International Journal of Education, Humaniora, and Social Studies
Vol. 1, No. 2, pp. 53-59, 2024
e-ISSN 3032-1271 | p-ISSN 3032-4467
https://journal.dpipublish.com/index.php/ijehss/

DEVELOPMENT OF DIFFERENTIZED TEACHING MODULE ON LIVING CREATURES' CLASSIFICATION MATERIAL TO IMPROVE CRITICAL THINKING SKILLS LEARNERS

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Received 24 July 2024 | Revised 28 August 2024 | Accepted 29 August 2024
doi: 10.63895/j30321271.2024.v1.i2.pp53-59

Abstract

This research was conducted at SMP Negeri 4 Witaponda in the 2023/2024 academic year. The aim of the research is to produce differentiated teaching modules to improve students' critical thinking abilities. The development of differentiated teaching modules is a type of research and development (R&D) research that refers to the ADDIE model, which consists of five stages, namely: analysis, design, development, implementation and evaluation. The research subjects were 27 students. The research instrument consists of: Product validation sheet for developing differentiated teaching modules, teacher response questionnaire, and critical thinking skills test. The research results show that the differentiated teaching module developed is in the category suitable for use. This is shown by the average expert validation results of the differentiated teaching module which obtained a score of 86.88% with very valid criteria, the results of the practicality questionnaire using the teacher response questionnaire obtained a score of 92.71% with very practical criteria, and the effectiveness of the teaching module obtained a score The effect size is $d = 0.82$ with large effect criteria. It can be concluded that the differentiated teaching module is effective in improving the critical thinking skills of students at SMP Negeri 4 Witaponda.

Keywords: Teaching modules, differentiation, classification of living things, critical thinking skills

Email the corresponding author: arrung84hajar@gmail.com
How to quote: Hajar, Napitupulu, M., Kundera, I. N., Jamhari, M., Werdhiana, I. K. (2024). Development of differentiated teaching modules on the classification of living things to improve students' critical thinking skills. *Journal of Education, Humaniora, and Social Studies, 1*(2), 53-59.

Introduction

21st century learning does not only emphasize mastery of academic content, but also the development of critical thinking, collaboration, communication and creativity (4C) skills. These skills are very important to prepare students to face future challenges. One way to achieve this goal is to use teaching modules that are specifically designed to meet the needs of students, known as differentiated teaching modules. These teaching modules must include various methods and strategies that can adapt to the abilities, interests and learning styles of different students. vary (Tomlinson, 2001; Logan *et al.*, 2021; Diansah & Asyhari, 2020; Sukmadewi & Jumadi, 2023; Widya *et al.*, 2021).

Modern educational theories, such as Howard Gardner's theory of multiple intelligences and Jean Piaget's constructivist learning theory, support the importance of differentiation in learning. According to Gardner, each student has various types of unique intelligence (Watini & Efendy, 2018), while Piaget emphasized that learning occurs most effectively when students actively construct their own knowledge (Lefa, 2014). Differentiated teaching modules allow teachers to accommodate these individual differences by providing various ways for students to understand the material, demonstrate their knowledge, and be involved in the learning process (Ginja & Chen, 2020; De Jesus, 2012; Fitra, 2022).

Previous research shows that the use of differentiated teaching modules can improve student learning outcomes. A study by Zens (2021) and Manoj (2020) shows that differentiation in teaching can increase student engagement and help them reach their full potential. In addition, research by (Geletu & Mihiretie, 2022) found that differentiation can help reduce achievement gaps in heterogeneous classes. Therefore, this research focuses on developing differentiated teaching modules on the classification of living things to improve students' critical thinking abilities (Verdamil *et al.*, 2024; Savran Gencer & Dogan, 2020).

Several studies have been conducted on differentiated learning to improve students' critical thinking skills, including research (Muhlisah *et al.*, 2023) that differentiated learning can improve students' critical thinking skills. According to (Lailiyah, 2016), the increase in critical thinking skills of students who receive Differentiated Instruction (DI) learning is better than students who receive regular learning. Differentiated learning helps students to build abilities (Saputri *et al.*, 2023).

The urgency of this research is based on the challenges teachers face in implementing an independent curriculum, especially in developing effective and differentiated teaching modules. Even though the independent curriculum emphasizes personalized and flexible learning, there are still many teachers who have difficulty implementing it (Linda Bransford, 2000). Therefore, the development of differentiated teaching modules that are valid, practical and effective is very important to support the successful implementation of this curriculum (Tomlinson, 2017; Pranajaya *et al.*, 2022; Andajani, 2023).

There is a lack of understanding about differentiated teaching modules so that the modules created by teachers are not yet based on the characteristics of students, and are not in accordance with the Minister of Education and Culture of the Republic of Indonesia Regulation Number 16 concerning process standards that require flexible, clear and simple learning planning and content that supports it so that it can be applied in learning effectively. concept of differentiated learning. This can have a significant impact on the learning process, especially students who have medium and low levels of understanding have difficulty in solving HOTS-oriented questions. It is necessary to innovate the development of teaching modules in accordance with the principles of differentiated learning that can accommodate the diversity and characteristics of students

The novelty of this research lies in the systematic approach used in developing different teaching modules, as well as the focus on improving students' critical thinking skills. This is expected to make a significant contribution to teaching practices in Indonesia, especially in the context of an independent curriculum (Urip Umayah, 2023; Andajani, 2023). Based on previous research on the development of differentiated teaching modules, researchers are motivated to develop differentiated teaching modules on the classification of living things to improve the critical thinking skills of students at SMP Negeri 4 Witaponda

Method

This research is research and development (R&D) research which focuses on developing Differentiated Learning Modules with the ADDIE model. The research was conducted at SMP Negeri 4 Witaponda, Central Sulawesi, Indonesia, with a population of class VII students. The sample is class VII-B which was selected through purposive sampling from 3 existing classes. The sample was determined based on initial data from the Middle School Entrance Test results, where the population was homogeneous and not too geographically dispersed. The research subjects were 27 people, consisting of 10 male and 17 female, with an average age of 13.5 years. This research was carried out in 3 class meetings with material on the classification of living things.

Data collection techniques include observation, science teacher interviews, validation, surveys with questionnaires, and written tests. Data interpretation was carried out descriptively for the validation results of differentiated teaching modules, and indicators of critical thinking skills were analyzed using certain formulas and converted into criteria for critical thinking skills. Specific data collection techniques used to assess the effectiveness of differentiated teaching modules include 1-4 Likert scale analysis, surveys, written tests, interviews with teachers, and product validation forms with 20 statements, teacher response questionnaires with 11 statements.

Analysis of students' critical thinking abilities is obtained through tests, namely pretest and posttest questions. Researchers used test questions in the form of essays consisting of 5 questions to see the level of students' critical thinking abilities. These questions are created based on indicators of critical thinking abilities. The test questions will be validated first by expert lecturers. After validation, the next step is to test the effectiveness of the product application using the Cohen's effect size test which is carried out to determine the increase in students' critical thinking abilities after being given treatment. Effect Size is a measure of the strength and weakness of an independent variable influencing the dependent variable. In this case, the application of differentiated teaching modules contributes to improving students' critical thinking skills

Results and Discussion

Development is carried out based on the ADDIE stages. At the analysis stage, it was discovered that students' learning readiness consisted of three categories, namely Category-1: Full understanding, totaling 5; Category-2: Partial understanding, totaling 10; and Category-3: Don't understand, totaling 12. Apart from that, learning objectives (TP) and ATP were also identified in one learning outcome (CP). The results of the analysis showed that the learning objectives (TP), learning objective flow (ATP) and teaching modules used by teachers did not accommodate learning readiness, learning styles, interests. and students' talents. From this analysis, learning objectives (TP) are then prepared based on learning outcomes (CP), namely: "At the end of stage D, students are able to classify living creatures and objects based on observed characteristics"

In the design Stage, differentiated teaching modules are designed in the following order: selecting materials, preparing differentiated teaching modules, designing learning strategies, and preparing instruments. The material chosen is "classification of living things" material because it is related to everyday life.

The differentiated teaching module prepared by the researcher is a complete version of the teaching module which includes three parts, namely: General Information, Core Components, and Appendix. General information includes: (1) Identity of the module author, (2) Initial competencies, (3) Profile of Pancasila students, (4) Learning outcomes, (5) Facilities and infrastructure, (6) Targets of students, and (7) Model learning used. The core components consist of: (1) learning objectives, (2) flow of learning objectives, (3) assessment, (4) meaningful understanding, (5) triggering questions, (6) learning activities, and (7) reflection of students and educators . Attachments include: (1) Student Worksheets, (2) Enrichment and Remedial, (3) Reading Materials, (4) Glossary, and (5) Bibliography.

The learning strategy design is cooperative, with a Problem Based Learning (PBL) model, with three groups based on the results of identifying students' learning readiness. Category 1 consists of group 1, namely students who have a complete level of understanding of the material on the classification of living things, category 2 consists of groups 2 and 3, namely students who have a partial level of understanding of the material on the classification of living things, category 3 consists of groups 4 and 5 of participants students who do not yet understand the material on the classification of living things. The next stage is to develop instruments, namely a validation sheet for differentiated teaching modules, a teacher response questionnaire, and a test of students' critical thinking abilities with 5 essay questions.

At the development stage, validation and revision of differentiated teaching module products are carried out. The validation results by two validators can be seen in Table 1.

Table 1 Expert validation results

Rated aspect	Teach Module Score	
	Validator 1	Validator 2
General identity	100	87.50
Learning objectives	87.50	100
Material selection	100	83.33
Learning steps	75.00	83.33
Selection of learning resources	100	100
Learning assessment	87.50	75.00
Language	75.00	100
Rate-rate	89.58	
Interpretation	Very valid	

In addition to the validation scores, the differentiated teaching module was revised based on the validator's suggestions for improvement, including: 1) Learning objectives were based on ABCD elements, 2) Learning reflections were clarified, 3) at meeting one 4) at meeting one the problem to be resolved was clarified, 5) differentiation was clarified. After revision, the differentiated teaching module product is ready to be implemented, as shown in Figure 1.

Figure 1. Differentiated teaching module products

The Implementation Stage consists of three stages, namely first implementation, product revision, and second implementation. The first implementation was carried out by a science teacher in one class of 28 students. The results of the science teacher's assessment of the differentiated teaching module were 89.58% in the very good category, with several suggestions for improvement, namely: (1) Clarify the division of time in the differentiated teaching module, (2) Increase the achievement profile of Pancasila students, (3) Include a Glossary, (4) Adding references. After revision, the second implementation was carried out in the research subject class, namely class VIIB, which involved 27 students. From its implementation, the practical results of the differentiated teaching module can be seen in Table 2.

Table 2. Response to teaching module

Respondent	Percentage %	Criteria
IPA teacher 1	90.91	Very practical
IPA teacher 2	93.18	Very practical
Rate-rate	92.01	Very practical

The effectiveness of differentiated teaching module products was analyzed using the Cohen's Effect size formula, to provide an in-depth picture of how much influence the differentiated teaching module intervention had on improving students' critical thinking skills. Cohen's effect size is a statistical metric that measures the size of the difference between two conditions or groups, in this case the difference between critical thinking skills before and after implementing differentiated teaching modules. The effect size results can be seen in Table 3.

Table 3 Effect size of critical thinking skills

Results	Score (%)
Pretest is average	36.76
Posttest rate	85.88
Mpretest – Mposttes	49.12
Pooled standard deviation	60.21
Effect size (*d*)	0.82
Criteria	Big Effect

Improving students' critical thinking skills formulated based on each indicator is explained in Figure 2.

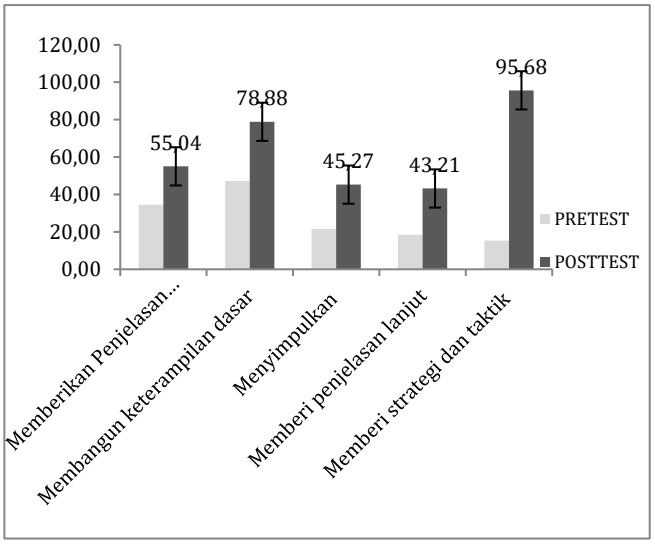

Figure 2. Improving critical thinking skills in the implementation of differentiated teaching modules

The evaluation stage was carried out to perfect the differentiated teaching module that was developed after it was implemented. The evaluation stage includes formative and summative evaluations.

The analysis stage identifies students' learning readiness, learning objectives, and learning outcomes. The results of the analysis of the learning readiness of class VII B students at SMP Negeri 4 Witaponda based on the tree of students' level of understanding of the learning material were obtained: Full understanding (Category 1 students) totaling 5 students; Partial understanding (Category 2 students) amounted to 10 students; and don't understand (Category 3 students) totaling 12 students. From this analysis, it can be seen that the majority of students do not understand the classification of living things as a whole, this shows the need to develop more effective teaching modules.

Validation of differentiated teaching modules is a process of requesting approval regarding the suitability of the product being developed. Based on the level of validity, the differentiated teaching module that has been developed is in the very valid category. The differentiated teaching module which was developed using the ADDIE model, has been validated and implemented on a limited and expanded scale, and is within the criteria of being suitable for use, so it can be concluded that the differentiated teaching module is effective and efficient to use (Basri *et al.*, 2018).

The results of the practicality test analysis obtained through the teacher response questionnaire with very practical criteria, this indicates that the teaching modules prepared are relevant to teachers' needs in teaching in accordance with the curriculum that applies in schools, namely the independent curriculum. This research further shows that the differentiated teaching module developed can be used as a model for other teachers in developing teaching modules that are in accordance with the independent curriculum. This module can be adapted and implemented in various learning contexts, thereby providing flexibility for teachers in adapting their teaching methods to the needs of students. This is important to support the successful implementation of the independent curriculum in various schools in Indonesia (Tomlinson, 2017; Andajani, 2023; Pranajaya *et al.*, 2022).

Good teaching modules are not only valid, practical but also effective in the learning process. The effectiveness of the teaching module is measured using students' pretest and posttest scores. The results of the effectiveness analysis using the Cohen's effect size formula with large effect criteria indicate that differentiated teaching modules have a significant influence on student achievement. Differentiated teaching modules are not only successful in presenting learning material in an inclusive and diverse manner. This finding is consistent with the findings of various studies which show that differentiated learning has a significant influence in improving students' critical thinking skills (Solikhin *et al.*, 2023).

The results of this study support previous research findings regarding the effectiveness of differentiated teaching modules in improving students' critical thinking skills. For example, research by (Ginja & Chen, 2020; Verdamil *et al.*, 2024; Tomlinson, 2017) show that differentiation in teaching can improve student engagement and learning outcomes. In addition, a study found that learning modules are designed to meet individual needs students can reduce achievement gaps in heterogeneous classrooms. Research also shows that the use of differentiated teaching modules can help teachers implement independent curricula more effectively, because these modules provide clear and structured

guidance to accommodate students' individual differences (Pranajaya *et al.*, 2022; Maryanti *et al.*, 2021).

The implementation of differentiated teaching modules also provides additional benefits for teachers, namely increasing their understanding of the importance of differentiation in learning. By using this teaching module, teachers can see firsthand how differentiation strategies can improve student engagement and learning outcomes. According to (Rohmaniyah *et al.*, 2024) differentiated learning not only improves student learning outcomes but also helps teachers develop their professional skills. Through the use of different teaching modules, teachers can better understand the importance of accommodating individual student differences and how this can affect the overall teaching and learning process. Other research also shows that teachers who implement differentiated learning are better able to create a learning environment that is inclusive and oriented to the needs of students (Onyishi & Sefotho, 2020; Santoso *et al.*, 2022).

Differentiated learning allows teachers to design and implement teaching strategies that are more responsive to the needs of individual students. This creates a more inclusive and effective learning environment, because teachers can adapt their teaching methods to students' abilities, interests and learning styles. Apart from that, differentiated learning also provides opportunities for teachers to continue learning and developing through reflection and collaboration with colleagues. With this reflection, teachers can evaluate the effectiveness of the strategies they use and make necessary adjustments to improve student learning outcomes (Auditor & Mutya, 2022). Recent research also shows that collaboration between teachers in designing and implementing differentiated learning can improve their professional competence and enrich classroom teaching practices (Tomlinson, 2017; Pranajaya *et al.*, 2022; Andajani, 2023).

This research also emphasizes the importance of collaboration between teachers, students and education experts in the process of developing teaching modules. By involving various parties in module development, it is hoped that the resulting teaching module will be more comprehensive and in line with students' needs. This collaboration not only enriches the content and teaching methods, but also ensures that teaching modules are designed with different perspectives and experiences in mind. For example, teachers can provide input based on daily teaching practices, students can provide input about what they need and their preferences, while educational experts can provide insights based on current research and educational theory. (Linda Bransford, 2000). This effective collaboration can produce teaching modules that are more adaptive and responsive to individual student needs, thereby increasing teaching effectiveness.

This collaboration can also help create a more inclusive and supportive learning environment, thereby supporting the development of students' critical thinking skills and learning outcomes. Through collaboration, teachers can learn from each other and from educational experts about the best strategies for teaching critical thinking skills. In addition, by involving students in this process, they feel more appreciated and motivated to actively participate in learning. Research shows that an inclusive and supportive learning environment can significantly increase student engagement and their learning outcomes (Ginja & Chen, 2020; Manoj Chandra Handa, 2020; Zens, 2021). Collaboration involving various parties can also help create a richer and more diverse curriculum, which not only focuses on academic knowledge but also on developing students' social and emotional skills. (Sukmawati *et al.*, 2019) Thus, good collaboration in developing Differentiated teaching modules can support the implementation of a more effective and meaningful independent curriculum.

Conclusions

Development of differentiated teaching modules in the subject of classification of living things at SMP Negeri 4 Witaponda reached a level of validity with a very valid category. This shows that the module developed has met high quality standards and is suitable for use in the learning process. This differentiated teaching module shows a very high level of practicality. Teachers and students assess this module as easy to use and helpful in organizing learning more effectively. The availability of clear guidelines and well-structured material makes this module very practical to use in the classroom. The use of differentiated teaching modules has proven effective in improving students' critical thinking abilities. Data shows that there is a significant increase in students' critical thinking abilities after implementing this module. The large effect category shows that this module not only helps in understanding the material, but also encourages students to think more analytically and critically. Based on research findings, we suggest that this differentiated teaching module can be further developed for other subject matter in the field of science.

Acknowledgments

The authors would like to thank Validation Expert, who has taken the time to provide validation and constructive feedback on the teaching modules developed; SMP Negeri 4 Witaponda, to the Principal, teachers and staff who have given permission and full support in carrying out this research. Especially to class VII B students who have participated enthusiastically in every stage of the research; Morowali Regency Regional Education Office as student sponsor.

Conflict of interest

The author declares that there is no conflict of interest in this research. All parties involved have given their consent and contributed without any bias or influence that could affect the research results.

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International Journal of Education, Humaniora, and Social Studies, September 2024 Volume 1 Number 2, pp 53-59