SELF-EFFICACY MATHEMATICS EDUCATION STUDENTS IN DIFFERENTIAL CALCULUS COURSES

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Abstract

Self-efficacy is one of the important soft skills for students because it affects success in solving a problem. This study aims to: (1) describe the self-efficacy of Mathematics Education students in the differential calculus course; (2) analyze the effect of the self-efficacy of Mathematics Education students on learning outcomes in the differential calculus course. This research is a survey research with a descriptive quantitative approach. In taking the sample, the researcher used a purposive sampling technique, namely class C differential calculus with a sample of 22 students. The instruments used in this study were test questions and self-efficacy questionnaires. The results showed that in general students self-efficacy was in the moderate category, with details of 18% in the high category (H), 59% in the medium category (M), and 23% in the low category (L). In addition, self-efficacy has a positive effect on student learning outcomes by 57.3%.

Keywords: Self-efficacy, learning outcomes, differential calculus

Introduction

One of the subjects that must be studied by students of the mathematics education study program is calculus. Calculus (Latin: calculus meaning "little stone" for calculating) is a mathematical science that includes limits, derivatives, integrals and infinite series. Almost every level of education includes calculus material (Al Hakim & Setyowisnu, 2021). These materials are studied in different courses, namely: differential calculus, integral calculus and advanced calculus, so that all three are mutually sustainable (Sumargiyani & Nafi, 2020). In differential calculus the material studied is limits, derivatives and their applications. Solving problems related to differential calculus requires accuracy and a good understanding of concepts (Ranti & Budiarti, 2018).

A person's success in learning is not determined by knowledge and technical abilities (hard skills), but also the ability to manage oneself and others (soft skills) (Hendriana et al., 2017). One of the important soft skills to have is self-efficacy (Huang et al., 2020; Martalyna et al., 2018) because it has a positive effect and is a predictor of one's academic achievement (Dzulfikar, 2022; Yuliyani et al., 2017). The concept of self-efficacy is one aspect of self-knowledge proposed by Bandura (Sunarti., Zubaidah R, 2020).

Self-efficacy is a person's perception of his ability to plan and implement his ability to complete tasks (Bandura, 1997). In line with this, according to (Zimmerman, 2000) Self-efficacy is a person's assessment of his own ability to regulate and carry out certain behaviors to achieve certain goals. Then Bandura in Howard (2008) also added that self-efficacy has an important impact, even as the main motivator for one's success. People are more likely to do activities they believe they can do than to do work they feel they cannot (Hardianto et al., 2016).

There are three dimensions to self-efficacy, namely the dimensions of magnitude, strength, and generality (Bandura, 1997). The magnitude dimension relates to a person's belief in the level of difficulty that can be completed, the strength dimension relates to belief in the level of strength or weakness of one's abilities, and the generality dimension relates to the belief in one's ability to master a task under certain conditions. There are four main sources that influence self-efficacy, namely self-success experiences, other people's success experiences, social persuasion, and psychological and affective states (Ahn & Bong, 2019; Huang et al., 2020).

Based on this description, it is important for lecturers to understand well the self-efficacy of their students. Differential calculus is the basic concept so that if students understand at the beginning it will be a reference to determine completeness for other courses and if at the beginning students have difficulty understanding calculus material, it will affect the mastery of calculus material to be studied further (Sumargiyani & Nafi, 2020) . Therefore, this study describes the level of student self-efficacy in learning outcomes of differential calculus. It is hoped that with an understanding of self-efficacy and its sources, it can optimize student learning outcomes in differential calculus courses. In addition, it also analyzed how big the influence of student self-efficacy in learning outcomes of differential calculus.

Method

This study uses survey research with a descriptive quantitative approach, where the researcher tries to describe the phenomena that occur based on data taken from respondents using instruments that have been validated by expert validators. The population of this research is all students of Mathematics Education in semester 2 of the academic year 2021/2022. While the sample in this study were students of class C mathematics in the differential calculus course. The sampling technique used in this research is purposive sampling, which is a method of sampling that is done by selecting subjects based on specific criteria set by the researcher (Novalia & Syazali, 2014). The data collection instruments used in this study were using test questions and self-efficacy questionnaires. The test was used to determine the learning outcomes of differential calculus, while the questionnaire was used to determine the student's self-efficacy. In this study, the development of the self-efficacy scale refers to the dimensions of self-efficacy with a response scale of 0-10 according to the recommendations of previous researchers (Bandura, 2006). Before being used, the self-efficacy scale was validated by two psychologists. Furthermore, the instrument has also been empirically tested for validity and reliability, with a Cronbach score of 0.923.

Analysis with descriptive statistics is used to describe the level of student self-efficacy in differential calculus learning outcomes both as a whole and based on each of its dimensions. In this analysis process, the researcher was assisted by Microsoft Excel and SPSS.

Result and Discussion

This study aims to describe the self-efficacy of Mathematics Education students in the differential calculus course and analyze the effect of the self-efficacy of Mathematics Education students on learning outcomes in the differential calculus course. In analyzing and describing self-efficacy, the author refers to the dimensions developed by Albert Bandura, namely magnitude, strength, and generality (Bandura, 1997). From the student self-efficacy data, calculations and data grouping were carried out using the calculation of

the ideal criteria stated by Manullang (1996) which was based on the ideal average and standard deviation as follows:

Table 1. Categories of Self-Efficacy

Range	Score	Criteria
$\boldsymbol{X \geq \bar{x} + SB}$	X	High (H)
$\boldsymbol{\bar{x} - SB \leq X < \bar{x} + SB}$	X	Medium (M)
$\boldsymbol{X < \bar{x} - SB}$	X	Low (L)

Based on the data processing of the questionnaire results on the Mathematics Education student self-efficacy scale, the minimum score (X_{min}), maximum score (X_{max}), and average score (mean), as shown in table 2 below:

Table 2. Results of the Self-Efficacy Scale

Number of Students	Ideal Score	X_{min}	Category	X_{maks}	Category	Mean	Category
22	201	126	Low	271	High	196.318	Medium

Based on Table 2, it is known that the total self-efficacy of Mathematics Education students in the second semester is in the medium category. The percentages of students in each category of self-efficacy are categorized as follows: 18% in the high category (H), 59% in the medium category (M), and 23% in the low category (L). The data is presented in Figure .

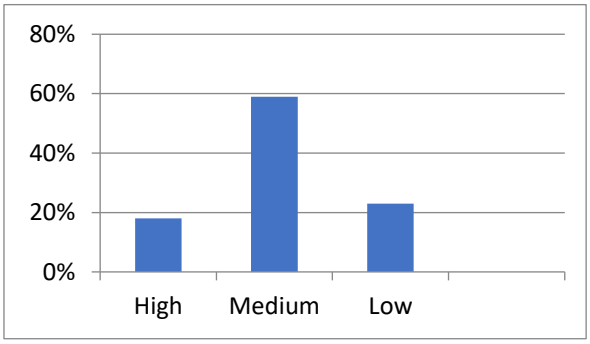

Figure 1. Percentage of Self-Efficacy Questionnaire Results on Each Criterion

These results illustrate that not all students have high self-confidence in solving differential calculus problems. This condition can be seen from the existence of students who are not sure in understanding and mastering the task at hand, so students need to increase their confidence in solving problems in differential calculus (Johanda et al., 2019).

Another thing because in this study students were asked to provide self-assessment or their ability to solve problems in the differential calculus course, where problem solving showed higher complexity and difficulty. Van de Walle, Karp, & Bay-Williams (2020) stated

that problem solving involves challenging questions, the solution strategy is not immediately obtained, and requires effort to solve it. Bandura (1994) and Bandura (2009) state that the more difficult and complex the task at hand, the lower a person will assess his ability.

In this study, the level of student self-efficacy in solving problems in differential calculus courses was also analyzed in terms of three indicators that were used as references to measure self-efficacy, namely magnitude, strength, and generality (Sihaloho, 2018). The magnitude dimension relates to the level of difficulty that individuals believe can be solved. For example, if a person is faced with problems or tasks that are arranged according to a certain level of difficulty, his self-efficacy will fall on easy, medium, and difficult tasks according to the perceived ability limit to meet the behavioral demands needed for each that level. In this dimension, students explore their self-assessment regarding the level of difficulty of the task or problem given by giving a score between 0-10. According to Bandura's (2006) recommendation in exploring one's self-efficacy, the development of a self-efficacy scale emphasizes more on ability, instead of using the diction "will".

Table 3. Results of the Self-Efficacy Scale of Magnitude Dimensions

Number of Students	Ideal Score	X_{min}	Category	X_{maks}	Category	Mean	Category
22	68	43	Low	90	High	68	Medium

Based on Table 3 above, it is known that the total self-efficacy dimension of the magnitude dimension of students is in the medium category. If the percentage of students in each category of self-efficacy is calculated, successively the self-efficacy dimensions of the magnitude of students are categorized as follows: 14% in the high category (H), 63% in the medium category (M), 14% in the low category (L). The percentage of each category is obtained from the quotient of the frequency of students in each category by the total number of students multiplied by 100%.

These findings indicate that students only provide self-assessment regarding the level of difficulty of the task or problem given in the medium category. This is presumably because the task that students face is a problem that poses a challenge for them, which they cannot immediately obtain problem-solving strategies and solutions.

The strength dimension relates to the level of strength or weakness of an individual's beliefs about his or her perceived competence (Sowanto et al., 2019). In other words, this dimension indicates the degree of a person's stability in his beliefs about the difficulty of the task that can be done. This dimension is usually directly related to the magnitude dimension, namely the higher the level of difficulty of the task, the weaker the perceived confidence to complete it. A person with weak self-efficacy is easily defeated by difficult experiences. Meanwhile, people who have strong self-efficacy in competence will maintain their business even though they experience difficulties.

Table 4. Results of the Strength Dimension Self-Efficacy Scale

Number of Students	Ideal Score	X_{min}	Category	X_{maks}	Category	Mean	Category
22	65.5	41	Low	89	High	64.1364	Medium

Based on Table 4 above, it is known that the total self-efficacy dimension of student strength is in the moderate category. If the percentage of students in each self-efficacy category is calculated, successively the self-efficacy dimensions of student strength are categorized as follows: 14% in the high category (H), 68% in the medium category (M), 18% in the low category (L). The percentage of each category is obtained from the quotient of the frequency of students in each category by the total number of students multiplied by 100%.

n this study, the moderate level of self-efficacy dominated the proportion of students' self-efficacy in solving problems in the differential calculus course. Therefore, even though the assignments or problems in the differential calculus course are challenging, students still try and persevere to be able to successfully complete them well.

The generality dimension shows whether self-efficacy beliefs will take place in a particular domain or apply in various activities and situations (Herdwiyanti & Sudaryono, 2012). This dimension relates to the area or level of achievement of a person's success in overcoming or solving problems or tasks under certain conditions (Seman et al., 2017). Researchers generally explore beliefs by asking individuals about the level and strength of their confidence in achieving their goals and their success in a situation.

Table 5. Results of the Self-Efficacy Scale of the Generality Dimension

Number of Students	Ideal Score	X_{min}	Category	X_{maks}	Category	Mean	Category
22	65.5	39	Low	92	High	64.1818	Medium

Based on Table 5 above, it is known that in total the self-efficacy dimension of the generality dimension of students is in the moderate category. If the percentage of students in each category of self-efficacy is calculated, successively the self-efficacy dimensions of generality are categorized as follows: 14% in the high category (H), 63% in the medium category (M), 23% in the low category (L). The percentage of each category is obtained from the quotient of the frequency of students in each category by the total number of students multiplied by 100%. As a branch of mathematics, differential calculus is a mathematical, hierarchical, and structured science where to learn a concept or procedure also requires prior knowledge or prerequisites (Irawati, 2017). Therefore, the linkage encourages a person to provide transferability of belief in the task or problem at hand.

This study also aims to analyze the effect of Mathematics Educatio student self-efficacy on learning outcomes in the differential calculus course with simple linear regression analysis. In analyzing the data, the researcher was assisted by Microsoft Excel and SPSS. The results of linear regression analysis can be seen in the following table.

Table 6. Regression Coefficient Significance Test

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3,701	8,833		,419	,680
	X	,229	,044	,757	5,185	,000

a. Dependent Variable: Y

Based on table 6, the linear regression equation in estimating student learning outcomes can be influenced by self-efficacy:

$$\hat{y} = 3.701 - 0.229x.$$

This shows that every increase in self-efficacy value will have an impact on the addition of 0.229. Student learning outcomes in the differential calculus course at the initial conditions were 3,701. Therefore, self-efficacy has a positive effect on student learning outcomes in the differential calculus course. Next, test the hypothesis by analyzing the linearity of the regression equation. The results of the analysis can be seen in the following table.

Table 7. Regression Equation Linearity Test

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1536,863	1	1536,863	26,880	,000[b]
	Residual	1143,500	20	57,175		
	Total	2680,364	21			

a. Dependent Variable: Y

b. Predictors: (Constant), X

From table 7, the significant value obtained is sig = 0.000 = 0% < 5%. Therefore, H_0 is rejected and H_1 is accepted. So, there is a linear relationship between self-efficacy and student learning outcomes, or it can be said that self-efficacy has a positive effect on student learning outcomes.

The results showed that self-efficacy had a positive influence on student learning outcomes. So that with increasing self-efficacy, student learning outcomes will also increase. This is in line with previous research which showed that self-efficacy had a positive effect on learning outcomes (Suryani et al., 2020; Wahdaniah et al., 2017). Strengthened by research by Monika & Adman, 2017 that self-efficacy affects student learning outcomes. The next in the following table, we will find out how much influence self-efficacy has on student learning outcomes in the differential calculus course.

Table 8. Regression Test

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,757[a]	,573	,552	7,561

a. Predictors: (Constant), X

From table 8 below, the R square value is 0.573 or 57.3%. This value indicates that self-efficacy affects student learning outcomes by 57.3%, and there are still 42.7% student learning outcomes influenced by other factors.

From the analysis above, it can be concluded that the increase in student learning outcomes in the differential calculus course is influenced by one of them by self-efficacy. For this reason, it is imperative for an educator to learn how to increase student self-efficacy in learning (Sari et al., 2021).

Conclusion

The purpose of this study was to describe the self-efficacy of Mathematics Education students in the differential calculus course and to analyze the effect of the self-efficacy of Mathematics Education students on learning outcomes in the differential calculus course. Based on the data analysis and discussion that has been done, this study found several things. First, both overall and in every dimension, the self-efficacy of students in the differential calculus course is in the moderate category. Second, based on the results of data analysis through excel and SPSS on a simple linear regression test, it shows that there is a linear relationship between self-efficacy and student learning outcomes, or it can be said that self-efficacy has a positive effect on student learning outcomes by 57.3%.

References

Ahn, S. H., & Bong, M. (2019). *Self-efficacy in learning: Past, present, and future*. Cambridge University Press.

Al Hakim, R. R., & Setyowisnu, G. E. (2021). Rancang Bangun Media Pembelajaran Matematika Berbasis Android pada Materi Kalkulus Diferensial. *Prosiding Pendidikan Matematika Dan Matematika*, *3*. https://doi.org/10.21831/pspmm.v3i0.133

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. W.H. Freeman and Company.

Bandura, A. (2006). Guide to the construction of self-efficacy scales. *Self-Efficacy Beliefs of Adolescents*, 307–337.

Dzulfikar, A. (2022). *Self-Efficacy dalam Pemecahan Masalah Statistika Mahasiswa : Analisis Berdasarkan Gender*. *02*(01), 15–28.

Hardianto, G., Erlamsyah, E., & Nurfahanah, N. (2016). Hubungan antara Self-Efficacy Akademik dengan Hasil Belajar Siswa. *Konselor*, *3*(1). https://doi.org/10.24036/02014312978-0-00

Hendriana, H., Rohaeti, E. E., & Sumarmo, U. (2017). *Hard Skills dan Soft Skills Matematika Siswa*. Refika Aditama.

Herdwiyanti, F., & Sudaryono. (2012). Perbedaan Kesiapsiagaan Menghadapi Bencana Ditinjau dari Tingkat Self-Efficacy pada Anak Usia Sekolah Dasar di Daerah Dampak Bencana Gunung Kelud. *Jurnal Psikologi Kepribadian Dan Sosial*, *1*(03).

Huang, X., Mayer, R. E., & Usher, E. L. (2020). Better together : Effects of four self-efficacy-building strategies on online statistical learning. *Contemporary Educational Psychology*, *63*(October), 101924. https://doi.org/10.1016/j.cedpsych.2020.101924

Johanda, M., Karneli, Y., & Ardi, Z. (2019). Self-efficacy siswa dalam menyelesaikan tugas sekolah di SMP Negeri 1 Ampek Angkek. *Jurnal Neo Konseling*, *1*(1), 1–5.

Manullang, M. (1996). *Penilaian Hasil Belajar*. Medan: IKIP Medan.

Martalyna, W., Isnarto, & Asikin, M. (2018). Students' Mathematical Literacy Based on Self-Efficacy By Discovery Learning With Higher Order Thinking Skills-Oriented. *Unnes Journal of Mathematics Education Research*, *7*(1).

Ranti, M. G., & Budiarti, I. (2018). Kemampuan pemecahan masalah mahasiswa pada mata kuliah kalkulus diferensial. *Math Didactic: Jurnal Pendidikan Matematika*, *4*(2), 110–120. https://doi.org/10.33654/math.v4i2.88

Sari, D. P., Yana, Y., & Wulandari, A. (2021). Pengaruh Self Efficacy dan Motivasi Belajar terhadap Hasil Belajar Matematika Siswa MTs Al-Khairiyah Mampang Prapatan di Masa Pandemi COVID-19. *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, *13*(1), 1–11. https://doi.org/10.37640/jip.v13i1.872

Seman, S. C., Yusoff, W. M. W., & Embong, R. (2017). Teachers Challenges in Teaching and Learning for Higher Order Thinking Skills (HOTS) in Primary School. *International Journal of Asian Social Science*, *7*(7). https://doi.org/10.18488/journal.1.2017.77.534.545

Sihaloho, L. (2018). Pengaruh Efikasi Diri (Self Efficacy) Terhadap Hasil Belajar Ekonomi Siswa Kelas Xi Ips Sma Negeri Se-Kota Bandung. *JINoP (Jurnal Inovasi Pembelajaran)*, *4*(1), 62. https://doi.org/10.22219/jinop.v4i1.5671

Sowanto, S., Mutmainnah, M., Saputra, H. A., & Andang, A. (2019). Kemampuan Self-Efficacy Mahasiswa Melalui Bahan Ajar Metode Statistika Menggunakan Hybrid Learning Pada Tantangan Revolusi Industri 4.0. *Supermat (Jurnal Pendidikan Matematika)*, *3*(2). https://doi.org/10.33627/sm.v3i2.245

Sumargiyani, & Nafi, B. (2020). Analisis Kesulitas Mahasiswa Dalam Menyelesaikan Soal Kalkulus Diferensial. *Prisma*, *3*, 591–598.

Sunarti., Zubaidah R, R. I. (2020). *Artikel Penelitian Oleh : 2020*. *1*(1), 1–15.

Yuliyani, R., Handayani, S. D., & Somawati, S. (2017). Peran Efikasi Diri (Self-Efficacy) dan Kemampuan Berpikir Positif terhadap Kemampuan Pemecahan Masalah Matematika. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *7*(2). https://doi.org/10.30998/formatif.v7i2.2228

Zimmerman, B. J. (2000). Self-Efficacy: An Essential Motive to Learn. *Contemporary Educational Psychology*, *25*(1), 82–91. https://doi.org/10.1006/ceps.1999.1016