module is determined based on the results of validation by material experts and learning design experts. The validation results showed that the PjBL-based Geography teaching module obtained an average eligibility percentage of 94% from teaching module experts and 91% from material experts, which was categorized as "very feasible". This achievement shows that the module structure has met the standards for the preparation of teaching materials as stipulated in the guidelines for the preparation of teaching modules for the Independent Curriculum (BSKAP, 2022).

This qualification is reflected in several key aspects. First, the module components are considered very complete, including identity, learning objectives, assessments, meaningful understanding, learning activities, and student worksheets. This is in line with the view of Arends (2022) who states that good teaching materials must contain clear goals, meaningful activities, and evaluation instruments that support competency-based learning.

Second, the presentation of the material is considered systematic, relevant, and in accordance with the characteristics of high school students. The validators assessed that the flow of learning activities had followed the *stages of Project Based Learning* as stated by Thomas (2023), starting from determining fundamental questions, project planning, conducting investigations, to evaluating project results. This reinforces the role of modules as an active learning tool that leads students to real-world problem-based learning experiences.

Third, the language and display aspects of the module obtained excellent scores with an average of above 90%. The language used is considered communicative, easy to understand, and in accordance with the level of cognitive development of students. The module's display is also considered interesting and informative as it includes visual illustrations, maps, as well as examples of implementing Remote Sensing in a local context. According to Sutrisno and Hakim (2021), attractive visual displays in modules can increase *engagement* and motivate students to learn more independently.

In addition, aspects of critical and spatial thinking skills are the main characteristics in the feasibility assessment of this module. The validation results showed that the module was able to encourage students to analyze, evaluate, and interpret spatial data independently through project-based activities. This finding is in line with the research of Rahmawati and Sari (2022), who stated that the application of PjBL in Geography subjects can improve *higher-order thinking skills* because students are directly involved in solving real geospatial problems.

Overall, the high validation results show that the developed teaching modules have met



academic, pedagogic, and technical criteria. Therefore, this module is considered very feasible to be used in the project-based Geography learning process in high school.

Practicality of Teaching Modules

The practicality aspect of the module is measured through two main indicators, namely the results of observation of teacher and student activities during learning and the results of the response questionnaire to the teaching module. Based on the results of observations, teachers' activities obtained an average score of 97% (very good category), while students' activities reached 87–96% in various aspects of project activities such as formulating questions, designing products, and evaluating learning outcomes.

This data shows that teachers are able to carry out project-based learning well, starting from the planning, implementation, to reflection stages. According to Hmelo-Silver (2023), the success of the implementation of PjBL is highly dependent on the teacher's ability to act as a facilitator who guides the investigation process and reflection of students. In the context of this research, teachers are able to manage the classroom effectively and provide space for students to work collaboratively and creatively.

Meanwhile, the results of the responses from 25 students showed an average satisfaction score of 92% (very positive category). Most students consider that the teaching module is easy to understand, interesting, and helps them in understanding the concept of Remote Sensing contextually. Students also stated that the use of field projects, such as creating image interpretation path maps with *the Google My Maps application*, made learning more meaningful and applicable. The same is also shown by the results of the teacher's response, which on average gave a score of 89–95% (very good category) on the quality of the module. The teacher considers that this teaching module is in line with the demands of the Independent Curriculum because it fosters the character of the Pancasila Student Profile such as critical reasoning, creativity, and being able to work together. According to Trilling and Fadel (2022), project-based learning not only develops cognitive aspects, but also social and emotional competencies that are relevant to the needs of the 21st century.

This finding strengthens that the teaching modules developed have a high level of practicality both in terms of teachers and students. These modules are easy to implement without requiring large additional resources, while still providing an immersive and contextual learning experience



The Effectiveness of Teaching Modules in Improving Spatial Abilities

The effectiveness of the teaching module was measured through improving student learning outcomes using *pretest* and *posttest* tests in two groups (classes X.7 and X.8). The results showed that the average pretest score of 39.88 increased to 80.8 in group A and from 40 to 81.16 in group B. *N-Gain values* were 0.68 and 0.69 respectively, which were included in the moderate category according to the criteria of Hake (1998).

This improvement shows that learning using PjBL-based teaching modules is effective in improving students' spatial thinking skills. According to Rafiq and Hasan (2021), spatial thinking is the ability to understand, interpret, and manipulate spatial information, which is an important skill in learning modern Geography. PjBL provides opportunities for students to develop these skills through exploratory activities such as satellite image analysis, interpretation of geospatial objects, and digital mapping.

The results of this study also support the findings of Kusumawati and Wulandari (2023), who stated that the application of *Project Based Learning* is able to significantly improve spatial thinking skills because students are involved in direct and authentic experiences. In the context of this research, students not only receive the material theoretically, but also apply it practically through a digital mapping project. In addition, the improvement in learning outcomes also shows that students better understand the basic concepts of Remote Sensing such as components, types of images, and stages of image interpretation. This is in line with Piaget and Vygotsky's theory of constructivism which emphasizes that knowledge is built through active experience and social interaction (Slavin, 2022). Thus, project-based activities in the teaching module play an important role in facilitating the process of constructing students' knowledge independently.

The Relationship of Research Results with Previous Theory and Research

The results of this study are in line with various findings of previous research that affirm the effectiveness of Project Based Learning (PjBL) in improving the ability to think at a higher level. For example, Nugroho and Yuliana (2022) show that the application of PjBL is able to improve students' spatial analysis skills and collaboration skills in Geography subjects at the high school level. In addition, Nurhadi (2023) reported that the use of project-based teaching modules on topographic map materials can increase student engagement rates by up to 90%. The findings of this study also support the theoretical view of Bell (2022) who states that PjBL is effective in encouraging deep learning, because students are actively involved in the learning process and produce meaningful learning products or artifacts. In learning Remote Sensing material, students not only understand the concept of satellite imagery theoretically, but are

also able to relate it to real phenomena found in the surrounding environment. Furthermore, the results of this study are relevant to the principles of the Independent Curriculum (BSKAP, 2022) which emphasizes project-based learning as one of the main approaches in 21st century competency development. Thus, the teaching modules developed not only have academic value, but are also in line with the direction of national education policies.

CONCLUSION

Based on the previous discussion, it can be concluded that the results of the study show that the Geography teaching module based on *Project Based Learning* on Remote Sensing material has met the criteria of valid, practical, and effective, and is able to improve the spatial thinking skills of students at SMAN 4 Gorontalo. The researcher's suggestion for Geography Teachers is that this teaching module can be used as an alternative teaching material to implement project-based learning in the classroom. Teachers are expected to be able to adapt the project to the local conditions and potential of students so that the activities become more meaningful

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