International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com
editor@ijmmu.com
ISSN 2364-5369
Volume 12, Issue 9
September, 2025
Pages: 1-12

Development of E-Modules Based on Discovery Learning Oriented to Mathematical Representation Ability of High School Students

Husnul Khotimah; Dhoriva Urwatul Wutsqa

Yogyakarta State University, Indonesia

http://dx.doi.org/10.18415/ijmmu.v12i9.6976

Abstract

The low mathematical representation ability of students encourages the author to develop a learning e-module that can facilitate this ability. This research aims to find out how the characteristics of valid, practical, and effective learning e-modules and to determine the validity, practicality, and effectiveness of discovery learning-based e-modules oriented to students' mathematical representation skills. This type of research is Research and Development (R&D). The development model used in this research is the ADDIE development model which includes the stages of Analysis, Design, Development, Implementation, and Evaluation. The test subjects in this study consisted of two types, namely expert test subjects and product test subjects. The expert test subjects were two lecturers from the Mathematics Education Department at Yogyakarta State University, while the product test subjects were 35 X grade high school students. Expert trials were conducted to assess the validity or feasibility of the products developed. Product trials were conducted to assess the practicality and effectiveness of the developed products. The results showed that the e-module developed met the criteria of valid, practical, and effective. This research produces e-modules that can be used in mathematics learning to facilitate students' mathematical representation skills.

Keywords: *Discovery Learning; E-module; Mathematical Representation*

Introduction

Three important aspects are assessed in PISA: math literacy, science literacy and reading literacy (OECD, 2015). The term mathematical literacy has been coined by NCTM (National Council of Teachers Mathematics), where there are five competencies in learning mathematics, namely mathematical problem solving, mathematical communication, mathematical reasoning, mathematical connections and mathematical representation (Keller et al., 2001). Correspondingly, the Mathematics Learning Outcomes (CPs) organize mathematics into a scope of five content elements and five process elements (Kemendikbud). One of the content elements in mathematics learning is mathematical representation.

Kilpatrick et al., (2001) suggests that mathematical representation is a way of presenting mathematical ideas or concepts in various forms, including the use of diagrams, graphs, symbols, equations, tables, words, or physical objects to describe mathematical concepts or relationships.

Mathematical representation ability is an important element in mathematics learning that needs to be further developed by students (Patac et al., 2022). Furthermore, (Knuth & Jones, 1991) stated that there are several reasons for the importance of mathematical representation skills, namely the basic ability to build mathematical concepts and thinking, to have good concept understanding skills and can be used in problem solving. Thus, it is important for students to have good mathematical representation skills to be able to support the process elements in Mathematics subjects related to the view that mathematics is a conceptual tool for constructing and reconstructing mathematics learning materials in the form of mental activities that form a flow of thinking and a flow of understanding that can develop student skills.

There are several studies that have been conducted on the description of students' mathematical representation skills in Indonesia. For example, research conducted by Minarni et al., (2016) shows that the comprehension and representation skills of students of 4 public junior high schools in North Sumatra are in the low category. Other research results are from Utomo & Syarifah (2021) Where the research involving students in Malang Regency there are still students with moderate and low representation skills, especially in visual and symbolic representations. Visual representation occurred in both high, medium, and low ability classes. High and low ability students perform the symbolic representation process, while medium ability students perform the symbolic representation process at the problem solving stage.

One of the steps that a teacher can take in realizing learning that involves the active role of students is by realizing innovative learning by designing the right learning model. One of them is discovery learning. According to (Singer et al., 2016) Some of the obstacles that occur in the learning process are due to a lack of attention to the learning process itself, one of which is the lack of support for discovery learning. Discovery learning itself according to (Lestari and Yudhanegara, 2018) discovery learning is one of the learning models that organizes learning to be more meaningful. Discovery learning is a learning model that is designed in such a way that learning activities are able to encourage students to make discoveries of concepts and principles by thinking for themselves. This provides space for students to be able to explore various things which in turn will produce a pleasant learning environment for students because it uses a discovery approach (Castronova, 2002).

Discovery Learning is a learning model designed for students to discover and build knowledge independently. Hosnan (2014) emphasizes that this model demands the active role of students in the learning process, while the teacher acts as a facilitator who encourages students to gain learning experience. Hosnan & Sikumbang (2014) added that discovery learning emphasizes the understanding of important structures and ideas through the active involvement of students. The process in the discovery learning model encourages students to build understanding through various forms of representation such as graphics, diagrams, or narratives that help students in problem solving. These representations become important tools to explain and understand mathematical concepts more deeply. Research (Sanjaya et al., 2018) shows that in the discovery learning model, students need practice in building their own representations to develop strong and flexible abilities and understanding in solving problems.

When implementing learning activities, of course, good planning is needed first. The teacher's ability to plan and implement each learning process plays an important role in achieving learning objectives. Based on Permendikbudristek Number 16 of 22 concerning Education Process Standards in Primary and Secondary Schools, it is stated that lesson planning contains learning objectives that aim to provide quality learning experiences with practical problems or contexts, interactions, and the use of technological devices. The development of teaching materials that utilize technology is one of the learning competencies that a teacher needs to have. This is regulated in the Regulation of the Minister of National Education Number 16 of 2007, where one of the teaching competencies of teachers is to utilize information and communication technology to carry out learning activities optimally.

However, based on research conducted by (Kharisma & Asman, 2018), In some schools, the teaching materials used do not provide situational problems and only a few contain problem solving questions. Therefore, it is necessary to have a learning innovation, one of which is in the form of developing teaching materials. Based on research conducted by Kumalasari et al., (2022) It was found that teachers are still not able to maximally develop their own teaching materials due to various factors. One of these factors is the difficulty of teachers in compiling teaching materials that are in accordance with the abilities of students. So that many teachers choose to only refer to books or makeshift materials that are already available at school.

Therefore, one alternative that teachers can do is to develop teaching materials (Fikri & Madona, 2018). One of the teaching materials that can be developed and then used is in the form of e-modules designed based on discovery learning oriented to students' mathematical representation abilities that can help students maximize the learning process in the classroom. According to (Russell, 1974) "Module is "an instructional package dealing with single conceptual unit of subject matter". The sequence within the module should be consistent from one module to another for ease of use. The quality of the learner guide is reflected in the structure and format of the module as well as the layout and design of the guide.

The product to be developed is in the form of a math e-module with module characteristics according to Depdiknas (2003) namely self instructional, self contained, stand alone, adaptif, and user friendly. The use of e-modules in Discovery Learning-based learning provides various significant advantages in the learning process. One of the main advantages of e-modules is that they allow the presentation of content in various formats such as text, images, videos and animations. This makes it easier for students to visualize abstract concepts and increase students' active involvement in the learning process.

In this study, the researcher aims to describe the development process and results of e-modules that use the Discovery Learning Model, with a focus on facilitating mathematical representation skills. In addition, this study also aims to assess the quality of e-modules in terms of validation, practicality, and effectiveness, with the hope that the module can become a viable alternative learning resource.

Method

This research is a development research or *research and development* (*R&D*). The Research and Development method is a research method used to produce certain products, and test the effectiveness of these products (Sugiyono, 2009). The purpose of this research is to develop discovery learning-based teaching materials to facilitate students' mathematical representation skills. The products in this development pay attention to three aspects of quality, namely valid, practical, and effective. According to (Branch, 2010) The development model chosen for this development research is the ADDIE development model which includes the stages of Analysis, Design, Development, Implementation, and Evaluation.

Product trials are intended to test the feasibility of teaching materials developed based on material aspects, media aspects and assessment by users. There are two stages in product trials to determine the feasibility level of teaching materials, namely expert validation and user trials. Expert validation aims to determine the feasibility level of teaching materials in the form of e-modules developed based on material aspects and media aspects. The implementation of the feasibility test is carried out by showing the teaching materials developed along with a number of assessment questionnaires that will be filled in by material experts and media experts to assess whether or not the teaching materials are feasible along with suggestions and criticisms that can be used as improvements in the development of teaching materials developed. Meanwhile, the usage trial is intended to determine the feasibility level of teaching materials for users. The test subjects in this study were grade X students in the 2024/2025 school year in the odd semester at one of the state high schools in East Lombok.

The data collection technique in this study used a mathematical representation ability test. The research that was carried out used test questions in measuring how students' mathematical representation skills were after using the developed e-modules. The test results are then used in measuring and determining the effectiveness of the product work. In addition, non-test instruments were used to collect data on the validity and practicality of the products developed using product validation sheets, assessment sheets from teachers, assessment sheets from students, observation sheets of learning implementation.

The data analysis techniques used in this research are qualitative and quantitative data analysis techniques. Qualitative data analysis techniques are used in processing qualitative data such as comments and suggestions. While quantitative data analysis techniques are used in processing quantitative data sourced from product validation sheets, product practicality sheets and mathematical representation ability test scores. Data analysis was conducted after obtaining data from all research subjects including material experts, media experts, and students. The conversion of quantitative data into qualitative data was modified from (Widoyoko, 2014) in Table 1 below.

Table 1. Expert Validation Scoring Guidelines

E-module validity score (from the material side)	E-module Validity Score (from the media side)	Criteria
$X > 62{,}7$	$X > 53{,}1$	Highly Valid
$54{,}4 < X \leq 62{,}7$	$46{,}1 < X \leq 53{,}1$	Valid
$51{,}4 < X \leq 54{,}4$	$43{,}5 < X \leq 46{,}1$	Valid Enough
$38 < X \leq 51{,}4$	$32{,}1 < X \leq 43{,}5$	Less Valid
$X \leq 38$	$X \leq 32{,}1$	Invalid

In this study, it was determined that the validity value of the product was declared valid if the empirical score (X) obtained was at the minimum criteria of “Sufficient” according to the score of each instrument.

The following is presented the calculation of the components of the teacher and student practicality instruments along with the criteria for assessing teacher practicality presented in Table 2 below.

Table 2. Categories of Product Practicality Assessment by Teachers

Teacher Practicality Sheet Score	Student Practicality Sheet Score	Criteria
$X > 96{,}7$	$X > 67{,}6$	Highly Practical
$83{,}9 < X \leq 96{,}7$	$58{,}7 < X \leq 67{,}6$	Practical
$79{,}2 < X \leq 83{,}9$	$55{,}4 < X \leq 58{,}7$	Practical enough
$58{,}4 < X \leq 79{,}2$	$40{,}8 < X \leq 55{,}4$	Less Practical
$X \leq 58{,}4$	$X \leq 40{,}8$	Impractical

The developed product is declared practical if the empirical score (X) obtained is at the minimum criteria of “Sufficient” for each practicality assessment by teachers and students.

The assessment criteria in analyzing the practicality of the product based on the results of the implementation observation. The criteria for assessing the implementation of learning can be seen in Table 3 below (Sudjana, 2005).

Table 1. Learning Implementation Assessment Criteria

Score Range	Criteria
$p \geq 90\%$	Very good
$80\% \leq p < 90\%$	Good
$70\% \leq p < 80\%$	Good enough
$60\% \leq p < 70\%$	Not good enough
$p < 60\%$	Not very good

The practicality of the product based on the results of the implementation observation is declared practical if the percentage of learning implementation achieved is at least in the "Good" category.

The analysis of the effectiveness of the product is carried out to determine whether the product developed has met the effective criteria or not. The effectiveness of using this product is reviewed based on students' mathematical representation skills. The data analysis steps to review this effectiveness are after conducting the test, the researcher corrects the test answers and the students' questionnaires based on the scoring guidelines that have been made. The effectiveness criteria for the aspect of mathematical representation ability in this study are: (1) The average score of the mathematical representation ability test is more than KKTP which is 75; (2) The percentage of many students who get a score reaching KKTP (75) for mathematical representation ≥ 75%. The classification of mathematical representation ability criteria can be seen in Table 4 below.

Table 4. Mathematical Representation Ability Criteria

Interval Score of Mathematical Representation Ability	Criteria
$X > 95{,}8$	Very High
$79{,}8 < X \leq 95{,}8$	High
$74 < X \leq 79{,}8$	Fair
$48 < X \leq 74$	Low
$X \leq 48$	Very Low

The data analysis to determine the effectiveness of the products used based on the test results was carried out with the one sample t-test test. The one sample t-test test was used to evaluate the effectiveness of using products oriented to students' mathematical representation skills. This test aims to test whether the product developed is effective in facilitating these variables. The one sample t-test test.

Results and Discussion

Results

The product in this study is a teaching material in the form of a discovery learning-based mathematics e-module on row and series material in class X SMA developed with the steps in the ADDIE model development research. The process of developing e-modules based on discovery learning is oriented towards students' mathematical representation skills. The general characteristics of discovery learning-based modules are packaged in the form of e-modules equipped with pictures, sample problems, practice problems, and competency tests based on discovery learning syntax.

The developed product is run by students using a smartphone or laptop and connected to an internet connection. The developed product can facilitate students to learn math on row and sequence material more independently. The material presented is not only in the form of writing, but also accompanied by illustrative images that will make it easier for students to understand the context. In addition, the material presented in the developed product can also help students in imagining the form of representation of some data into other forms.

Product development in this study uses the ADDIE development model which has 5 stages, namely: Analyze, Design, Development, Implementation, and Evaluation. Analyze stage where the author collects data and facts as materials to be used and designed in the product to be developed. Some steps in the analyze stage include needs analysis, curriculum analysis and analysis of student characteristics. At this stage, the main focus is on planning and designing the product to be developed. This design stage is very important because it is the basis for the next stage of development. The result of this stage is usually a detailed design document, which will guide the development of the learning product. At the development stage, the product is designed in accordance with the learning design, compiling instruments and also conducting a validation process and limited trials.

The developed product is then uploaded and then distributed via a link. When the link provided is clicked, the initial appearance of the e-module will appear. The cover of this e-module contains the title, material, and the intended class. The following is the cover of the e-module.

Figure 1. Teaching Module Cover

This module uses the Discovery Learning model, which emphasizes constructivist learning. The structure of the learning activities in this module follows the stages outlined in the model followed by evaluation activities, as illustrated in Figure 2 and Figure 3 below.

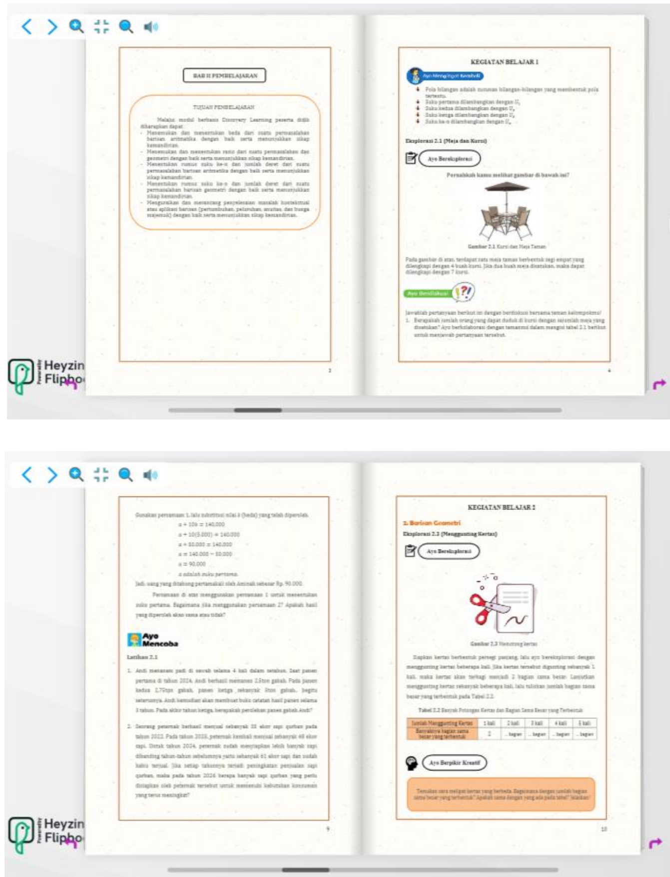

Figure 2. Stages of Discovery Learning Activities in E-Modules

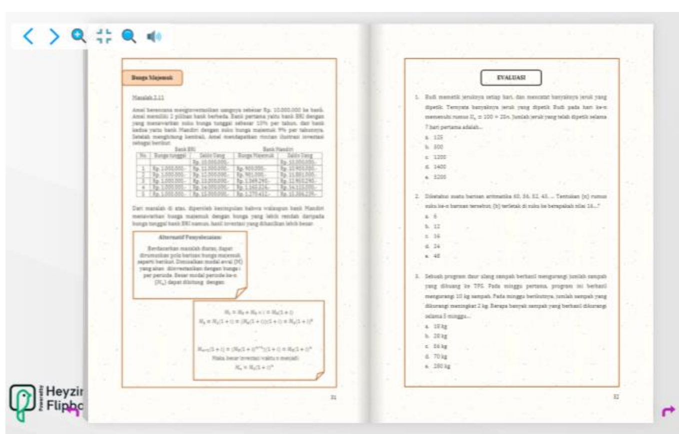

Figure 3. Evaluation Activity and Answer Key

Small-scale trials or limited trials were carried out to describe the readability and practicality of teaching materials before being widely tested. This limited trial was conducted with 9 students from class X.

The discovery learning-based e-module that focuses on students' mathematical representation ability, which has been proven valid and has been tested in a limited trial, is applied in the research subject in class X SMA. This trial aims to evaluate the effectiveness and practicality of the discovery learning-based e-module. The evaluation stage is the final stage in the ADDIE research and development model. Evaluation activities consist of assessment activities, namely the practicality and effectiveness of the product, in this case the media that has been made. The practicality of the e-module is seen based on the practicality sheet that has been filled in by teachers and students and based on observations of the implementation of learning that has been carried out. The effectiveness of e-modules focuses on facilitating students' mathematical representation skills.

The validity of the product is obtained from the results of validation by experts, namely two validators from Mathematics Education, Yogyakarta State University. Validation by experts shows the results that the mathematical representation test instrument is included in the "very valid" category, the product in terms of media is included in the "valid" category, the product in terms of material is included in the "valid" category, the validation sheet for learning implementation observation is included in the "very valid" category, the product practicality validation sheet by teachers and students is included in the "valid" category. These results indicate that the e-module developed meets the validity criteria.

In this validation process, there are many suggestions and input from validators so that revisions need to be made until they meet the criteria for use. In line with that, according to Sugiyono (2009) that if it is theoretically correct, then in this case the measurement results using the guided measuring device will be considered valid. This e-module meets the valid criteria because in the preparation process it is guided by relevant theories. This is in line with the opinion of (Nieveen, 1999), where a product is said to be valid if the product has an appropriate framework and components.

The discovery learning-based e-module product to improve students' mathematical representation skills has met the criteria of practicality. These results are based on aspects of the teacher's assessment of the e-module where the teacher gave an assessment in the "practical" category. The components assessed in the e-module include aspects of the suitability of the material to the level of student thinking, language feasibility, suitability and accuracy of the material, clarity of material, appearance, presentation of material, ease of operation, ease of instructions, and ease of understanding the flow. Furthermore, students' assessment of the developed e-modules. Overall, students rated the developed product as being in the "quite practical" category.

The last is the observation of learning implementation which shows that in each meeting the learning implementation is always ≥80%. The product in the form of e-modules developed is said to have met the criteria of practicality, meaning that the product can be used and utilized easily by teachers and students. This is in line with the view of (Nieveen, 1999) which states that the product can be said to be practical if teachers and experts consider the product easy and can be used by teachers and students in accordance with the purpose of its development. The discovery learning-based e-module product oriented to students' mathematical representation skills has met the effectiveness criteria.

Based on the data analysis of mathematical representation test results, the p-value is $1{,}666 \times 10^{-6} < 0.05$. Based on the inference criteria, H_0 is rejected, so it is concluded that the average value of students' mathematical representation ability after using the e-module in learning is more than KKTP (75) which is 81,6, greater than the average before using the e-module which is 15,7. Based on the results of the test proportion of students' mathematical representation ability test with a significance of 0.05, the value is obtained $Z = 1{,}855 > Z_{\alpha} = 1{,}645$. From these results, H_0 is rejected Therefore, it can be concluded that the proportion of students' mathematical representation test results that reached KKTP (75) was more than 75%. So based on all these tests, it can be concluded that the e-module based on dicovery learning developed oriented to students' mathematical representation skills is declared effective.

Discussion

This learning e-module development research produces products with valid, practical, and effective categories. The developed e-module can be recommended as one of the mathematics e-modules using the Discovery Learning model that can hone students' mathematical representation skills. The results of this study are in line with research conducted by Nissa (2023) with the title of the development of mathematics teaching materials with the help of the discovery learning-based Math City Map application that focuses on mathematical reasoning and representation skills on triangular and rectangular material. The results of the product research developed obtained a validity score with very good criteria. The module practicality results obtained a very practical category. The results of student responses to the developed product obtained a fairly practical category. In addition, the developed product meets the effectiveness criteria with the average student scores on mathematical reasoning and representation skills of 78,25 and 80,80 exceeding the minimum completeness criteria.

This study obtained the lowest results on indicators of mathematical representation ability related to verbal representation at 81.2% and visual/graphical representation at 62%. This is also in line with research conducted by Utomo & Syarifah, (2021) where the research involving students in Malang Regency shows that there are still students with moderate and low representation skills, especially in visual/graphic and symbolic representations.

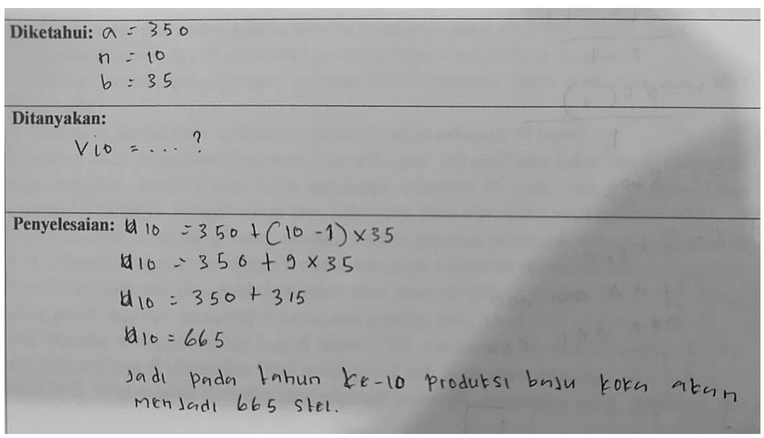

Figure 4. Students Answers for Indicator 1

As shown in Figure 4, students were able to represent the given problems accurately using appropriate mathematical symbols. This indicates that they understood how to translate contextual information into symbolic form. However, some students were not successful due to their inability to select or apply suitable symbols, or because their symbolic representations were inaccurate.

For the second indicator, verbal representation, a mastery percentage of 81.2% was achieved. Examples of students who successfully met this indicator are shown in Figures 5.

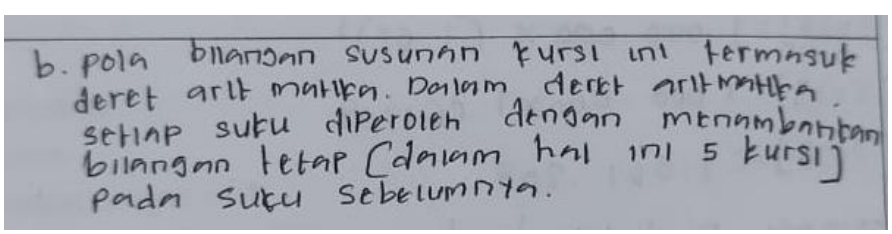

Figure 5. Students Answers for Indicator 2

These responses demonstrate that the students were able to communicate mathematical ideas clearly using appropriate verbal explanations. This reflects their understanding of the concepts presented in the questions. On the other hand, students who did not master this indicator generally struggled to express mathematical information coherently or completely in verbal form.

The third indicator, graphical representation, had the lowest mastery percentage at 62%.

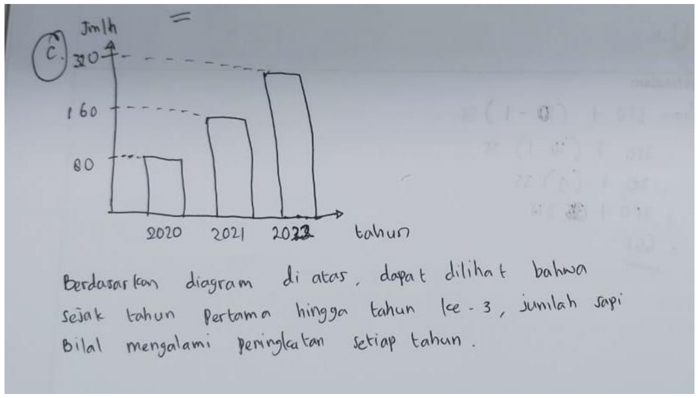

Figure 6. Students Answers for Indicator 3

Figure 6 shows an example of a student's answer that successfully met this indicator. The student was able to organize data and information in a relevant graphical form, appropriate to the context of the problem. Students who did not achieve mastery in this indicator typically had difficulties connecting mathematical concepts with visual representations or lacked accuracy in presenting data graphically.

Overall, the three indicators of mathematical representation showed varying levels of student proficiency. Symbolic and verbal representations were more easily mastered compared to graphical representation. This suggests a need for instructional strategies that strengthen visual understanding and encourage the use of graphical media to support comprehensive mathematical representation skills. The results of this study may be difficult to generalize to a wider population due to the limited sample and research context, due to time constraints, the methods used in this study did not reach the implementation stage. In addition, to test the effect of the developed module on statistical literacy, quasi-experimental research can be conducted for further research. This research can further determine the effect of e-module provision on mathematical representation skills.

Conclusion

The conclusion of this research is that the results of product development in the form of discovery learning-based e-modules oriented to students' mathematical representation abilities reach valid, practical, and effective criteria. The validity aspect of the e-module was reviewed from the experts' assessment which reached the criteria of "valid" and "very valid". The practicality aspect reached the "practical" criteria based on the observation of learning implementation, assessment by teachers, and assessment by students. The effectiveness aspect has been achieved in terms of students' mathematical representation test results. The results of the field trial showed that more than 75% of students had achieved the Learning Objective Achievement Criteria (KKTP) with an average student mathematical representation ability score of 81,6.

References

Branch, R. M. (2009). Instructional Design: The ADDIE Approach. New York, NY: Springer.

Castronova, J. (2002). *Discovery Learning* for The 21st Century: What is it and How does it Compare to Traditional Learning in Effectiveness in The 21st Century?. Literature Reviews, *Action Research Exchange (ARE)*, 1(2). [Online]. Diakses dari teach.valdosta.edu/are/Litreviews/vol1no1/castronova_litr.pdf.

Depdiknas. (2003). *Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional.*

Fikri, H., & Madona, S. A. (2018*). Pengembangan Bahan ajar Berbasis Multimedia Interaktif*. Yogyakarta: Samudra Biru.

Hosnan, M., & Sikumbang, R. (2014). *Pendekatan Saintifik dan Kontekstual Dalam Pembelajaran Abad 21: Kunci Sukses Implementasi Kurikulum 2013*. Bogor: Ghalia Indonesia.

Knuth, R. A., & Jones, B. F. (1991). What does research say about mathematics. *Retrieved September, 10*, 2006.

Keller, B. A., Hart, E. W., & Martin, W. G. (2001). Illuminating NCTM's principles and standards for school mathematics. *School Science and Mathematics*, 101(6), 292-304.

Kharisma, J. Y., & Asman, A. 2018. Pengemabangan Bahan Ajar Matematika Berbasis Masalah Berorientasi pada Kemampuan Pemecahan Masalah Matematis dan Prestasi Belajar Matematika. *Indonesian Journal of Mathematics Education*. 1 (1), 34-46.

Kilpatrick, J., Jane, S., & Bradford, F. (2001). *Adding It Up: Helping Children Learn Mathematics*. Washington, DC: National Academy Press.

Kumalasari, T., Rambe, I. W., Julia, N. T., & Asriati, W. W. (2022). Pelatihan Pengembangan Bahan Ajar dan Bahan Ajar Matematika di SMP Pangeran Antasari. *J-ABDI: Jurnal Pengabdian Kepada Masyarakat*, 2(7), 5673–5680. https://doi.org/10.53625/jabdi.v2i7.4133.

Lestari, K. E., & Yudhanegara, M. R. (2018). *Penelitian Pendidikan Matematika*. Bandung: PT. Refika Aditama.

Minarni, A., Napitupulu, E. E., & Husein, R. (2016). Mathematical understanding and representation ability of public junior high school in North Sumatra. *Journal on Mathematics Education*, *7*(1), 43–56. https://doi.org/10.22342/jme.7.1.2816.43-56.

Nieveen, N. (1999). *Prototyping to Reach Product Quality*. London: Kluwer Academic Publisher.

Patac, A. J. V., Patac, L. P., & Crispo, N. E. (2022). Students' understanding of a geometric theorem: A case of grade 9 problem posing. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *7*(2), 105–115. https://doi.org/10.23917/jramathedu.v7i2.16394.

Russell, J. D. (1974). *Modular Instruction*. Minneapolis: Burgess Publishing Company.

Sanjaya, I. I., Maharani, H. R., & Basir, M. A. (2018). Kemampuan Representasi Matematis Siswa pada Materi Lingkaran Berdasar Gaya Belajar Honey Mumfrod. *Kontinu: Jurnal Penelitian Didaktik Matematika*, 2(1), 72. https://doi.org/10.30659/kontinu.2.1.72-87.

Singer, F., Sheffield, L. J., Freiman, V., & Brandl, M. (2016). *Research On and Activities For Mathematically Gifted Student*. Springer. 10.1007/978-3-319-39450-3_1.

Sudjana, N. (2016). *Penilaian Hasil Proses Belajar Mengajar*. Bandung: PT Remaja Rosdakarya.

Sugiyono. (2009). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D*. Bandung : Alfabeta.

Utomo, D. P., & Syarifah, D. L. (2021). Examining mathematical representation to solve problems in trends in mathematics and science study: Voices from Indonesian secondary school students. *International Journal of Education in Mathematics, Science, and Technology* (IJEMST), 9(3), 540-556. https://doi.org/10.46328/ijemst.1685.

Copyrights