(JIML) JOURNAL OF INNOVATIVE MATHEMATICS LEARNING
Volume 7, No. 4, December 2024
P-ISSN 2621-4733
E-ISSN 2621-4741
https://dx.doi.org/10.22460/jiml.v7i4.p21645

BEST PRACTICE STEM-BASED DIFFERENTIATED MATHEMATICS LEARNING FOR IMPROVING LEARNING OUTCOMES AND SELF-EFFICACY OF HIGH SCHOOL STUDENTS

Angga Permana Slk[1], Nelly Fitriani[2]
[1]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
anggapermanaslk@gmail.com
[2] IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
nellyfitriani@ikipsiliwangi.ac.id

ARTICLE INFO

Article history:

Received Dec 09, 2023
Revised Dec 12, 2023
Accepted Dec 13, 2023

Keywords:

Differentiated Learning
STEM
Learning Outcome
Self-Efficacy

ABSTRACT

Learning outcomes and self-efficacy are important learning factors. Mathematics learning outcomes can reflect the extent to which students have developed as learners, while self-efficacy reflects students' self-confidence in their own abilities in solving mathematical problems. This study was based on a qualitative approach, best practice. This best practice uses the STAR flow ("Situasi, Tantangan, Aksi, Refleksi"). The situation at SMAN 1 Mande, especially class XI, shows low learning outcomes and lack of self-efficacy. The challenge faced is planning and implementing differentiated learning to improve learning outcomes and student self-efficacy. Through a STEM-based differentiated learning approach, researchers designed and implemented contextual learning on the theme of global warming with integrating science, technology, engineering and mathematics. The results of this best practice indicate an increase in learning outcomes and student self-efficacy. STEM-based differentiated learning can also improve understanding of mathematical concepts at the high school level. Researcher recommend that educators embrace differentiated learning strategies by customizing their approaches to accommodate the diverse needs such as students' level of readiness, interests, and student's learning profile. The significance of comprehending student characteristics, such as learning styles and thinking abilities is paramount, especially in the implementation of student-centered learning. Additionally, educators are advised to prioritize aligning learning objectives with the curriculum, ensuring relevance and engagement. This various approach aims to create a dynamic learning environment to resonates with students individualized level. Develop interventions to address students' lack of confidence in solving mathematical problems can improve self efficacy.

Corresponding Author:

Angga Permana Slk,
Department of Mathematics Education,
Institut Keguruan dan Ilmu Pendidikan Siliwangi,
Jl. Terusan Jend. Sudirman, Cimahi, Indonesia
Email: author_corresponding@ikipsiliwangi.ac.id

How to Cite:

Slk, A. P., Fitriani, N. (2024). Best Practice STEM-Based Differentiated Mathematics Learning for Improving Learning Outcomes and Self-efficacy of High School Students. *JIML*, 7(4), 337-350.

INTRODUCTION

Learning outcomes are an indicator of the success of learning implementation. When students have good learning outcomes, it means their understanding of the subject matter is also good.

Mathematics learning outcomes according to (Firmansyah, 2015) are the final results obtained by students at the end of the mathematics learning process and are marked with a value scale in the form of letters or symbols or numbers. Student learning outcomes are performance results which are indicated as abilities that students have acquired after receiving learning experiences (Yanni, 2018). Learning outcomes are not just numbers or letters, but describe the extent to which students have developed as learners. Learning outcomes also reflect how students respond to mathematical challenges and problems and utilize their experiences to solve these mathematical problems.

Learning outcomes are not independent things but are an accumulation of intelligence, thinking ability, confidence and motivation. According to Bandura (in Indirwan et al., 2021) self-efficacy is a person's belief in their ability to plan and carry out a series of actions required to complete a particular task. Self-efficacy is an inseparable factor in learning. Students who have high self-efficacy tend to be more motivated to face challenges. Self-efficacy helps students overcome learning obstacles and difficulties. Learning outcomes and self-efficacy are closely related. When students have good learning outcomes, it can increase self-efficacy. Meanwhile, with strong self-efficacy you will get good learning results.

The initial assessment carried out in class XI at SMAN 1 Mande showed that student learning outcomes were still low and self-efficacy was lacking. The results of the 2023 education report card show that only 48.89% of students are able to think using concepts, procedures, facts and mathematical tools in various relevant contexts in solving everyday problems. Apart from that, students tend to be passive in learning. When students are asked to work on mathematics questions in front of the class, they prefer to remain silent. Several studies such as those conducted by Egok (2016) show that students who have low learning outcomes are due to a lack of motivation to learn mathematics. One study reveals that students have low learning outcomes when they encounter difficulties in understanding concepts, specifically facing challenges in designing and solving problems in the class (Yanni, 2018).

Several studies indicate that students had low self-efficacy levels before the experiments were conducted (Fajri et al., 2017; Dewi et al., 2017; Nur Chalim et al., 2019; Ratnawati et al., 2022). Therefore, efforts are needed to improve learning outcomes and student self-efficacy. Based on the above background, the researcher implemented differentiated mathematics learning based on STEM (Science Technology Engineering and Mathematics) to determine its effect on learning outcomes and self-efficacy of high school students.

The novelty of this research lies in its adoption of a qualitative approach coupled with the best practice methodology using the STAR (“Situasi, Tantangan, Aksi, Refleksi”) flow. The utilization of the STAR flow provides a structured framework for the research, allowing for a thorough exploration of the educational context, challenges, actions taken, and reflective insights gained. This methodological choice ensures a systematic and comprehensive examination of the implemented practices. Furthermore, the research introduces innovation by focusing on STEM (Science, Technology, Engineering, and Mathematics) learning through the lens of differentiated larning. STEM approach has an effect on creative thinking abilities and can improve mathematics learning outcomes (Widana & Septiari, 2021).

This perspective acknowledges the diverse learning needs and profiles of students, aiming to tailor the educational experience to individual readiness, interests, and learning styles. The intersection of qualitative research and the best practices of STAR, along with the emphasis on differentiated STEM learning, contributes a unique and comprehensive approach to understanding effective teaching strategies in the context of mathematics education.

METHOD

The method of this study was based on a qualitative approach, best practice. Best practice is the best success story in solving the problems of educators when carrying out learning in the classroom and school principals in carrying out their main duties (Suryani, 2017). Not all experiences can be used as best practices, but experiences that are meaningful and can inspire are best practices. Researchers implemented this best practice from September 1 – October 20 2023 at SMAN 1 Mande, Cianjur Regency. The subjects were 32 students in class XI. The class had not yet implemented STEM-based learning. The need for improvement in learning outcomes and self-efficacy became evident, as the class exhibited low proficiency in mathematical concepts and a lack of confidence in tackling mathematical challenges.

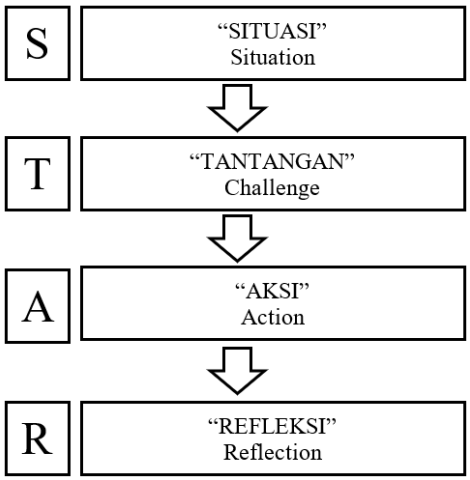

Figure 1. Best practice in STAR Flow

The best practice used by researchers uses the STAR flow. STAR has four stages that will be carried out to implement best practice (Ritonga et al., 2023). The first stage is the situation. The situation illustrates the gap between expectations and reality on the ground. Second, "tantangan" or challenges explain the obstacles to overcoming these gaps. Third is action, which details the actions and steps taken to overcome previous challenges, including who is involved in resolving these obstacles. The final stage is reflection which focuses on the impact of changes resulting from the implementation of best practices. This stage also explains the responses received by other parties regarding the implementation of best practices. The use of the STAR flow helps researchers communicate in a structured manner how the situation is faced, the challenges of solving the problem, the actions taken, and the impact and response of best practices.

In this research, three key instruments were employed to gather comprehensive data. Firstly, observation sheets were utilized to meticulously document and analyze the various stages of the best practice STAR flow method. These sheets served as a qualitative tool, allowing for the systematic recording of the educational context, encountered challenges, actions taken, and the subsequent reflections. The observational data provided valuable insights into the effectiveness of the STAR flow in implementing best practices within the learning environment.

Secondly, performance rubrics were utilized to evaluate the students learning outcomes, particularly in terms of project-based tasks related to STEM learning. The rubrics were structured to assess not only the accuracy of mathematical solutions but also the application of STEM principles and the creativity demonstrated in solving real-world problems. This quantitative tool enabled a detailed and standardized evaluation of student performance across various dimensions.

Finally, to gauge the influence of the STEM-based differentiated learning on students' self-efficacy, a closed questionnaire was administered. This instrument sought the students' reflections on their confidence levels in approaching mathematical challenges after the implementation of the new teaching approach. The questionnaire utilized a Likert scale to quantify self-efficacy, providing valuable insights into the psychological impact of the instructional method on students' beliefs in their own mathematical abilities. By combining these three instruments, the research aimed to triangulate data, offering a comprehensive understanding of the multifaceted impact of STEM-based differentiated learning on both the process and outcomes of mathematics education.

RESULTS AND DISCUSSION

Results

1. Situation ("Situasi")

Mathematics is still considered a difficult subject because it contains symbols that are difficult to understand. Even though mathematics is a science that makes it easier for us to solve problems. Mathematics lessons are often identified with numbers, symbols, formulas and arithmetic operations (Egok, 2016). Therefore, mathematics tends to be disliked by students.

The initial assessment carried out in class XI at SMAN 1 Mande showed that mathematics ability was low. The initial assessment consists of basic mathematics questions such as arithmetic operations on whole numbers and fractions as well as simple algebra. The results show that the average student score is only 48. In line with the initial assessment, the SMAN 1 Mande education report card regarding numeracy in the geometry domain has a score of 50, in the data and uncertainty domain 50, in the number domain 50, in the algebra domain 52. Education report shows that the numeracy skills of students at SMAN 1 Mande are still low.

Table 1. Statements about mathematics self-efficacy

Statments	**SA**	**A**	**D**	**DA**
I am confident that I have sufficient skills and knowledge to complete difficult mathematical tasks.				
Despite facing difficulties, I believe that I can find solutions and overcome obstacles that may arise.				
Other people are better able to solve mathematical problems than I am, so I will not be able to compete or be as successful as they are.				
Every problem is an opportunity to learn and grow, and I have the capacity to respond well to those challenges.				
I always feel overwhelmed when faced with mathematical problems. It seems like there's nothing I can do.				
Every time there is a new challenge solving a mathematical problem, I feel overwhelmed and don't know where to start. I'm not sure I can finish it well.				
New challenges give me motivation to improve my skills and knowledge. I believe I can master it.				
I believe that I have good communication skills and can easily interact with various types of people.				

I often worry that what I say will be misunderstood or not accepted by others. Maybe I'm not able to communicate well.	
I feel confident to express my ideas and opinions clearly, and confident that others will understand them	

Apart from cognitive assessments, non-cognitive assessments are also carried out. The assessment carried out is measuring students' confidence in their ability to work on mathematics problems. The assessment used used a closed questionnaire with a Linkert scale with 10 statements (table 1). The results of the non-cognitive assessment show that the average score of students is 43. This shows that students are less confident in their ability to solve mathematical problems.

The initial assessment of students shows that mathematics learning outcomes are low and self-efficacy is lacking. Learning outcomes are influenced by internal factors, namely the ability to understand, reason, problem solve, motivation, self-confidence and self-assurance. External factors that influence learning outcomes include learning methods. Kamal (2021)stated that the obstacle for students in learning mathematics is the learning method implemented. Researchers need to apply learning methods and strategies that are appropriate to the content of the material being taught. From the results of the initial assessment, researchers need to improve learning outcomes and student self-efficacy.

2. Challenge (“Tantangan”)

Low learning outcomes and lack of self-efficacy are challenges for researchers in implementing future learning. The independent curriculum invites researchers to carry out student-centered learning. Understanding student characteristics is key in implementing student-centered learning. The importance of understanding the characteristics of students is the basis for researchers to develop learning models and strategies (Magdalena et al., 2021). These student characteristics include learning styles, thinking abilities, and students' social interactions. Other characteristics that researchers can understand include will, commitment, responsibility, motivation, and cooperation(Mufidah, 2021).

Student-centered learning can be done with differentiated learning. Differentiated learning is a learning process that looks at students' needs in the areas of learning readiness, learning profile, interests and talents (Aprima & Sari, 2022). Differentiated learning is considered a learning process that has great possibilities for students to learn according to their abilities, preferences and needs (Evendi et al., 2023).

Finding learning methods and strategies that can be used to support differentiated learning is a challenge for researchers. Another challenge is creating teaching tools that suit the methods and strategies used, as well as how to implement these methods and strategies. Researchers must be able to solve these challenges in order to know their impact on learning outcomes and students' self-efficacy. The suitability of learning methods with the material being taught also needs to be considered, because not all learning methods or strategies are suitable for learning certain material in mathematics.

3. Action (“Aksi”)

Mathematics learning should be interactive, inspiring, challenging, motivating, fun and meaningful, and can develop students' creativity, talents and potential (Gusteti & Neviyarni, 2022). One learning model that suits the talents and potential of students is differentiated learning. Differentiated learning is a form of effort in a series of learning that pays attention to students' needs in terms of learning readiness, students' learning profiles, interests and talents (Aprima & Sari, 2022).

Differentiated learning has 5 objectives, namely: 1) providing assistance to all students in achieving learning objectives; 2) increase student motivation through learning stimuli so that learning outcomes can increase; 3) establishing a harmonious relationship in the learning process so that students are more enthusiastic; 4) provide stimulation to students to become independent students and have an attitude of respect for diversity; 5) increasing educator satisfaction with more creative learning challenges and developing teaching competencies (Muslimin et al., 2022).

Differentiated learning is a series of student-centered decisions. These decision indicators include: 1) how to create a learning environment that stimulates students to achieve learning goals; 2) how educators respond to students' learning needs which include learning plans, learning strategies, learning resources, learning media, and different assessments; 3) how to create an effective class and allow flexibility even though the learning activities are different but the class still runs well (Suwartiningsih, 2021).

According to Andini (2016), differentiation learning applies various approaches (multiple approaches) to learning, including content, processes and products. In differentiated learning, students pay attention to 3 important elements, namely; 1) the content that students learn; 2) process, namely how students search for information and create ideas about what they are learning; 3) product (output) regarding the results they have learned.

The learning that will be implemented in mid-September 2023 is algebraic elements with the aim of modeling real world situations with linear functions and determining inverse functions from the results of linear function modeling. Researchers conducted a literature study related to differentiated learning with a certain model approach that is suitable for inverse function material. Researchers finally decided to implement STEM-based differentiated mathematics learning. STEM learning is in line with the demands of 21st century education, namely that students have scientific and technological literacy skills and are able to solve everyday problems. Apart from that, differentiated learning can be implemented with a STEM approach.

STEM learning is also in line with the demands of the 4.0 revolution era where integrating technology in learning is needed to speed up the problem solving process. Learning in the modern era no longer focuses on certain subjects but collaborates between scientific fields to solve problems. With STEM learning, students will learn to integrate science, technology, engineering and mathematics to solve actual problems. STEM learning is able to create differentiated learning, one of which is at the stage of making problem-solving product prototypes. Students can make prototypes according to their talents and interests. In identifying problems, students can examine sources that suit their interests.

The main focus of learning remains on mathematics, namely about inverse functions. With STEM learning, mathematics learning will be more contextual. The first action stage has been determined, namely using STEM-based differentiated mathematics learning. To measure the influence of learning, two different instruments were used. To measure learning and learning outcomes, a performance assessment instrument is used, while to measure students' self-efficacy, a closed questionnaire with a Likert scale is used.

The next action that will be taken is designing STEM-based learning tools. The learning tools created by researchers are lesson plans and student activities. The lesson plans in the independent curriculum are in the form of modules, as a guide for researchers in implementing STEM-based differentiated mathematics learning. Meanwhile, “Lembar Kerja Peserta Didik” (LKPD) are used as teaching materials or student activities. According to Sari et al., (2018) the design of teaching materials that are equipped with illustrations and have contextual problems related to science, technology and engineering can make it easier for students to learn mathematics.

The teaching module is made in accordance with the algebra elements in phase F of the curriculum "Merdeka" with learning outcomes at the end of phase F, namely that students can express data in matrix form. They can define inverse functions, function composition, and function transformations to model real-world situations using appropriate functions (linear, quadratic, exponential).

Learning outcomes are then reduced to learning objectives which focus on mathematics content. Delving the intricacies of linear functions to portray and understand the dynamics of actual situations. The goal of mathematics learning is to model real world situations using linear functions and determine the inverse function from linear function modeling of real world situations. In essence, the emphasis is not only on understanding the theoretical aspects of linear functions but also on applying this understanding to solve practical problems, fostering a bridge between mathematical concepts and their practical utility in addressing authentic challenges.

This STEM-based learning module also contains science, technology, engineering and of course mathematics content. The big theme of this STEM-based differentiated learning is global warming because it is currently current. The average temperature in early September during the day is around 33^{o} C. Students are asked to solve problems related to global warming. This theme is explained in the content of science, technology, engineering and mathematics. The science content in this teaching module is,

a. The concept of temperature and temperature scale. This experiment will help students understand the concept of temperature and the difference between the Celsius and Fahrenheit temperature scales. They will learn about the freezing and boiling points of water on these two scales.

b. Data processing. After collecting data from the experiment, students can compare the temperature results on both scales and calculate the differences. They can understand the concept of conversion between Celsius and Fahrenheit.

c. Cooling principle. Students will understand the basic principles of cooling and temperature changes. It involves physics concepts such as heat transfer and phase changes from ice to water.

The technological content created is,

a. Use of a digital thermometer. Students will learn how to use a digital thermometer to measure temperature quickly and accurately. This can teach them about the technology used in modern measurement tools.

b. Use of a scientific calculator. Students will learn how to use a scientific calculator to perform temperature calculations and conversions between the Celsius and Fahrenheit scales. This involves understanding the functions contained in a scientific calculator.

c. Air conditioning design. Students will design an air conditioning device using improvised tools such as a fan and ice cubes. This involves understanding simple technology to create cooling solutions.

The engineering content in this module is,

a. Experimental development. Students can understand how to plan and develop experiments.

b. Solution to problem. Students will be faced with challenges in designing cooling solutions and will need to address issues such as the effectiveness and efficiency of their homemade air conditioning devices.

c. Continuous improvement. After carrying out experiments, students can reflect on how they can improve the design and performance of their homemade air conditioning equipment. It integrates sustainable engineering concepts.

The main content is mathematical content containing,

a. Understanding conversion equations. Students need to understand the mathematical equations that relate temperatures on the Celsius and Fahrenheit scales. This involves understanding a linear equation (i.e. $y = mx + b$) where the temperature in one scale is a linear function of the temperature in the other scale.

b. Concept of function and inverse function. Students can understand the basic concepts of function and how a value on one scale can be related to a value on another scale through a conversion function/inverse function.

c. Extrapolation and interpolation. When students calibrate a thermometer or create a conversion function model, they may need to use the concepts of extrapolation (extending data beyond the observed range) and interpolation (estimating values between existing data) to obtain accurate results)

d. Chart analysis. If students are to create a graph that depicts the relationship between temperature on both scales, they need to understand how to read and analyze the graph, including a linear regression line if used.

After determining the learning content, then create learning steps. This STEM-based learning uses the Engineering Design Process (EDP) model approach. Jolly (in Argianti & Andayani, 2021) states the EDP steps as follows: 1) determine the problem; 2) research the problem; 3) plan the best solution; 4) create a prototype; 5) test and evaluate prototypes; 6) communicate solutions; and 7) redesign to improve the prototype as needed. The learning steps that the researcher created were based on the EDP steps.

After the teaching module has been created, the next step is to create an LKPD that is in accordance with the EDP steps. Before being applied in the classroom, teaching modules and LKPD are carried out for construct validity and content validity. This validity is carried out to determine the suitability of the teaching modules and LKPD. Based on contruct validity and content validity, it was stated that the teaching modules and LKPD were suitable for use in learning. The final action taken was implementing the learning plan. The learning stages were carried out based on the EDP approach.

The first stage of learning is identifying the problem. Before students start identifying problems, researchers conduct conditioning first by conveying the learning objectives and the learning process that will be carried out. In carrying out problem identification, students are divided into several groups, each group consisting of 5-6 people. After initial conditioning, students are given an LKPD containing an article as a learning trigger with the title "Earth's surface temperature will rise by 0.89^{o} Celsius in 2022". In accordance with the big theme that has been designed about global warming, students are asked to fill in the LKPD and answer questions. In the process of identifying this problem, students carry out content differentiated learning. During the observation, students were seen discussing based on the articles provided, some were looking for literature on the internet, and some were looking video sharing platform like Youtube.

Students are given the freedom to search for learning resources in the first stage. In the second stage, students conduct problem research. Students are asked the trigger question "How can we make the indoor environment more comfortable when the air outside is very hot?". Researchers guide students to formulate problems and hypotheses. In class discussions, each group presents

problem formulations and hypotheses from the results of guidance on working on LKPD. One of the groups, even though their hypothesis was not yet perfect, became a joint hypothesis to answer the initial question. The hypothesis put forward is that by doing a special trick with the fan you can produce soft air that can cool the room. Other hypotheses proposed by students include reducing the intensity of air entering the room and saving electricity usage. In this second stage, students have started to dig up information about how air conditioning works and the concept of temperature. At this stage the science content is more dominant.

The next stage is for students to develop possible solutions. At this stage students discuss with their groups to develop a product. In this stage, students carry out differentiated learning that focuses on product differentiation. After discussing in their groups, students share their ideas in front of the class. When their idea makes it possible to make a product, the next stage is building a prototype.

The prototype of a simple air conditioning product to overcome hot indoor temperatures for each group is different because it is part of differentiated learning. Each group may create a model that they believe is effective in cooling the room. Two groups built coolers from mineral water bottles and large room fans. The other four groups used plastic or tin containers with the help of a small fan as a tool for air circulation. In the process of building this prototype the engineering content becomes the dominant content. In this stage, students use simple tools to build the prototype using ice as the basic material.

The next process when the prototype is finished is testing and evaluation. To test the effectiveness of this tool, two thermometers are used at once to determine the decrease in room temperature every two minutes. At this trial stage, integrating technology content in solving problems becomes the main content. The working principle of a thermometer in seeing a decrease in room temperature has become new knowledge, including calibrating the temperature difference between two different scales. At this stage the performance of the tools made will also be evaluated.

The results of the product trial evaluation made by group five showed a decrease in room temperature. The results of other groups also showed a decrease in temperature. To find out the relationship between values on the Fahrenheit scale and values on the Celsius scale, a scientific calculator is used. The use of technology in learning is a necessity for learning with a STEM approach. From the results of the group experiment, it was found that the relationship between Fahrenheit and Celsius is $F = 1.8\ C + 34$. According to the literature, to convert Celsius to Fahrenheit, it is $F = 1.8\ C + 32$. Differences in experimental results and literature can be caused by the accuracy of recording the results or accuracy and incorrect calibration of the tool. After the results of the experiment are known, the mathematical content at the end acts as a reinforcement for learning and a more dominant focus of learning.

Learning inverse functions is like converting one variable to another variable. Students are asked to find out how to convert Fahrenheit to Celsius. When it is understood, students are given contextual questions on the LKPD. Students are asked to model these contextual problems in functional form. In addition, students are asked to solve mathematical problems presented with the concept of inverse functions.

The final stage of STEM learning with the EDP process is communicating solutions and redesigning. Each group was asked to present the results of testing the products they made. Following the completion of their respective prototypes, each group is tasked with presenting the outcomes of their product testing. This presentation serves as a platform for learners to articulate the effectiveness of their creations, elucidating the strengths and potential areas for improvement. The communicative aspect underscores the importance of effective expression

and demonstration, fostering the development of presentation skills within a collaborative learning environment.

4. Reflection (“Refleksi”)

Best practice results show that STEM-based differentiated learning can improve students' learning outcomes and self-efficacy. A total of 28 students or 87.5% of the total students completed and met the criteria for completing the learning objectives. On average, four of them still haven't finished. From the results of observations, students are still reluctant to work together in groups and still do not participate in solving LKPD, especially regarding solving inverse function problems.

Table 2. Results of the learning outcome

Category	Number of students
Passed	28
Not passed	4

Self-efficacy based on the results of the questionnaire, on average is at the confident level. This means that after students receive STEM-based differentiated mathematics learning, their self-confidence in their ability to solve mathematical problems is high. This self-efficacy can be seen when students explain the concept of the product they will make, communicate the results of the product, and are able to complete the worksheet on inverse functions with confidence. From the results of the questionnaire, there were even three people who felt very confident in their ability to solve mathematical problems.

Table 3. Student self-efficacy

Category	Number of students
Very confident	3
Confident	25
Less confident	4

In the learning process, there is visible differentiation of content and process. Content differentiation in the problem identification process and product differentiation in building and prototyping. Students' activeness can be seen when presenting ideas in front of the class, making products and testing the results of their products. With learning that elaborates on science, technology, engineering and mathematics, students receive meaningful learning and are able to strengthen their understanding of mathematical concepts.

Discussions

Researchers feel more motivated to provide learning that focuses on students. Researchers realize that an initial assessment is important to determine initial abilities and provide appropriate learning. The individual differences of each student require us to carry out differentiated learning. Researchers feel proud of the students who actively carried out learning and succeeded in solving the solutions provided even though they used simple tools. The right learning model can solve the problems or situations faced. Researchers feel that the challenges can be resolved with the support of all parties. The actions carried out were maximal and had an impact on students.

Firmansyah (2015) stated that learning strategies have a significant effect on learning outcomes. One effort that can be made to improve learning outcomes and student self-efficacy is differentiated learning. Research conducted by Kamal (2021) shows that the application of

differentiated learning can improve students' mathematics learning activities and outcomes. Other research conducted by Syarifuddin & Nurmi (2022) shows that the application of differentiated learning to mathematics subjects can improve student learning outcomes according to the students' abilities and using varied material development.

Muslimin et al., (2022) stated that the application of differentiated learning with a problem based learning model approach is able to optimize learning activities and student learning outcomes. The application of differentiated learning can improve students' mathematical creative thinking abilities (Astria & Kusuma, 2023). STEM-based learning is problem-based learning and requires students to solve these problems creatively. Other research shows that the project based learning model based on the STEM approach has an effect on creative thinking abilities and mathematics learning outcomes (Widana & Septiari, 2021). Apart from that, STEM-based learning allows students to carry out differentiated learning. With STEM learning, students can create prototypes for solving various problems.

STEM, which stands for Science, Technology, Engineering, and Mathematics, is a learning approach that integrates four fields of science, namely science, technology, engineering, and mathematics with problem solving processes in everyday life (Susanti & Kurniawan, 2020). The integration of STEM in mathematics learning has a tendency to improve 21st century mathematics competence, especially critical thinking and problem solving abilities (Saputri & Herman, 2022). Other research shows that using the TAPPS learning strategy with a STEM approach can increase students' activities and learning outcomes (Yanni, 2018). Nur Chalim et al., (2019) stated that STEM-based project based learning can increase self-efficacy. STEM-based differentiated mathematics learning can improve students' learning outcomes and self-efficacy.

The research results confirm that the chosen learning strategy has a significant effect on students' mathematics learning activities and outcomes. The integration of STEM in mathematics learning shows great potential in improving 21st century competencies, especially in problem solving abilities. Thus, differentiated learning approaches, especially those integrated with STEM, not only enrich students' learning experiences, but also help improve learning outcomes and self-efficacy.

CONCLUSION

Best practice is an educator's effort to carry out the best learning to improve the competence of their students. Differentiated learning is one way to implement student-centered learning. The results of the initial assessment are used as a reference for learning planning that adapts to learning styles and learning readiness. STEM-based differentiated mathematics learning can be used to improve students' learning outcomes and self-efficacy.

Researcher recommend that educators embrace differentiated learning strategies, customizing their approaches to accommodate the diverse needs, learning profiles, interests, and talents of their students. The significance of comprehending student characteristics, encompassing learning styles, thinking abilities, and social interactions, especially in the implementation of student-centered learning. Additionally, educators should prioritize aligning learning objectives with the curriculum, ensuring relevance and engagement.

REFERENCES

Andini, D. W. (2016). “Differentiated Instruction”: Solusi Pembelajaran Dalam Keberagaman Siswa Di Kelas Inklusif. *Trihayu: Jurnal Pendidikan Ke-SD-An*, *2*(3), 340–349.

Aprima, D., & Sari, S. (2022). Analisis Penerapan Pembelajaran Berdiferensiasi Dalam Implementasi Kurikulum Merdeka Pada Pelajaran Matematika SD. *Cendikia : Media Jurnal Ilmiah Pendidikan*, *13*(1), 95–101.

Argianti, A., & Andayani, S. (2021). Keefektifan pendekatan STEM berbantuan Wolfram Alpha pada pembelajaran matematika ditinjau dari motivasi dan kemandirian belajar. *Jurnal Riset Pendidikan Matematika*, *8*(2), 217–230. https://doi.org/10.21831/jrpm.v8i2.35263

Astria, R. T., & Kusuma, A. B. (2023). Analisis Pembelajaran Berdiferensiasi Untuk Meningkatkan Kemampuan Berpikir Kreatif Matematis. *Proximal: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *6*(2), 112–119. https://doi.org/10.30605/proximal.v5i2.2647

Dewi, B. A. K., Caswita, C., & Widya, W. (2017). Pengaruh Guided Discovery Learning Terhadap Pemecahan Masalah Matematis dan Self-Efficacy Siswa. *Jurnal Pendidikan MIPA*, *18*(2), 13–25. https://doi.org/10.23960/jpmipa/v18i2.pp13-25

Egok, A. S. (2016). Kemampuan Berpikir Kritis Dan Kemandirian Belajar Dengan Hasil Belajar Matematika. *Jurnal Pendidikan Dasar*, *7*(2), 186–199.

Evendi, H., Rosida, Y., Zularfan, D., & Negeri, S. (2023). Pembelajaran Berdiferensiasi dalam Pembelajaran Matematika di Kurikulum Merdeka SMPN 4 Kragilan. *Jurnal Pengabdian Masyarakat*, *2*(2).

Fajri, H. N., Johar, R., & Ikhsan, M. (2017). Peningkatan Kemampuan Spasial dan Self-Efficacy Siswa Melalui Model Discovery Learning Berbasis Multimedia. *Beta Jurnal Tadris Matematika*, *9*(2), 180. https://doi.org/10.20414/betajtm.v9i2.14

Firmansyah, D. (2015). Pengaruh Strategi Pembelajaran Dan Minat Belajar Terhadap Hasil Belajar Matematika. *JURNAL PENDIDIKAN UNSIKA*, *3*(1), 34–44.

Gusteti, M. U., & Neviyarni. (2022). Pembelajaran Berdiferensiasi Pada Pembelajaran Matematika Di Kurikulum Merdeka. *Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, *3*(3), 636–646. https://doi.org/10.46306/lb.v3i3

Indirwan, Suarni, W., & Priyatmo, D. (2021). Pentingnya Self-Efficacy Terhadap Prestasi Belajar Matematika. *Jurnal Sublimapsi*, *2*(1), 61–70.

Kamal, S. (2021). Implementasi Pembelajaran Berdiferensiasi Dalam Upaya Meningkatkan Aktivitas Dan Hasil Belajar Matematika Siswa Kelas XI MIPA SMA Negeri 8 Barabai. *Julak: Jurnal Pembelajaran Dan Pendidik*, *1*(1), 89–100.

Magdalena, I., Yoranda, D. O., Savira, D., Billah, S., Guru, P., Dasar, S., & Keguruan, F. (2021). Pentingnya Memahami Karakteristik Siswa Sekolah Dasar Di SDN Sudimara 5 Ciledug. *Desember*, *3*(2), 50–59.

Mufidah. (2021). Studi Perbandingan Sistem Pendidikan Dasar di Indonesia dan Finlandia. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(3), 1146–1156. https://doi.org/10.31004/obsesi.v6i3.1696

Muslimin, Hirza, B., Septra Nery, R., Elfira Yuliani, R., Heru, Supriadi, A., Desvitasari, T., & Khairani, N. (2022). Peningkatan Hasil Belajar Matematika Siswa Melalui Pembelajaran Berdiferensiasi dalam Mewujudkan Merdeka Belajar. *Jurnal Pendidikan Matematika RAFA*, *8*(2), 22–32. http://jurnal.radenfatah.ac.id/index.php/jpmrafa

Nur Chalim, M., Mariani, S., & Wijayanti, K. (2019). Kemampuan Komunikasi Matematis Siswa SMK Ditinjau dari Self Efficacy pada Setting Pembelajaran Project Based Learning Terintegrasi STEM. *PRISMA: Prosiding Seminar Nasional Matematika*, *2*, 540–550. https://journal.unnes.ac.id/sju/index.php/prisma/

Ratnawati, Z., Ulya, H., Ratri Rahayu, dan, & Keguruan dan Ilmu Pendidikan, F. (2022). *Pengaruh Model Discovery Learning Berbantuan Aplikasi Android Terhadap Kemampuan Komunikasi Matematis Dan Self Efficacy Siswa*.

Saputri, V., & Herman, T. (2022). Integrasi STEM Dalam Pembelajaran Matematika: Dampak Terhadap Kompetensi Matematika Abad 21. *Journal Pembelajaran Matematika Inovatif*, *5*(1), 247–260. https://doi.org/10.22460/jpmi.v5i1.247-260

Sari, N., Syarif Sumantri, M., & G Bachtiar, I. (2018). The Development of Science Teaching Materials Based on STEM to Increase Science Literacy Ability of Elementary School Students. *International Journal of Advances in Scientific Research and Engineering*, *4*(7), 161–168. https://doi.org/10.31695/ijasre.2018.32808

Suryani, E. (2017). *Best practice: Pembelajaran inovasi melalui model project based learning*. Deepublish.

Susanti, E., & Kurniawan, H. (2020). Design Pembelajaran Matematika Dengan Pendekatan STEM (Science, Technology, Engineering, Mathematics). *AKSIOMA: Jurnal Matematika Dan Pendidikan Matematika*, *11*, 37–52.

Suwartiningsih, S. (2021). Penerapan Pembelajaran Berdiferensiasi untuk Meningkatkan Hasil Belajar Siswa pada Mata Pelajaran IPA Pokok Bahasan Tanah dan Keberlangsungan Kehidupan di Kelas IXb Semester Genap SMPN 4 Monta Tahun Pelajaran 2020/2021. *Jurnal Pendidikan Dan Pembelajaran Indonesia (JPPI)*, *1*(2), 80–94. https://doi.org/10.53299/jppi.v1i2.39

Syarifuddin, S., & Nurmi, N. (2022). Pembelajaran Berdiferensiasi dalam Meningkatkan Hasil Belajar Matematika Siswa Kelas IX Semester Genap SMP Negeri 1 Wera Tahun Pelajaran 2021/2022. *JagoMIPA: Jurnal Pendidikan Matematika Dan IPA*, *2*(2), 35–44. https://doi.org/10.53299/jagomipa.v2i2.184

Widana, I. W., & Septiari, K. L. (2021). Kemampuan Berpikir Kreatif dan Hasil Belajar Matematika Siswa Menggunakan Model Pembelajaran Project-Based Learning Berbasis Pendekatan STEM. *Jurnal Elemen*, *7*(1), 209–220. https://doi.org/10.29408/jel.v7i1.3031

Yanni, M. H. (2018). Meningkatkan Aktivitas dan Hasil Belajar Matematika Melalui Strategi Pembelajaran TAPPS Berbasis Pendekatan (STEM). *Jurnal Pendidikan Matematika (JUDIKA EDUCATION)*, *1*(2), 117–125. https://doi.org/10.31539/judika.v1i2.373