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Development of Differentiated Learning Module with Undo Procedure to Improve Learning Outcomes Students on Function Inversion Material

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ABSTRACT

Objective: This study aims to develop a teaching module focusing on differentiated learning by applying the undo procedure to improve student learning outcomes and understanding of inverse functions. **Method:** This study is the development of a differentiated learning teaching module on the inverse function material using the four-D (4-D) model from Thiagarajan (Define, Design, Develop, and Disseminate). Meanwhile, to determine the effectiveness of the teaching module, the research subjects were students of class XI SMAIQu (Qurani Islamic High School) Al Bahjah Cirebon. **Results:** The teaching module based on the Undo procedure was considered valid by experts, with an average validation score reaching the very valid category. This module is very practical, as evidenced by its ease of use by teachers and students' high level of readability (80–90%). The module effectively improves student learning outcomes, with an average N-Gain Score of 0.65 (moderate to high category). The module supports differentiated learning, allowing students to learn according to their abilities. **Novelty:** This module uses the Undo procedure as a learning strategy, which has not been widely applied in developing mathematics teaching materials, especially for inverse function material. The module integrates the principle of differentiated learning, providing solutions to the diversity of student abilities in the classroom. The module is designed to help students understand concepts through a procedural approach, which is rarely focused on in conventional teaching modules.

INTRODUCTION

The ability to understand and apply inverse functions helps solve a variety of practical mathematical problems, such as personal financial planning, where an understanding of inverse functions allows for the estimation of investment growth or the calculation of loan payments (Charpentier et al., 2020). In data analysis, the concept of inverse functions helps reverse mathematical transformations applied to data, helping to return data to its original state or identify inverse relationships between variables. In addition, in computer science and technology, understanding inverse functions is important in developing algorithms and software, including digital image processing, where inverse functions are used to obtain the original image from a modified image. Thus, understanding the concept of inverse functions not only provides benefits in the academic sphere but also has broad and relevant applications in various aspects of daily life and various professional fields (Biza et al., 2022; Dreyfus et al., 2021; Liang et al., 2023; Meyer & Lima, 2023; Shurygin et al., 2024). However, the learning that has occurred so far has not been optimal because the classroom conditions are not conducive, students are less active, and learning has not accommodated students' diverse abilities, the impact of which is that student learning outcomes are less than optimal. For this reason, efforts are needed to improve learning.

Based on the view that each student has unique characteristics, differentiated learning is one of the recommended learning approaches in the independent curriculum (Nur'azizzah et al., 2023). In principle, students can learn material according to their respective abilities and learning needs (Indrawatiningsih et al., 2024). Hence, students do not feel stressed or feel like they have failed in their learning experience. Differentiated learning is believed to provide benefits, including increasing student participation because the material and activities are adjusted to the level of understanding of students (Karst et al., 2022; Komang, 2021), accelerating student development by providing material that is appropriate to the level of understanding of students (Tuhuteru et al., 2023), improving conceptual understanding. After all, teachers can use various teaching methods and strategies to ensure deeper conceptual understanding. Differentiated learning allows students more control over their learning process so that they will feel more motivated and involved in learning (Handiyani & Muhtar, 2022).

To reduce the difficulty of learning mathematics, mainly inverse functions due to its abstract nature, the undo procedure is a solution because it can relate to actual conditions in life so that learning is more meaningful. Based on the description above, the formulation of the problem in this study is how the results of the development of the inverse function teaching module in differentiated learning using the undo procedure through the stages of the four-D (4-D) model from Thiagarajan achieve valid, practical criteria, and have a potential effect on the learning outcomes of class XI students. The problem-solving approach in this research is to develop a teaching module inverse function material. This research will conduct an in-depth analysis of the difficulties often experienced by students in understanding the concept of inverse functions. This includes identifying the conceptual points that most often cause confusion and the steps that are most difficult for students to understand. After this identification (Komikesari et al., 2020), the teaching module will be designed in such a way as to provide a clear and structured explanation of these concepts.

The next step is to integrate a differentiated approach into the teaching module. In this case, it involves adjusting the learning materials and methods to meet students' individual learning needs. The module will be designed according to the different levels of student understanding; for example, additional materials or extra exercises can be provided for students who need them, while students who are faster in grasping concepts can be given additional challenges (Chan et al., 2021; Corral Abad et al., 2021; Fitrianto, 2024; Javaid et al., 2023; Nowak et al., 2023). In differentiated learning, individual differences in students are valued and accepted, which will hopefully help reduce the stigma associated with learning difficulties or disabilities and increase students' self-confidence (Alhumaid & Said, 2023; Gibbs, 2023; Nørby, 2023; Stoeber & Rountree, 2021). Gradually, students will feel more prepared and braver to face higher academic challenges. Applying the undo procedure is also an important part of this problem-solving approach. Students will be guided to understand the steps required to solve inverse function problems in reverse. This helps students understand the concept more deeply and teaches them problem-solving skills that are useful in both mathematical and everyday life contexts.

During the learning process, the modules will be structured to allow students to practice independently (Komikesari et al., 2020), collaborate with classmates, and receive constructive feedback from teachers. This will ensure that every student has an equal opportunity to understand the concept of inverse functions. Through this approach, the

developed teaching module will improve students' understanding of inverse functions and provide them with the skills and confidence needed to face various mathematical challenges in their lives.

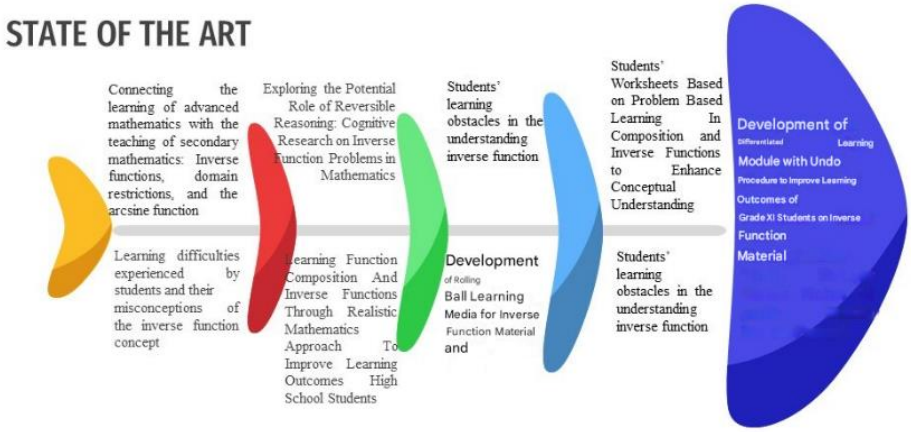


Figure 1. State of the art of this research.

Several studies on the inverse function material have been carried out based on the image. Designing pedagogical situations in which continuity, injectivity, and monotonicity theorems are used to inform teacher instruction on inverse trigonometric functions and solving trigonometric equations (Weber et al., 2020). Researching learning difficulties and misconceptions on the material of inverse functions. Ikram et al. (2020) argue that reversible reasoning is involved in all topics in mathematics. Several studies have not developed a differentiated learning module with the undo procedure for student learning outcomes on function inverses. The learning module that will be developed accommodates the diversity of student abilities and makes contextual learning meaningful and enjoyable by linking it to real life so that learning is more meaningful. To determine the inverse of a function with the undo procedure, it is as in Figure 2.

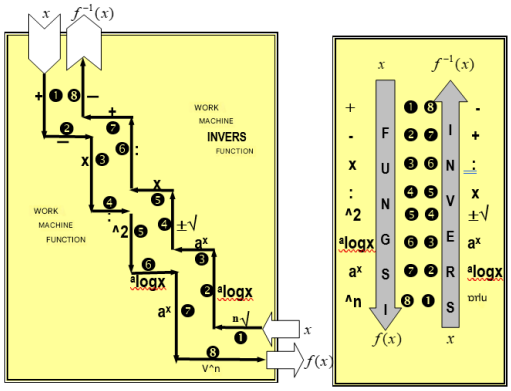


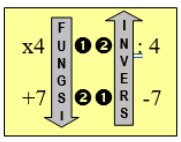
Figure 2. Undo procedure.

Example 1.

Find the inverse of the function: f(x) = 4x +7

Answer:

$f(x) = 4x + 7$



$f^{-1}(x) = \frac{x-7}{4}$

Figure 3. Example of undo procedure.

To reduce the difficulty of learning mathematics, mainly inverse functions due to its abstract nature, the undo procedure is a solution because it can relate to actual conditions in life so that learning is more meaningful. Based on the description above, the formulation of the problem in this study is as follows: How are the results of the development of the inverse function teaching module in differentiated learning using the undo procedure that achieves valid criteria? Does the inverse function teaching module in differentiated learning using the undo procedure achieve practical criteria? Is there an increase in learning outcomes on the inverse function material with a teaching module based on differentiated learning using the undo procedure? Nur'azizzah et al. (2023b) state that students' mathematical abilities have increased with the implementation of a differentiated learning approach. This can be seen from the learning process, which is more enjoyable because they can learn according to their style, and the test results show a significant increase; for students with a visual learning style, mind mapping, reading, and teaching aids are used. For students who have an auditory learning style, the concept of lectures, discussions, questions and answers, and presentations are applied. Finally, students with a kinesthetic learning style try to make teaching aids and products and learn outdoors.

Nur'azizzah et al. (2023a), based on the results of the literature review (System Literature Review), it can be concluded that (a) differentiated learning is very suitable to be implemented in schools, especially in mathematics subjects at the secondary school level; (b) Differentiated learning can improve student learning outcomes; (c) Differentiated learning can reduce student anxiety in solving mathematics problems; (d) Differentiated learning can address students' learning needs; (e) the role of teachers dramatically influences the success of implementing differentiated learning in the Independent Curriculum.

RESEARCH METHODS

Research Design

This uses the research and development (R&D) method with the 4D Model approach (Define, Design, Develop, Disseminate) (Mumtaza & Zulfiani, 2023; Qurtubi et al., 2023; Yusuf, 2023). The focus is on producing a teaching module based on differentiated learning with the Undo procedure, effectively improving student learning outcomes on the inverse function material. The design flow of this research development can be seen in Figure 4.

Subject

The research is conducted by the students of class XI at SMAIQu (Qurani Islamic High School) Al Bahjah Cirebon. The limited trial stage involves one class with heterogeneous characteristics. The extensive trial stage involves several classes of XI to test the effectiveness of the module. Other subjects include mathematics teachers who are module users and expert validators who evaluate the module.

Research Procedures

Research procedures include analyzing students' needs on the inverse function material, identifying the characteristics of differentiated learning, and studying the Undo procedure to be applied in learning—a design compiling teaching modules based on differentiated learning and creating supporting devices. Develop, which is a validation of the module by experts, limited trials to test the practicality and effectiveness of the

module, and revisions based on input from the validator of the trial results. Disseminate, a large-scale trial in several grade XI classes, and socialization of the module to other mathematics teachers through training.

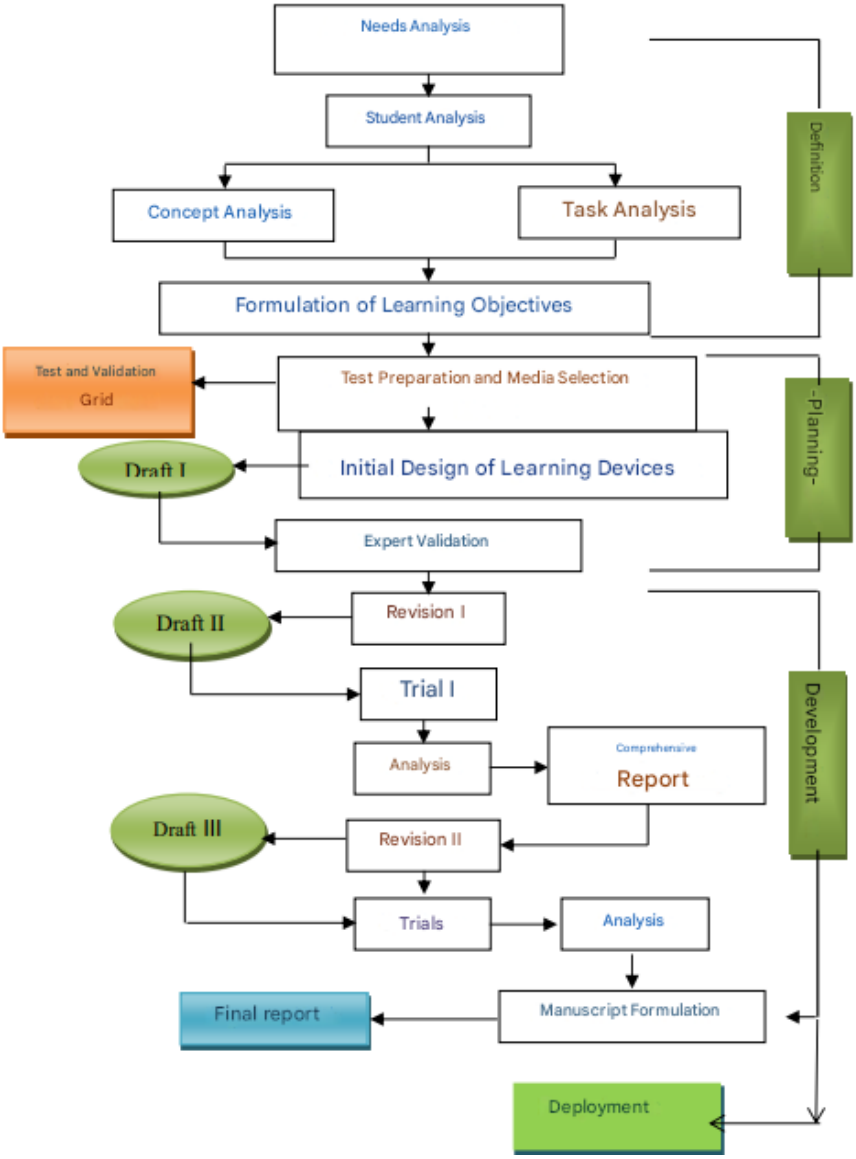


Figure 4. 4D model development procedure.

Data Collection Instruments and Techniques

Assessing the validator of the teaching module using the validation sheet instrument and the module validator technique. Measuring the implementation of the module in the classroom using the teacher observation sheet and observation techniques. Knowing the ease of use of the module using the module readability questionnaire instrument and the questionnaire technique. Measuring the increase in learning outcomes using the test instrument (pretest-posttest) and the learning outcome test question technique. Getting qualitative input using the interview guide instrument, and interview techniques.

Data Analysis Techniques

Module validation uses the average validator score with validity assessment criteria. Module practicality data uses quantitative descriptive statistics with **a readability** percentage. Module effectiveness data uses the N-Grain Score to calculate the increase in learning outcomes and a t-test to test the significance of the increase. Qualitative analysis uses input from students, teachers, and validators about module improvements.

RESULTS AND DISCUSSION

Results

The stages of developing the teaching module have been developed through a series of stages as follows:

Define Stage

This stage aims to determine and define the requirements needed in learning by analyzing the objectives and limitations of the material (Rahmatsyah & Dwiningsih, 2021). Activities: literature review, identification of Learning Achievements, Learning Objectives, Learning Objective Flow, designing mathematical content (inverse functions), products and processes with differentiated learning on inverse and function materials, determining good learning outcomes. To produce completeness of theory and suitability of class implementation, a Focus Group Discussion (FGD) was conducted involving mathematics teachers of class XI SMAIQu Al Bahjah Cirebon, lecturers, and students (colleagues).

Design Stage

The design stage is the second stage in developing learning media teaching materials. Activities in this design stage include planning the creation of differentiated learning teaching modules with undo procedures, which include collecting material references, compiling texts, selecting media, and designing media. The activities carried out by researchers at this design stage can be explained as follows:

1. Collecting Reference Materials
   The researcher's activities at this stage include collecting references that will be used as sources for making teaching modules. In this activity, the researcher uses several reference books on media and sources from the Internet regarding the differentiated learning teaching modules that have been developed.
2. Text Composition
   The researcher compiled the text in this activity using the KBBI (Indonesian Dictionary Big Book). As for the arrangement of sentences, the researcher compiled non-standard sentences so that this teaching module is not stiff when read. However, the researcher still pays attention to the language rules that must be used not to reduce the
3. language selection of modules.
   The selection of teaching modules based on the results of the analysis stage showed that no modules had been used by previous media lecturers.
4. Teaching Module Design
   The researcher used Canva and Microsoft Word to design this module. The initial stage of module design consists of a title page, table of contents, and foreword. The researcher can present the initial complimentary display of this module as in Figures 5, 6, and 7.

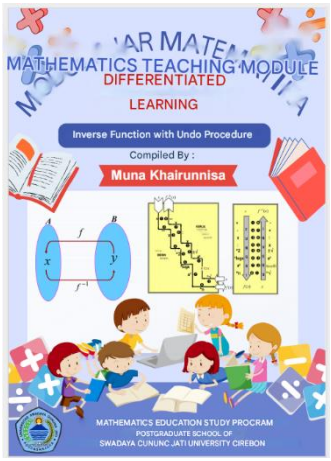


Figure 5. Title page

Figure 6. Foreword

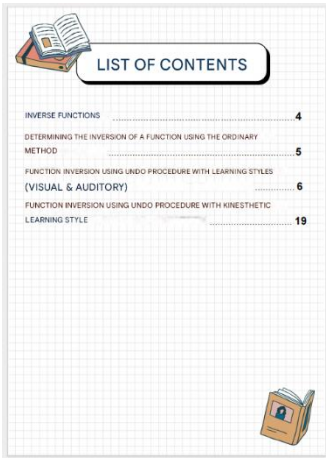


Figure 7. List of contents

At the content and closing stages, the module consists of inverse functions and inverse functions with the Undo procedure with differentiated learning reviewed from the learning style. In addition, several examples and practice questions are also given. The researcher can present the appearance of the contents page of this module as in Figures 8, 9, 10, 11, and 12.

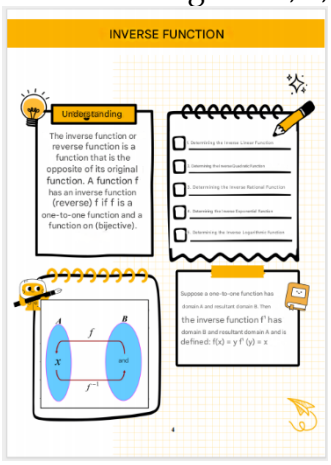


Figure 8. Inverse function

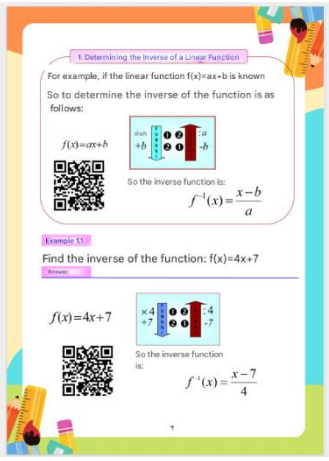


Figure 9. Material and example questions

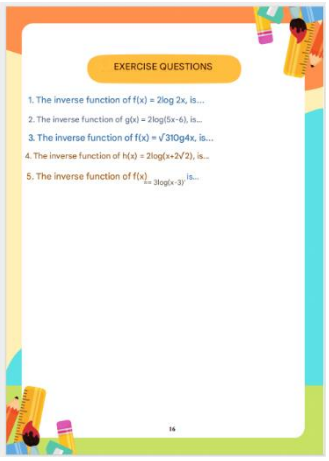


Figure 10. Practice questions

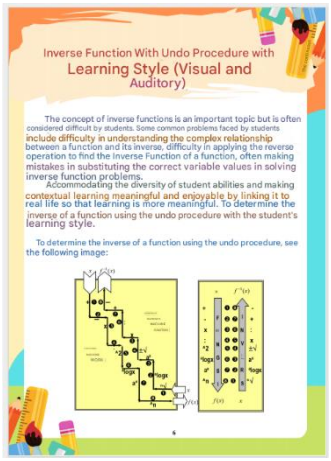


Figure 11. Inverse function with undo procedure viewed from a

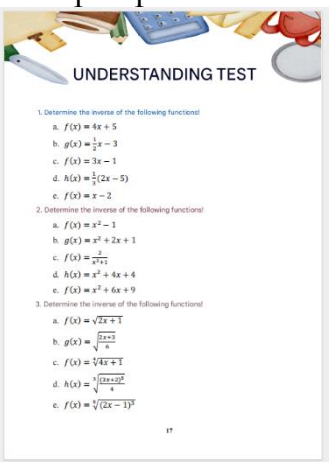


Figure 12. Test of understanding

learning style perspective

Development Stage

This stage of product realization will be developed, namely a differentiated learning module with the Undo procedure to improve the learning outcomes of class XI students on the inverse function material based on the results of expert validation.

a. Module validation by experts

This validation is one way to evaluate and improve the results of researchers' development of learning media modules. Researchers have selected lecturers, mathematics teachers, and students Susilawati, M.Pd, Retna Novitasari, S.Pd, and Shinta Izatul Lailah for the validation assessment. The validated aspects include content feasibility, language, presentation, and usability. Table 1 recapitulates the validation results assessment data from experts.

Table 1. Module validation results by experts.

Assessment Aspects	Indicator	Expert Score			Average Score	Category
		1	2	3		
Content Eligibility	Compliance with the curriculum	4.0	4.0	4.0	4.0	Very Valid
	Relevance to student needs	3.0	4.0	4.0	3.7	Valid
Linguistics	Simple and clear language	4.0	3.0	4.0	3.7	Valid
	Consistency in the use of terms	4.0	4.0	4.0	4.0	Very Valid
Presentation	Attractive layout and design	3.0	4.0	4.0	3.7	Valid
	Systematic learning flow	4.0	4.0	4.0	4.0	Very Valid
usability	Supporting differentiated learning	3.0	4.0	4.0	3.7	Valid
	It can be applied to various conditions	4.0	4.0	4.0	4.0	Very Valid
	Overall average				3.85	Very Valid

b. Practicality of the module

For assessing the practicality of the teaching module based on the results of teacher observations and student questionnaires. The aspects assessed include ease of use, readability, suitability, completeness of the material, and attractive presentation. Table 2 is a recapitulation of the data from the assessment of the results of the practicality of the teaching module.

Table 2. Practical results of teaching modules.

Assessment Aspects	Indicator	Teacher Observation	Student Questionnaire	Average (%)	Category
Ease of Use	Modules are easy to use in learning	85.0	88.0	86.5	Very Practical
Legibility	Language that is easy for students to understand	83.0	87.0	85.0	Very Practical
Time Conformity	Modules according to time allocation	80.0	84.0	82.0	Practical
Completeness of Materials	Presentation of material supports student understanding	82.0	86.0	84.0	Practical
Attractive Presentation	Modules attract students' attention	88.0	90.0	89.0	Very Practical
Overall average (%)		83.6	87.0	85.3	Very Practical

c. Effectiveness of teaching modules based on learning outcomes
For the effectiveness of the teaching module in improving learning outcomes, researchers use the pretest and posttest results. The following is a summary of the data on the effectiveness of the teaching module based on learning outcomes.

Table 3. Effectiveness of teaching modules based on learning outcomes.

Student Group	Pretest Average	Posttest Average	N-Gain Score	N-Gain Category
Trial class 1	55.0	80.0	0.56	Currently
Trial class 2	50.0	85.0	0.70	Tall
Trial class 3	60.0	88.0	0.70	Tall
Average	55.0	84.3	0.65	Medium

Discussion

The study results indicate that the differentiated learning module with the Undo procedure is highly valid, practical, and effective in improving the learning outcomes of grade XI students on the inverse function material. This module uses the Four-Dimensional (4D) development model, which includes defining, designing, developing, and disseminating. Based on the validation results by three experts, the module was declared very valid, with an average validation score that reached the very feasible category.

The practicality of the teaching module was tested through teacher observation and student questionnaires, which showed a practicality value of 80.0-90.0%. This confirms that the module is easy for teachers and students to use independently and in groups during the learning process. The systematic presentation of the module, simple language, and the inclusion of relevant examples and exercises are the main factors in the high level of practicality. In addition, Semaranata et al. (2024) state that local wisdom-based teaching modules also show good validation and practical results, supporting the effectiveness

of using modules in learning contexts relevant to local culture. The effectiveness of the teaching module is proven through the increase in student learning outcomes with the calculation of the N-Gain Score in the medium to high category (Dini et al., 2023; Luthfiani & Yerimadesi, 2022; Nadia et al., 2024; Purnamasari et al., 2024). This module has succeeded in increasing students' understanding of the concept of inverse functions, especially in the ability to solve application problems. This study also shows that the Undo procedure.

The novelty of this research lies in integrating differentiated learning with the Undo procedure, which has not been widely applied in the development of mathematics teaching modules. As a form of learning support implemented through a differentiated approach, the undo procedure can enhance student learning outcomes in challenging topics, such as inverse functions. In addition to improving learning outcomes, scaffolding can explore possible answers, develop ideas, and engage in critical reflection (Waluya et al., 2024).

However, this study has limitations in the relatively small scope of subjects and limited implementation time. For future research, it is recommended that this teaching module be applied on a broader scale with a variety of learning materials to strengthen the research results and expand its benefits. The further development of the module can better utilize modern technology, such as integrating interactive multimedia, gamification features, and cloud-based access. Digital modules can enhance students' independence in learning as their use is not limited to the classroom (Setiyani et al., 2020).

CONCLUSION

Fundamental Findings: Experts consider the learning module based on differentiation learning with the Undo procedure valid. This module has the strength of presenting material that is to student needs and supports procedure-based learning. This module is easy for teachers and students to use, with the level of readability and ease of use reaching the very practical category. The use of the module significantly improves student learning outcomes, with an average N-Gain Score of 0.65, which is included in the medium to high category. The module successfully implements differentiation learning, allowing students to learn according to their abilities. **Implications:** This module provides a systematic and easy-to-implement learning tool, especially for complex materials such as inverse functions. Teachers can utilize this differentiation approach to improve student understanding. The module supports students in learning according to their style and pace, increasing participation and learning outcomes. Procedure-based approaches such as Undo can be a reference for developing teaching modules in other fields, especially for mathematics topics that require procedural skills. **Limitations:** The study was only conducted in several grade XI classes in one school, so the results cannot be generalized to a broader population. The research time was relatively short, so it could not evaluate the impact of the module in the long term. Research has not fully accommodated the varying abilities of students with special needs or specific learning difficulties. **Future Research:** Further studies can develop the Undo procedure-based module for other mathematics topics. Long-term research is needed to measure the impact of the module on students' learning and learning outcomes over a more extended period. Integrating this module into a digital learning platform or application to increase the flexibility of its use and developing deeper differentiation strategies for students with more diverse learning abilities, including students with special needs, and conducting

similar research in different schools in different regions to test the module's effectiveness in a broader population.

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REFERENCES

Alhumaid, M. M., & Said, M. A. (2023). Increased physical activity, higher educational attainment, and the use of mobility aid are associated with self-esteem in people with physical disabilities. *Frontiers in Psychology, 14*, 1-11. https://doi.org/10.3389/fpsyg.2023.1072709

Biza, I., González-Martín, A. S., & Pinto, A. (2022). 'Scaffolding' or 'Filtering': A review of studies on the diverse roles of calculus courses for students, professionals, and teachers. *International Journal of Research in Undergraduate Mathematics Education, 8*(2), 389–418. https://doi.org/10.1007/s40753-022-00180-1

Chan, J. R., Marasigan, A. C., & Santander, N. T. (2021). Multigrade teachers' experiences and learning assessments on modular remote teaching during the COVID-19 pandemic. *International Journal of Research Studies in Education, 10*(6), 15-22. https://doi.org/10.5861/ijrse.2021.6

Charpentier, A., Elie, R., & Remlinger, C. (2020). Reinforcement learning in economics and finance. *Computer Economy, 62,* 425-462. https://doi.org/10.1007/s10614-021-10119-4

Corral Abad, E., Gómez García, M. J., Diez-Jimenez, E., Moreno-Marcos, P. M., & Castejón Sisamon, C. (2021). Improving the learning of engineering students with interactive teaching applications. *Computer Applications in Engineering Education, 29*(6), 1665–1674. https://doi.org/10.1002/cae.22415

Dini, A., Rahmatan, H., Muhibbudin, Nurmaliah, C., & Safrida. (2023). Application of the E-module combined with the Guided Inquiry Learning Model to increase student motivation and learning outcomes on the structure and function of plant tissues. *Jurnal Penelitian Pendidikan IPA, 9*(6 SE-Research Articles), 4768–4776. https://doi.org/10.29303/jppipa.v9i6.3857

Dreyfus, T., Kouropatov, A., & Ron, G. (2021). Research as a resource in a high-school calculus curriculum. *ZDM – Mathematics Education, 53*(3), 679–693. https://doi.org/10.1007/s11858-021-01236-3

Fitrianto, I. (2024). Innovation and technology in Arabic language learning in Indonesia: Trends and implications. *International Journal Post Axial Futuristic Teaching and Learning, 2*(3), 134–150. https://doi.org/10.59944/postaxial.v2i3.375

Gibbs, K. (2023). Australian teachers and school leaders' use of differentiated learning experiences as responsive teaching for students with ADHD. *Emotional and Behavioural Difficulties, 28*(1), 18–31. https://doi.org/10.1080/13632752.2023.2194131

Handiyani, M., & Muhtar, T. (2022). Mengembangkan motivasi belajar siswa melalui strategi pembelajaran berdiferensiasi: Sebuah kajian pembelajaran dalam perspektif pedagogik-filosofis. *Jurnal Basicedu, 6*(4), 5817–5826. https://doi.org/10.31004/basicedu.v6i4.3116

Ikram, M., Purwanto, Parta, I. N., & Susanto, H. (2020). Exploring the potential role of reversible reasoning: Cognitive research on inverse function problems in mathematics. *Journal for the Education of Gifted Young Scientists, 8*(1), 591–611. https://doi.org/10.17478/jegys.665836

Indrawatiningsih, N., Qomariyah, S., Nubita, A. R., & Muarofah, L. (2024). Effectiveness of differentiated learning in improving literacy and numeracy of primary school students. *Asian Journal of Education and Social Studies, 50*(5), 8–17. https://doi.org/10.9734/ajess/2024/v50i51337

Javaid, M., Haleem, A., Singh, R. P., Khan, S., & Khan, I. H. (2023). Unlocking the opportunities through ChatGPT tool towards ameliorating the education system. *BenchCouncil Transactions on Benchmarks, Standards and Evaluations, 3*(2), 33-42. https://doi.org/10.1016/j.tbench.2023.100115

Karst, K., Bonefeld, M., Dotzel, S., Fehringer, B. C. O. F., & Steinwascher, M. (2022). Data-based differentiated instruction: The impact of standardized assessment and aligned teaching material on students' reading comprehension. *Learning and Instruction*, *79*, 1-11. https://doi.org/https://doi.org/10.1016/j.learninstruc.2022.101597

Komang, A. S. (2021). Differentiated Instruction for EFL Classroom. *TELL-US Journal*, *7*(1), 14–41. https://doi.org/10.22202/tus.2021.v7i1.4719

Komikesari, H., Mutoharoh, M., Dewi, P. S., Utami, G. N., Anggraini, W., & Himmah, E. F. (2020). Development of e-module using flip PDF professional on temperature and heat material. *Journal of Physics: Conference Series, 1572*(1), 1-7. https://doi.org/10.1088/1742-6596/1572/1/012017

Liang, B., Ng, O.-L., & Chan, Y.-C. (2023). Seeing the continuity behind "double discontinuity": Investigating Hong Kong prospective mathematics teachers' secondary–tertiary transition. *Educational Studies in Mathematics, 113*(1), 107–124. https://doi.org/10.1007/s10649-022-10197-7

Luthfiani, A., & Yerimadesi, Y. (2022). Effectiveness of e-module based on guided discovery learning on learning outcomes of high school students. *Jurnal Pijar Mipa, 17*(6), 770–774. https://doi.org/10.29303/jpm.v17i6.4252

Meyer, J. F. C. A., & Lima, M. (2023). Relevant mathematical modelling efforts for understanding COVID-19 dynamics: An educational challenge. *ZDM – Mathematics Education, 55*(1), 49–63. https://doi.org/10.1007/s11858-022-01447-2

Mumtaza, M. F., & Zulfiani, Z. (2023). Development of student worksheets based on science process skills on excretory system concepts. *Jurnal Penelitian Pendidikan IPA, 9*(1), 265–272. https://doi.org/10.29303/jppipa.v9i1.1474

Nadia, H., Wiyono, K., & Sriyanti, I. (2024). Effectiveness of using physics e-modules based on local wisdom of Palembang city food to improve collaboration skills for high school students. *Jurnal Penelitian Pendidikan IPA, 10*(9), 6376–6383. https://doi.org/10.29303/jppipa.v10i9.8439

Nørby, S. (2023). Depression: Implications for learning and education. *Emotional and Behavioural Difficulties*, 1–16. https://doi.org/10.1080/13632752.2024.2434982

Nowak, G., Speed, O., & Vuk, J. (2023). Microlearning activities improve student comprehension of difficult concepts and performance in a biochemistry course. *Currents in Pharmacy Teaching and Learning, 15*(1), 69–78. https://doi.org/10.1016/j.cptl.2023.02.010

Nur'azizzah, N., Aminah, N., Maharani, A., Swadaya, U., Jati, G., School, G., & Corresponding, I. (2023a). System literature review: Differentiated learning approach in mathematics subjects in the independent high school curriculum. *International Journal of Advanced Multidisciplinary Research Studies, 3*(5), 11-24.

Nur'azizzah, N., Pramuditya, S. A., & Rosita, C. D. (2023). Analisis kemampuan penalaran matematis siswa melalui pendekatan pembelajaran berdiferensiasi. *JUMLAHKU: Jurnal Matematika Ilmiah STKIP Muhammadiyah Kuningan, 9*(1 SE-Articles). https://doi.org/10.33222/jumlahku.v9i1.2744

Purnamasari, E. F., Maasawet, E. T., Hudiyono, Y., Subagiyo, L., Herliani, H., & Akhmad, A. (2024). Effectiveness of biology e-module teaching materials based on Flip PDF professional application to improve learning outcomes and critical thinking skills. *Jurnal Penelitian Pendidikan IPA, 10*(11), 8892–8898. https://doi.org/10.29303/jppipa.v10i11.9147

Qurtubi, A., Purwati, S., Ramli, A., Tutiliana, T., & Mardikawati, B. (2023). Development of learning tools with a self-organized learning environment model to facilitate students' academic abilities. *Community Development Journal: Jurnal Pengabdian Masyarakat, 4*(6), 11337–11342. https://doi.org/10.31004/cdj.v4i6.22312

Rahmatsyah, S. W., & Dwiningsih, K. (2021). Development of interactive e-module on the periodic system materials as an online learning media. *Jurnal Penelitian Pendidikan IPA*, *7*(2), 255-277. https://doi.org/10.29303/jppipa.v7i2.582

Semaranata, I. N., Sukadi, S., & Maryati, M. (2024). Pengembangan modul ajar berbasis kearifan lokal menyama braya di Kampung Saren untuk meningkatkan prestasi belajar dan nilai peduli sosial siswa. *Jurnal Pendidikan IPS Indonesia, 8*(1), 1–13. https://doi.org/10.23887/pips.v8i1.3250

Setiyani, Putri, D. P., Ferdianto, F., & Fauji, S. H. (2020). Designing a digital teaching module based on mathematical communication in relation and function. *Journal on Mathematics Education, 11*(2), 223–236. https://doi.org/10.22342/jme.11.2.7320.223-236

Shurygin, V., Anisimova, T., Orazbekova, R., & Pronkin, N. (2024). Modern approaches to teaching future teachers of mathematics: The use of mobile applications and their impact on students' motivation and academic success in the context of STEM education. *Interactive Learning Environments, 32*(6), 2884–2898. https://doi.org/10.1080/10494820.2022.2162548

Stoeber, J., & Rountree, M. L. (2021). Perfectionism, self-stigma, and coping in students with dyslexia: The central role of perfectionistic self-presentation. *Dyslexia, 27*(1), 62–78. https://doi.org/10.1002/dys.1666

Tuhuteru, L., Misnawati, D., Aslan, A., Taufiqoh, Z., & Imelda, I. (2023). The effectiveness of multimedia-based learning to accelerate learning after the pandemic at the basic education level. *Tafkir: Interdisciplinary Journal of Islamic Education*, *4*(1 SE-Articles), 128–141. https://doi.org/10.31538/tijie.v4i1.311

Waluya, S. B., Sukestiyarno, Y. L., & Cahyono, A. N. (2024). Construction of reflective thinking: A field independent student in numerical problems. *Journal on Mathematics Education, 15*(1), 151–172. http://dx.doi.org/10.22342/jme.v15i1.pp151-172

Yusuf, M. (2023). Development of Arabic language teaching materials with 4D model for the second semester at STAI Al-Furqan Makassar. *Bulletin of Science Education, 3*(3 SE-Articles), 152–170. https://doi.org/10.51278/bse.v3i3.662

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