Mathematics self efficacy and mathematics performance in online learning

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Abstract. Self-efficacy is the ability to perform in dealing with various activities. Changes in learning activities due to Covid-19 affect the learning environment which has an impact on self-efficacy. This study aims to obtain an explanation of mathematics self-efficacy and its relationship with mathematics performance in online learning. The sample in this study was the mathematics performance score on trigonometry, and the Mathematics self-efficacy score of 75 students at one of the universities in Mataram. This research is a correlational research. The research instruments were in the form of a Mathematics Self-efficacy questionnaire and mathematics performance scores on trigonometry. Data were analyzed using descriptive statistics to measure the mean and standard deviation of mathematical self-efficacy and analysis of the correlation between mathematical self-efficacy and mathematics performance. The results showed that most respondents had a high level of mathematical self-efficacy in online learning. Further analysis shows that there is a positive relationship between mathematics self-efficacy and mathematics performance, with an R coefficient of 14.8%. These results explain that variations in Mathematics performance can be explained by variations in Mathematics self-efficacy of 14.8%.

1. Introduction
The affective factor is one of the important factors in learning Mathematics besides cognitive factors. One of the affective factors that can affect the student learning process is self-efficacy [1]–[6]. Self-efficacy affects when students carry out an investigation process that is reflected in their actions, efforts, persistence, flexibility in differences, and goal realization. According to Bandura, self-efficacy is a student's consideration of his or her ability to achieve the desired or determined level of performance, which will influence further actions [7]. Garfield and Ben-Zvi emphasized that to be able to do mathematics it is not enough to know how to do it, but it must be accompanied by self-efficacy about the correctness of its concepts and procedures. [8]. For example, when doing calculations manually or by using a calculator, the element of self-efficacy is in it. Self-efficacy determines the level of motivation seen in the efforts made and the length of time devoted to completing and producing certain results [7], [9]. If people have a low level of self-efficacy towards a task, they are less likely to exert effort and complete the task. The research findings show that explaining self-efficacy is a predictor and very important for learning and performance [10], [11].

The learning process cannot be separated from the conditions of the learning environment. Changes in the learning environment can interfere with self-efficacy [12]. Changes in the learning environment from classroom-based to online-based that occur in Indonesia have made the Mathematics learning process need to be reviewed. This was reinforced by the spread of the corona virus in March 2020 [13],...
make the learning system become disrupted. The process of changing the learning environment makes teachers and students have to be able to adjust themselves by still paying attention to health protocols, including in the mathematics learning process. Student self-efficacy appears to be particularly important in challenging learning environments, such as online learning where students do not have the opportunity to interact with others and can consequently become socially isolated [14], [15].

Understanding self-efficacy in online learning is essential to improving online education, which can be a key component of academic success in distance education. [10]. However, the focus of previous research is more on self-efficacy situations in online learning (example, [16]–[23]) at normal conditions. Previous research presents the use of online learning by utilizing computer laboratories as a class in accessing online learning [16], [17], [19], as well as the existence of an online learning platform that is already available, so this helps students in terms of facilities [16]–[23]. The results obtained show that there is an effect of self-efficacy in online learning. It is inversely proportional to the current conditions, to the conditions of the spread of Covid-19, especially in Indonesia. Changes from this drastic condition occur because there is no good platform to accommodate online learning, and the need for quotas to access learning materials makes all these factors thought to influence self-efficacy. In general, the aspects of self-efficacy observed in online learning (before and after the Covid-19 pandemic) are the same. Self-efficacy is a self-assessment of the ability to perform and face a situation, in this case, online learning. This self-belief/judgment is a self-regulatory mechanism that can influence behavior (for example, using or avoiding online learning), motivation (for example, effort and persistence in using online learning technology), work levels, and levels of stress experienced in guiding circumstances [16], [24]. Based on the factors and definitions above, it is suspected that this could affect self-efficiency in online learning during the Covid-19 period.

Based on the above explanation, the purpose of this study is to obtain an explanation of mathematics self-efficacy and its relationship with mathematics performance in online learning. This research is important, given that affective factors, especially self-efficacy, are one of the factors that influence the success of the learning process, especially the change in learning patterns from classroom based to online based.

2. Method
This type of research design is correlational research which aims to obtain an explanation of mathematics self-efficacy and its relationship with mathematics performance in online learning. The number of participants in this study was 75 undergraduate students who took trigonometry courses. These students were selected through random sampling at one of the universities in Mataram city. Research was conducted during the second semester of 2019/2020. Courses are conducted during the Covid-19 pandemic, where learning is carried out by online learning.

The researcher used a Mathematics self-efficacy questionnaire consisting of 20 items. Each item is measured using a Likert scale consisting of four points, ranging from strongly disagree (1) to strongly agree (4). The items used to measure students’ Mathematical self-efficacy are related to what they believe in getting good grades in online learning, their confidence in learning and understanding Mathematical concepts and their confidence to master and complete the tasks given during the lecture. The reliability test found that the overall reliability of the Mathematics self-efficacy questionnaire was $\alpha = .78$. A self-efficacy questionnaire is given at the end of the lesson via a google form. The mathematics performance score is obtained from the final score on the evaluation of trigonometric material.

3. Results
The purpose of this study was to determine the mathematics self-efficacy of students when taking trigonometric mathematics courses in online learning. Table 1 below shows the distribution of respondents according to Mathematical self-efficacy. There are six negative items, namely items 3, 9, 14, 15, 17 and 19.
Table 1. The distribution of respondents according to Mathematical self-efficacy

| Item                                                                 | Strongly disagree | Disagree | Agree | Strongly agree | Average | SD  |
|---------------------------------------------------------------------|-------------------|----------|-------|----------------|---------|-----|
| I believe I can score very well in math on this online course.      | 8.0               | 28.0     | 48.0  | 16.0           | 2.72    | .831|
| I am sure I can learn important math concepts taught by the lecturer in this online learning. | 6.7               | 37.3     | 52.0  | 4.0            | 2.53    | .684|
| I am less interested in learning Mathematics online.                | 5.3               | 9.3      | 48.0  | 37.3           | 1.83    | .812|
| I am able to communicate or solve difficult Math problems in this online learning. | 4.0               | 58.7     | 37.3  | -              | 2.33    | .553|
| I can use examples or similar problems to solve the problem.        | -                 | 4.0      | 65.3  | 30.7           | 3.27    | .528|
| I believe I can understand the most difficult concepts in mathematics taught by lecturers even though they are online. | 16.0              | 52.0     | 29.3  | 2.7            | 2.19    | .730|
| I am confident that I can complete the assigned task.               | -                 | 14.7     | 73.3  | 12.0           | 2.97    | .519|
| I believe that I can do my best in this math.                      | -                 | 5.3      | 77.3  | 17.3           | 3.12    | .464|
| * I have a hard time getting used to studying math on time according to a schedule. | 5.3               | 46.7     | 45.3  | 2.7            | 2.55    | .643|
| I was able to choose a strategy for completing a Math assignment    | 1.3               | 18.7     | 70.7  | 9.3            | 2.88    | .569|
| I am confident that I can master the skills required in this course. | 1.3               | 24.0     | 62.7  | 12.0           | 2.85    | .630|
| Even though math is hard, I believe I can do very well.             | 1.3               | 5.3      | 66.7  | 26.7           | 3.19    | .586|
| I feel less confident about my math skills.                        | 5.3               | 24.0     | 52.0  | 18.7           | 2.84    | .789|
| * I avoided doing math tasks quickly and precisely in this online lesson. | 13.3              | 53.3     | 26.7  | 6.7            | 2.73    | .777|
| * I failed to find alternatives to solving math problems when the method I used got stuck in online learning. | -                 | 32.0     | 54.7  | 13.3           | 2.19    | .651|
| I am motivated to solve difficult math problems in online learning. | 1.3               | 40.0     | 52.0  | 6.7            | 2.64    | .629|
| * I am not able to improve the strategy that has been chosen to solve math problems | 1.3               | 29.3     | 64.0  | 5.3            | 2.27    | .577|
| I try to communicate with friends online to find the best solution of the math problem at hand | 1.3               | -        | 52.0  | 46.7           | 3.44    | .575|
| * I feel hopeless at work completing Math assignments online.       | 12.0              | 38.7     | 41.3  | 8.0            | 2.55    | .810|
| I hone my math skills regularly                                    | 1.3               | 32.0     | 62.7  | 4.0            | 2.69    | .569|

*Negative ITEM, SD: Deviasi standard

For positive items, the item "I try to communicate with friends online to find the best solution of the math problem at hand" was scored with the highest mean (Mean = 3.44, SD = 0.575) followed by the lowest mean on the item "I believe I can understand the most difficult concepts in mathematics taught by lecturers, even though online" (Mean = 2.19, SD = 0.730). For the negative item, the item "I avoided doing math tasks quickly and precisely in this online lesson" had the highest mean (Mean = 2.73, SD = 0.777). For the lowest mean on the item "I am less interested in learning Mathematics online" (Mean =
1.83, SD = 0.812). However, the majority of respondents get high scores for Mathematics self-efficacy, while the rest get moderate scores for Mathematics self-efficacy.

The overall mean for Mathematics self-efficacy was 2.69 (SD = 0.65). This analysis shows that the respondents have a high level of Mathematical self-efficacy. None of the respondents received low Mathematics self-efficacy scores. This means that the majority of respondents have a minimum requirement for Mathematics self-efficacy in online learning. This is presumably because online learning provides a new learning situation, in addition to students and lecturers who must continue to undergo protocols to prevent the spread of Covid-19. Online learning provides student learning freedom in organizing and searching for information related to the material being studied [12]. This is supported by the acquisition of the highest mean (Mean = 3.44, SD = 0.575) on the positive item "I try to communicate with friends online to find the best solution of the math problem at hand". In this item, it can be seen that 52% or as many as 39 students have self-efficacy to build communication in solving Mathematics problems in the online learning process.

Further analysis was carried out to identify the relationship between students' mathematical self-efficacy and mathematics performance. For this reason, the Pearson correlation test was conducted to determine the relationship between these two factors. The results showed that there was a positive relationship between mathematics self-efficacy and mathematics performance \( r (75) = 0.385; p < 0.05 \), the R squared coefficient \( r^2 \) is 0.148 or 14.8%, which means that variations in Mathematics performance can be explained by variations in Mathematics self-efficacy of 14.8% while the remaining 85.2% is influenced by other factors. The results of this correlation explain that the higher the self-efficacy, the higher the mathematics performance and vice versa, the lower the self-efficacy will be followed by lower mathematics performance. Students who have high self-efficacy are confident that they can rely on their abilities through high math performance. Students who have high self-efficacy can display high mathematical performance in completing assignments. Students who have high self-efficacy can adjust to the online learning environment. These findings support the results of previous studies [1] - [6] which indicate that there is a positive relationship between the two variables. This finding also strengthens the results of research that online learning can increase self-efficacy [20] - [23].

4. Conclusion

The research findings can provide an overview of the importance of mathematics self-efficacy on mathematics academic achievement. The total findings of this study indicate that most respondents have high and moderate scores in mathematics self-efficacy. Our findings also show that there is a positive relationship between mathematics self-efficacy and mathematics performance. The results showed that most of the respondents met the requirements of the respondents in doing math assignments in online learning. Research is limited to Mathematics Education students, so further research needs assessment and expansion of students in schools.

References

[1] Wang Y, Liang J, Lin C and Tsai C 2017 Identifying Taiwanese junior-high-school students’ mathematics learning profiles and their roles in mathematics learning self-efficacy and academic performance Learn. Individ. Differ. 54 92–101
[2] Skaalvik E M, Federici R A and Klassen R M 2015 Mathematics achievement and self-efficacy : Relations with motivation for mathematics Int. J. Educ. Res. 72 129–36
[3] Jaafar W M W and Ayu A F M 2010 Mathematics self-efficacy and meta-cognition among university students Procedia - Soc. Behav. Sci. 8 519–24
[4] Zimmerman B J 2000 Self-Efficacy : An Essential Motive to Learn Contemp. Educ. Psychol. 25 82–91
[5] Hoffman B 2010 “ I think I can, but I’m afraid to try ” : The role of self-efficacy beliefs and mathematics anxiety in mathematics problem-solving efficiency Learn. Individ. Differ. 20 276–83
[6] Cho M and Shen D 2013 Self-regulation in online learning Distance Educ. October 37–41
[7] Bandura A 1997 *Self Efficacy The Exercise Of Control* (New York: W H Freeman and Company)

[8] Garfield J and Ben-Zvi D 2009 Helping students develop statistical reasoning: Implementing a statistical reasoning learning environment *Teach. Stat.* **31** 3 72–77

[9] Bandura A, Cioffi D, Taylor C B and Brouillard M E, 1988 Perceived Self-Efficacy in Coping With Cognitive Stressors and Opioid Activation *J. Pers. Soc. Psychol.* **55** 479–88

[10] Hodges C B 2008 Self-Efficacy in the Context of Online Learning Environments A Review of the Literature and Directions for Research *Perform. Improv. Q.* **20** 7–25

[11] Schunk D H 1991 Self-Efficacy and Academic Motivation *Educ. Psychol.* **26** 207–31

[12] Gu P and Lee Y 2019 Promoting Students’ Motivation and Use of SRL Strategies in the Web-Based Mathematics Learning Environment *J. Educ. Technol. Syst.* **47** 391–410

[13] Mailizar, Almanthari A, Maulina S and Bruce S 2020 Secondary school mathematics teachers’ views on e-learning implementation barriers during the COVID-19 pandemic: The case of Indonesia *Eurasia J. Math. Sci. Technol. Educ.* **16**

[14] Cho M H and Jonassen D 2009 Educational Psychology: An International Journal of Experimental Development of the human interaction dimension of the Self-Regulated Learning Questionnaire in asynchronous online learning environments *Educ. Psychol.* **29** 117–38

[15] Cho M H, Demei S and Laffey J 2010 Relationships between self-regulation and social experiences in asynchronous online learning environments *J. Interact. Learn. Res.* **21** 297–316

[16] Bates R and Khasawneh S 2007 Self-efficacy and college students’ perceptions and use of online learning systems *Comput. Human Behav.* **23** 1175–91

[17] Barbeite F G and Weiss E M 2004 Computer self-efficacy and anxiety scales for an Internet sample: Testing measurement equivalence of existing measures and development of new scales *Comput. Human Behav.* **20** 11–15

[18] Wang S L and Wu P Y 2008 The role of feedback and self-efficacy on web-based learning: The social cognitive perspective *Comput. Educ.* **51** 1589–98

[19] Chu R J 2010 How family support and Internet self-efficacy influence the effects of e-learning among higher aged adults - Analyses of gender and age differences *Comput. Educ.* **55** 255–264

[20] Jan S K 2015 The Relationships Between Academic Self-Efficacy, Computer Self-Efficacy, Prior Experience, and Satisfaction With Online Learning *Am. J. Distance* **29** 30–40

[21] Wei H and Chou C 2020 Online learning performance and satisfaction: do perceptions and readiness matter? *Distance Educ.* **00** 1–22

[22] Peechapol C, Na-songkhla J, Sujiva S and Luangsodsai A 2018 An Exploration of Factors Influencing Self-Efficacy in Online Learning: A Systematic Review *Int. J. Emerg. Technol. Learn.* **13** 64–86

[23] Lee C 2015 Changes in self-efficacy and task value in online learning *Distance Educ.* **37**–41

[24] Bandura A 1991 Social Cognitif Theory of Self-Regulation *Organ. Behav. Hum. Decis. Process.* **50** 248–87