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# Analysis of students' algebra learning motivation through the use of desmos and amplify classroom

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**Abstract**

Learning motivation is a crucial factor in the success of mathematics education, a field that requires strong analytical skills and persistence. However, based on preliminary observations, students tend to exhibit low learning motivation when encountering algebraic materials, which are often abstract and theoretical. Due to this, the present study aimed to evaluate students' learning motivation after using interactive digital learning tools (Desmos and Amplify Classroom) in algebra. Using a descriptive quantitative approach, this study focused on Grade IX students of SMA Harapan in Bangka Regency. A learning motivation questionnaire consisting of 15 items was used, based on five motivational indicators: learning drive, attention, perseverance, diligence, and the desire to succeed. The data were descriptively analyzed by calculating the mean scores and categorizing the students' motivation levels. The results indicate that students' learning motivation, in general, fell into the moderate category, with a mean score of 2.79. Each indicator recorded results in the mild category, with the highest score of 2.91 for perseverance in completing tasks and the lowest score of 2.67 for the desire to succeed. The results suggest that the use of Desmos and Amplify Classroom had a positive impact on students' motivation to learn, particularly in the interest and engagement dimension, through the interactive algebraic graph visualizations. However, the effect had not yet reached a high level. The integration of interactive digital media for the first time in this study helps develop a more positively impactful approach to teaching mathematics by increasing students' motivation and deepening their engagement in the exploration phase of their learning.

**Keywords:** algebra; amplify classroom; desmos; learning motivation

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## INTRODUCTION

The technology we use today increasingly shapes our lives and makes us more dependent on digital systems. The use of various digital technologies has made learning experiences more flexible. Technologies such as computers, laptops, LCD projectors, and mobile phones serve as complementary tools that support the learning process (Suhaifi et al., 2022). Learning is no longer confined to the four walls of the classroom, nor is it as rigidly structured as it was before. Educational activities and interactions are becoming increasingly digital, making learning more flexible and global. This reflects a paradigm

shift from conventional learning toward more interactive, digitally based approaches (Buchori, 2019; Parinata, 2021). Undoubtedly, educational technology creates new opportunities for more effective learning.

Advances in technology have influenced nearly every foundational discipline, including mathematics education. Beyond calculation, mathematics plays a critical role in fostering logical, necessary, and systematic thinking (Nasikhah et al., 2022). In the 21st century, mathematics learning requires students to be active and participatory to develop critical thinking skills (Rosidi et al., 2022). However, many students still face difficulties in mathematics learning and learning in general, resulting in low learning outcomes due to challenges in engaging with abstract conceptual material (Farhan et al., 2022). This condition indicates the need for innovative instructional strategies to create engaging learning experiences that can enhance students' motivation.

Learning motivation has a profound impact on students' academic performance. Students with higher motivation tend to be more actively engaged in learning activities and achieve better learning outcomes, demonstrating a positive relationship between learning motivation and academic achievement (Kharis, 2020).

Higher motivation also serves as a foundation for improved learning performance (Hikmah & Saputra, 2020; Nurrawi et al., 2023). Therefore, teachers are required to adopt more varied, engaging, and motivating learning strategies and tools. One of the interactive digital tools commonly used in mathematics learning is Desmos. This application has been demonstrated to enhance students' understanding of mathematical topics, such as algebra, and increase learning motivation (Jabnabillah & Reza, 2022).

Desmos is a web-based mathematics learning platform equipped with an integrated graphing calculator, interactive tables, and geometric tools for digital instruction (Mustaqim, 2020; Zamzam, 2022). It helps students visualize abstract mathematical concepts such as functions and systems of equations, making these concepts more engaging and easier to understand. Previous studies have demonstrated that students' learning outcomes in linear programming and trigonometry improved with the use of Desmos (Haerunnisa et al., 2021; Isroil et al., 2021), supporting findings that interactive visual media enhance students' understanding of mathematical representations (Andini & Marlina, 2021).

In addition to improving learning outcomes, Desmos also enhances students' mathematical communication skills. According to Vygotsky's theory, students learn most effectively when guided within their zone of proximal development (Rahmawati & Purwaningrum, 2022). Desmos provides an exploratory framework that encourages interaction, collaboration, and communication of mathematical insights. The National Council of Teachers of Mathematics (NCTM) states that mathematical communication involves explaining concepts, using symbols and visual representations, and logically discussing solutions (Nurhayanti et al., 2022). Thus, the use of Desmos supports both conceptual understanding and mathematical communication.

Observations in several schools indicate persistent difficulties in understanding and communicating mathematical concepts. Data from the Trends in International Mathematics and Science Study (TIMSS) 2015 revealed that Indonesia's average mathematics score was categorized as low. This condition is primarily attributed to the dominance of conventional teaching methods, where teachers rely heavily on lectures rather than interactive digital media, resulting in suboptimal motivation and learning outcomes.

Numerous studies have shown that visual learning technologies, such as Desmos, have a beneficial impact on mathematics learning. For instance, the implementation of the Desmos application has been shown to enhance high school students' comprehension of function concepts and their engagement in learning through interactive graphical visualizations, which facilitate the connection between theoretical frameworks and the application of abstract concepts (Mirunnisa & Razi, 2025). Additionally, a descriptive quantitative study has reported that Desmos not only bolsters conceptual understanding but also significantly enhances student motivation and engagement in mathematics learning (Hakim et al., 2025). A further systematic literature review has concluded that the Desmos application is endorsed for mathematics education due to its advantageous effects on learning outcomes and processes (Tumanggor & Yahfizham, 2024).

Nevertheless, the majority of these studies concentrate on the enhancement of conceptual understanding and overall engagement, while the investigation of learning motivation, encompassing the drive to learn, persistence on tasks, and attention to material, remains underexplored and has not been thoroughly examined, particularly in

the context of integrating Desmos with a classroom management platform such as Amplify Classroom, especially concerning algebraic topics. This gap highlights the need for further research that not only assesses the visual and cognitive benefits of Desmos but also evaluates more nuanced aspects of learning motivation and its implications for the quality of students' sustained engagement in digital mathematics instruction.

The application of Desmos empowers students to independently construct concepts, thereby demonstrating its efficacy as a learning tool. This study aims to analyze the level of student motivation to learn algebra through the utilization of Desmos and Amplify Classroom interactive media.

## METHODS

This study measured learning motivation quantitatively using a Likert-scale questionnaire developed based on five indicators of learning motivation: (1) learning drive and needs, (2) attention and interest in tasks, (3) perseverance in completing tasks, (4) resilience in facing difficulties, and (5) desire and willingness to succeed. Several positively worded statements represented each indicator. Students' responses were scored on a scale of 1 to 5, ranging from "strongly disagree" (1) to "strongly agree" (5). Learning motivation scores were obtained by summing the scores of all items for each respondent, followed by calculating mean scores at both the indicator and overall levels.

Data analysis employed descriptive statistical techniques, including the calculation of mean scores, percentages, and categorization of motivation levels. The mean values were interpreted in accordance with predefined criteria for low, moderate, and high motivation levels. This approach aligns with descriptive quantitative analysis, which aims to provide a factual and systematic description of the variables studied without testing causal hypotheses (Arikunto, 2019; Riduwan, 2020). Thus, the results of the quantitative calculations in this study provide an empirical illustration of the degree of student learning motivation following the use of Desmos and Amplify Classroom in the context of algebra education.

Conceptually, the motivational indicators used in this study are based on learning motivation theory, which posits that learning motivation can be identified through aspects such as internal drive, task attention, perseverance, resilience in the face of difficulties, and the desire to achieve success (Uno, 2023). Therefore, the quantitative calculations conducted are not merely numerical in nature, but also represent the psychological

conditions and learning behaviors of students during technology-assisted mathematics learning.

The research was conducted at SMA Harapan, located in Bangka Regency, Bangka Belitung Islands Province. The research subjects consisted of Grade IX students in the first (odd) semester of the 2024/2025 academic year. The research activities included instrument preparation, teaching using Desmos and Amplify Classroom, administering a learning motivation questionnaire, and data analysis. The research sample was determined using a total sampling technique, in which all members of the population were included as research participants. This approach was adopted due to the small and homogeneous nature of the population. Additionally, all participants received the same instructional treatment, utilizing Desmos and Amplify Classroom. Therefore, all respondents were positioned equally to provide accurate data regarding their levels of learning motivation.

The primary instrument used in this study was a learning motivation questionnaire related to algebraic content, consisting of five indicators of learning motivation, namely: learning drive and needs, attention and interest in tasks, perseverance in completing tasks, resilience in facing difficulties, and the desire and willingness to succeed (Uno, 2023). The questionnaire comprised 15 statements developed in relation to the use of Desmos and Amplify Classroom. Respondents rated each statement using a five-point Likert scale, where "1" indicated strongly disagree and "5" indicated strongly agree.

The data collection process was carried out in two stages. First, data were collected through interactive learning activities involving the use of Desmos and Amplify Classroom by students over several instructional sessions to support their understanding of algebraic concepts. Second, data were collected through a questionnaire administered after students had completed the series of learning activities. The questionnaire responses were collected offline using printed forms. In addition to the questionnaire, the researcher conducted brief classroom observations and informal interviews with several students to gather further information about their learning experiences. These data were intended to provide rational support for the narrative description of the research findings.

The learning motivation questionnaire underwent validity and reliability testing, which indicated that the instrument demonstrated acceptable consistency and accuracy in

measuring students' learning motivation. Instrument validity was examined through content validity, utilizing expert judgment from mathematics education lecturers and experienced teachers to ensure alignment between the questionnaire items and the learning motivation indicators. Empirical validity was tested using the Pearson product–moment correlation between individual item scores and total scores. The results showed that all items had correlation coefficients greater than the critical value at a 0.05 significance level, indicating that all items were valid and suitable for use.

Instrument reliability was assessed using Cronbach's Alpha coefficient to determine the internal consistency of the questionnaire. The results indicated that the Cronbach's Alpha value fell within the reliable category ($\alpha > 0.70$), signifying that the instrument had good and stable internal consistency in measuring students' learning motivation.

In addition, data validity was strengthened through methodological triangulation by comparing questionnaire results with findings from classroom observations and informal interviews. This comparison demonstrated consistency between the quantitative data and students' learning experiences, thereby indicating that the measurement results of learning motivation were sufficiently accurate and reliable.

Data collected through the questionnaire were analyzed using descriptive quantitative analysis. Each statement was scored on a scale of 1 to 5 based on the responses provided by the respondents. Subsequently, the mean score for each indicator was calculated using the formula. $\bar{x} = \frac{\sum x_i}{n}$, where $\bar{x}$ Represent the mean score, $\sum x_i$ Is the sum of individual scores, and n denotes the number of respondents. The mean scores were then interpreted in relation to the assessment categories presented in Table 1.

**Table 1.** Range of scores and categories of learning motivation

| No. | Score Range | Category |
|---|---|---|
| 1 | 1,00 – 2,33 | Low |
| 2 | 2,34 – 3,66 | Moderate |
| 3 | 3,67 – 5,00 | High |

## RESULTS AND DISCUSSION

This study aimed to investigate the impact of using Desmos and Amplify Classroom on students' motivation to learn algebra. The following are several examples of Desmos interfaces used by students during algebra learning activities,

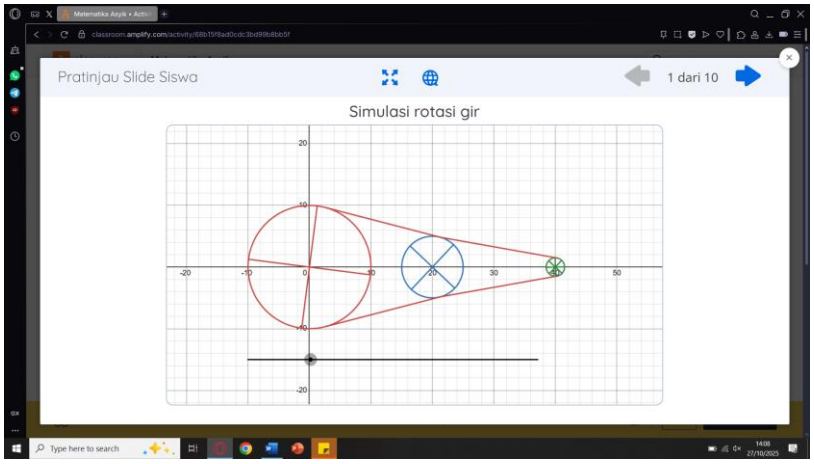


**Figure 1.** Gear rotation simulation

Figure 1 illustrates a simulation of the rotation of two gears connected by a drive belt. This rotational motion demonstrates a linear relationship between the angular velocities of the two gears. The visualization serves as an introduction to how the concept of a straight line can be used to represent a proportional relationship between two quantities. Subsequently, students are prompted with a guiding question, "Have you learned about straight lines before?", which aims to activate their prior knowledge of linear equations. Through this process, students are encouraged to recall the general form of a linear equation, $y = mx + c$, and to understand how the slope (gradient) and the intercept influence the shape of the graph.

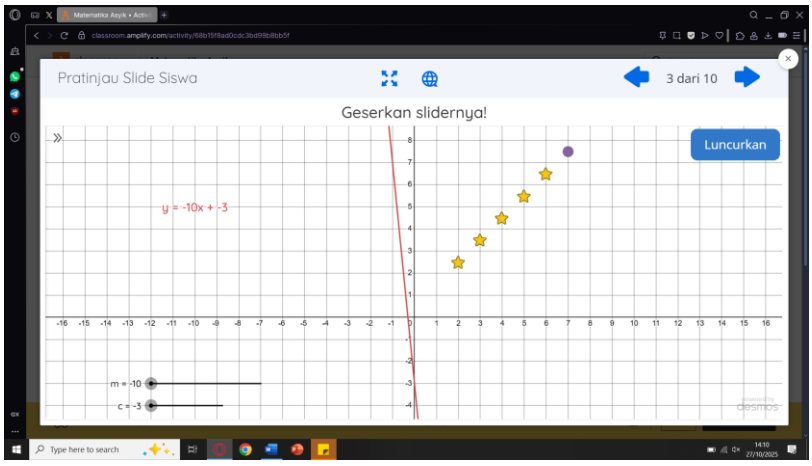


**Figure 2.** Interactive graph of $y = 10x - 3$

Figure 2 presents an interactive graph of the linear equation $y = 10x - 3$. By adjusting the slider to capture all the stars, students engage in an interactive experience

that allows them to observe changes in the position and slope of the line as the values of the gradient and the constant vary. This activity is designed to provide a visual understanding of the concept of a straight line. Subsequently, students are introduced to additional information through the prompt, "Did you know that, besides linear equations, this can also be created?" This serves to connect the discussion to a new concept: quadratic equations (parabolas). Through this transition, students are expected to recognize that not all relationships between variables are linear, as some functions produce straight lines while others generate curved graphs.

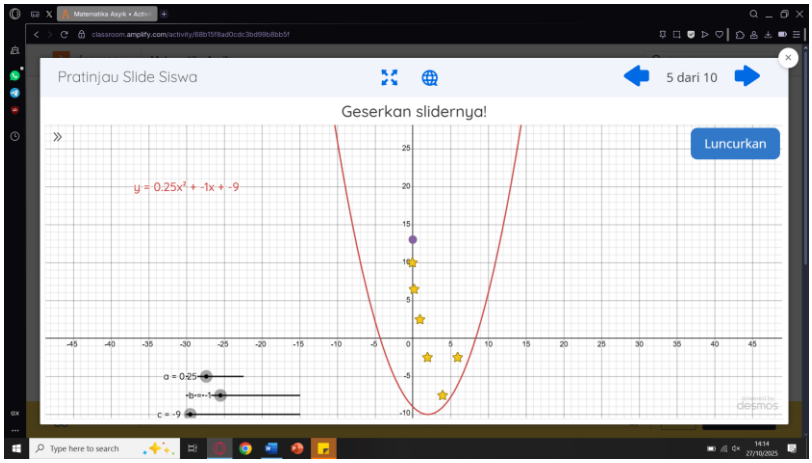


**Figure 3.** Interactive graph of $y = 0{,}25x^2 + bx + c$

Figure 3 presents a parabolic graph with the general form $y = 0{,}25x^2 + bx + c$. Students can adjust the sliders to capture all the stars, allowing them to change the coefficient values and observe how the shape of the parabola changes—whether it opens upward or downward and whether it becomes wider or narrower. This activity helps develop students' intuitive understanding of the influence of coefficients on quadratic equations.

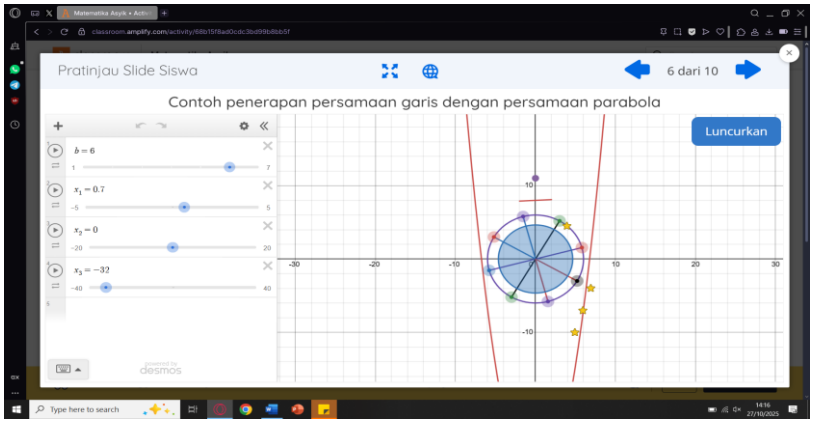


**Figure 4.** Example of a game implementing linear and parabolic equations

Figure 4 presents a rotating gear graph that functions as an obstacle in the game, along with a parabolic curve that serves as a net for the launched balls to capture the stars within the game. Students can adjust the sliders to deflect the balls appropriately and capture the stars during gameplay.

The primary focus of this study was directed toward five indicators of learning motivation, namely: (1) learning drive and needs, (2) attention and interest in tasks, (3) perseverance in completing tasks, (4) resilience in facing difficulties, and (5) the desire and willingness to succeed. Each indicator was represented by three statement items, using a five-point Likert scale that ranged from "strongly disagree" to "strongly agree." The data obtained were processed to generate mean scores for each indicator. The results of the analysis are presented in Table 2.

**Table 2.** Mean scores of students' algebra learning motivation using Desmos and Amplify Classroom

| No. | Learning Motivation Indicator | Item Numbers | Mean Score | Category |
|---|---|---|---|---|
| 1 | Learning drive and needs | 1-3 | 2,88 | Moderate |
| 2 | Attention and interest in tasks | 4-6 | 2,75 | Moderate |
| 3 | Perseverance in completing tasks | 7-9 | 2,91 | Moderate |
| 4 | Resilience in facing difficulties | 10-12 | 2,72 | Moderate |
| 5 | Desire and willingness to succeed | 13-15 | 2,67 | Moderate |
| | | Overall mean | 2,79 | Moderate |

Overall, the mean motivation score indicates that students' learning motivation was in the moderate category (mean = 2.79). This finding suggests that the use of Desmos and Amplify Classroom had a positive effect on students' learning motivation, although the impact had not yet reached a high level. Students appeared interested and engaged in the learning process; however, their motivation to study algebra in a deep and conceptual manner had not yet been fully optimized.

This condition reflects the general characteristics of students in the digital era, who tend to appreciate the interactive engagement offered by digital technology but have not yet fully utilized it strategically to deepen conceptual understanding. In the context of

algebra learning, visualization indeed helps students understand the relationship between equations and their graphical representations. However, without adequate teacher guidance to foster strong conceptual understanding, students' engagement may decline over time.

**Indicator 1: Learning Drive and Needs**

Learning drive and needs refer to students' intrinsic motivation to learn, their perceived learning needs, and the goals underlying learning activities. The mean score of 2.88, which falls into the moderate category, indicates that some students possess a sufficient level of learning drive; however, it is not yet strong enough to exert a dominant influence on their learning behavior.

In the context of using Desmos, students appeared to enjoy the graphical displays that illustrate the relationship between algebraic equations and their graphical representations, as the dynamic and interactive visualizations effectively captured their attention and provided an engaging learning experience. Nevertheless, this interest had not fully developed into a desire to understand the underlying mathematical principles of the graphs in depth. This is because students' attention tended to focus on the instantly displayed visual outcomes rather than on the mathematical reasoning processes that underpin them. Furthermore, the use of Desmos, which was mainly guided and followed pre-designed simulations, limited opportunities for independent exploration and interpretation. As a result, students functioned more as observers than as active constructors of mathematical concepts. Limited prior experience in interpreting graphs and low confidence in abstract thinking also contributed to the failure of visual interest to transform into intrinsic motivation for understanding the conceptual relationship between algebraic equations and their graphical representations.

Statements such as "I am quite interested in learning algebra after trying the Desmos features" suggest that the visual stimuli provided were insufficient to foster conceptual curiosity fully. According to Self-Determination Theory, motivation emerges when individuals experience three core psychological needs: autonomy, competence, and relatedness (Deci & Ryan, 2000). In this context, Desmos and Amplify Classroom support visual competence; however, learning autonomy remains limited because students primarily follow existing simulations rather than creating or interpreting graphs independently. Yet, learning autonomy requires active engagement and freedom in

constructing knowledge (Deci & Ryan, 2000; Duval, 2006). Consequently, authentic learning needs have not fully emerged and are replaced by mere interest in the instructional media. Therefore, teachers are encouraged to design tasks that require independent exploration, such as asking students to construct contextual graph models based on their own discoveries, so that awareness of learning needs can develop naturally.

**Indicator 2: Attention and Interest in Tasks**

The second indicator relates to the extent to which students can focus their attention on algebraic tasks after using Desmos and Amplify Classroom. The mean score of 2.75, which falls within the moderate category, indicates a moderate level of student interest and attention.

Some students expressed appreciation for the dynamic visual display of moving graphs, as it helped them understand the shapes of curves and functions. However, others reported feeling distracted by the large number of available features, which in turn reduced their focus on the learning tasks.

According to Cognitive Load Theory, excessive visual information can hinder deep learning processes because the human working memory has a limited capacity (Sweller, 1994). In the context of using Desmos, instructional materials should be designed with simple, well-structured, and focused instructions that align with students' cognitive capacities to optimize learning outcomes.

**Indicator 3: Perseverance in Completing Tasks**

The third indicator reflects the extent to which students demonstrate perseverance in completing algebraic tasks using Desmos and Amplify Classroom. This indicator obtained the highest mean score, namely 2.91, which nonetheless remains within the moderate category. This finding suggests that students demonstrated a relatively high level of perseverance, particularly because the platform facilitated their understanding of problem-solving steps.

Several students reported feeling more enthusiastic because Desmos provides instant feedback and displays graphical results immediately after equations are entered. However, this condition also created a tendency for students to focus primarily on the

final graphical outcomes rather than on understanding the processes of graph construction and transformation.

Students often demonstrate behavioral engagement in learning activities without fully grasping the cognitive understanding. According to Expectancy Value Theory, individuals are more likely to persist when they believe they can succeed and perceive the task as valuable (Eccles & Wigfield, 2002). Based on this theory, when students recognize the relevance of learning tasks to their real-life experiences, their level of perseverance tends to increase.

**Indicator 4: Resilience in Facing Difficulties**

Resilience refers to students' ability to persist despite encountering difficulties in understanding concepts or solving problems. The mean score of 2.72 indicates that students' resilience in facing challenges falls within the moderate category. Students were generally willing to continue trying, although their efforts had not yet reached an optimal level.

Many students utilized Desmos as a supporting tool when they experienced difficulties in understanding graphical representations. However, excessive reliance on such visualizations may reduce the development of symbolic and analytical thinking skills. Self-efficacy plays a crucial role in learning persistence (Bandura, 1997). When students can understand graphs visually, their confidence increases; however, as the graphs become more complex, this confidence tends to decline.

**Indicator 5: Desire and Willingness to Succeed**

The final indicator measures the extent to which students demonstrate a willingness to understand the learning material after using digital learning media. The mean score of 2.67 indicates that students' desire and willingness to succeed remain at a moderate level. Some students showed enthusiasm for exploring algebra more deeply after using Desmos; however, others felt sufficiently satisfied simply because they were able to "see moving graphs." This finding suggests that the level of learning achievement remains limited, as students tend to perceive successful visualization as equivalent to conceptual success.

According to Achievement Motivation Theory (McClelland, 1961), the drive to achieve emerges when individuals perceive success as the result of their own efforts rather than luck or external assistance. Excessive dependence on digital media may reduce

students' sense of personal achievement. Therefore, teachers are encouraged to emphasize and reinforce students' learning processes rather than focusing solely on final outcomes, so that intrinsic motivation to achieve success can develop more optimally.

## CONCLUSION

This study aimed to assess students' levels of learning motivation in studying algebra after the implementation of Desmos and Amplify Classroom as instructional media at SMA Harapan, Bangka Regency. The assessment was conducted through quantitative data analysis based on five learning motivation indicators: learning drive and needs, attention and interest in tasks, perseverance in completing tasks, resilience in facing challenges, and the desire and willingness to succeed. The analysis yielded an average score of 2.79 on a 1–5 scale, which was categorized as a moderate level of learning motivation. These findings indicate that the use of Desmos and Amplify Classroom had a positive, moderate impact on students' learning motivation, particularly in enhancing their algebra learning experiences. This result is consistent with learning motivation theory, which posits that motivation can be fostered through meaningful, relevant, and visually engaging learning experiences (Uno, 2023). In this context, Desmos and Amplify Classroom serve as a bridge between theory and instructional practice, helping students understand relational algebraic concepts in a more contextual and applicable manner; however, the level of motivation achieved has not yet reached a high category.

This study also has several limitations, including the absence of long-term observations, reliance on questionnaire-based quantitative data, a limited number of participants drawn from a single class, and the lack of control over other variables such as instructional strategies, students' prior knowledge, and the learning environment. Therefore, future research is recommended to employ a mixed-methods approach, incorporate additional variables such as learning outcomes, creativity, or critical thinking skills, and apply a quasi-experimental design with comparison groups. Such approaches would allow for a more in-depth analysis of the effects of digital learning media on learning motivation, while also strengthening the paradigm of visualization-based and exploratory mathematics learning.

## DECLARATIONS

Author Contribution : EMS: Author, Editor, Data Analyst; ST: Author, Editor, Data Collector; INDY: Author, Editor; RD: Supervisor, Advisor; DY: Supervisor, Advisor; NK: Data Collector.

Conflict of Interest : The authors declare no conflict of interest.

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