

THE EFFECT OF HYBRID LEARNING AND ENJOYMENT LEARNING IN INCREASING ADVANCE MATHEMATICAL THINKING

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Abstract

AMT ability is one of the skills that is a priority to be developed in learning mathematics in universities. This research aims to test the effect of hybrid learning and enjoyment learning in improving Advance Mathematical Thinking of prospective teacher students moderated by learning style. This research is a quantitative research that aims to examine the effect of the independent variable on the dependent variable. The sample in this study is conducted by purposive sampling based on certain criteria. The research data is obtained by distributing questionnaires to the mathematics education program student at University X in Bandung City. The data collected is analyzed by path analysis assisted by Smart PLS application. Smart PLS analysis in this study is carried out in 2 stages which are the analysis of the outer model and the inner model. Analysis of the inner model is aimed at (1) testing the validity and reliability of the instrument and (2) performing the r-square test to determine the percentage of influence. The test results show that learning enjoyment and hybrid learning have a significant positive effect on advanced mathematics learning. The learning styles in this study have not been able to moderate the relationship between hybrid learning and enjoy learning on Advance Mathematical Thinking. Hybrid learning can be used as an alternative or learning solution in improving advanced mathematical learning.

Keywords: Hybrid learning; advance mathematical thinking; enjoyment learning; prospective teacher students; learning style.

Abstrak

Kemampuan AMT merupakan salah satu kemampuan matematis yang menjadi prioritas untuk dikembangkan dalam pembelajaran matematika di perguruan tinggi. Penelitian Ini Bertujuan Untuk Menguji Pengaruh Hybrid Learning dan Enjoyment Learning Dalam Meningkatkan Berpikir Advance Mathematical Thinking of Prospective Teacher Students dimoderasi Gaya Belajar. Penelitian ini merupakan penelitian kuantitatif yang bertujuan untuk menguji pengaruh variabel independen terhadap variabel dependen. Sample dalam penelitian ini dilakukan dengan purposive sampling dengan berdasarkan beberapa kriteria tertentu. Data penelitian diperoleh dengan menyebarkan kuesioner pada mahasiswa program studi Pendidikan Matematika di Universitas X di Kota Bandung. Data yang terkumpul dianalisa dengan analisis path berbantuan aplikasi Smart PLS. Analisis smart PLS pada penelitian ini dilakukan dengan 2 tahapan yaitu analisa outer model dan inner model. Analisa inner model untuk 1) menguji validitas dan reliabilitas instrumen serta 2) melakukan uji r square untuk mengetahui presentase pengaruh. Hasil pengujian hipotesis menunjukkan bahwa enjoyment learning dan Hybrid learning berpengaruh secara positif signifikan terhadap Advance mathematic learning. Adapun, gaya belajar dalam penelitian ini belum mampu memoderasi hubungan hybrid learning dan enjoyment learning terhadap Advance Mathematic Thinking. Hybrid learning dapat dijadikan alternatif atau solusi pembelajaran dalam meningkatkan Advance Mathematic Learning.

Kata kunci: Pembelajaran hibrid; advance mathematical thinking; kenikmatan belajar; mahasiswa calon guru; gaya belajar.



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INTRODUCTION

Mathematics cannot be separated from everyday life. Therefore, mathematics is taught formally from elementary school to college level (Kilpatrick, 2020). College mathematics is generally more complex than school-level mathematics; it is because the material provided is more abstract. Therefore, students of the mathematics education study program are expected to be able to construct and find mathematical definitions/concepts independently, prove logically, and be able to develop their mathematical abilities further (Valente, 2020). This is very important for students in completing college level mathematics lecture assignments, especially advanced mathematics courses (Maya & Sumarmo, 2011). To realize these expectations, students' mathematical thinking skills must be developed and linked to mathematical thinking in order to form Advance Mathematical Thinking skills that focus more on formal definitions, logical deduction, and creative thinking (Minarni & Napitupulu, 2017).

AMT ability is one of the mathematical abilities that is a priority to be developed in learning mathematics in universities. However, based on the results of a survey conducted by Schoenfeld (2017) on Tennessee University of Technology students who had passed the calculus course, it turned out that not a single student was able to answer the questions correctly. In addition, Schoenfeld (2017b) also conducted tests on new students who excelled in high school and found that many of them had misconceptions about mathematical concepts. This is because students tend to have difficulty in obtaining the essence of abstract mathematical concepts and difficulties

in constructing the expected general form (Kashefi, Ismail, & Yusof, 2010).

The first problem faced by students in AMT ability is representation ability. The ability of representation can help students understand, communicate, and relate mathematical concepts in various forms. The problem of representation is seen from students who tend to use symbolic representations without paying attention to other forms of representation (Kuswardi et al. 2020). The study of Bistari (2010) shows that most students still have difficulty in using various mathematical representations to explain mathematical ideas and solve mathematical problems. The next problem is abstraction which is a basic process in the form of mathematics. According to Yao & Manouchehri (2020) abstraction and representation are two complementary processes. However, abstraction turns out to be one of the causes of students failing in the mathematics learning process. This is because students tend to have difficulty in obtaining the essence of abstract mathematical concepts. In line with Faradillah & Humaira (2021) who said that students generally still have difficulty in constructing the expected general form.

A survey indicates that developing AMT's ability to solve problems requires an appropriate learning model (Jacobs & Empson, 2016). The learning model must be active and support student involvement to understand concepts and think creatively in calculus courses. The hybrid learning model is an innovative learning model that utilizes information and communication technology (Nugraha, Sudiatmi, & Suswandari, 2020). The hybrid learning model has developed around 2000 and has been

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used in several countries such as North America, England, and Australia universities and training institutions. This learning model has several advantages, namely using learning technology such as computer media, iPhone, TV, video conferencing, picture and sound, multimedia presentations, weblogs, and social media (Suhery, Putra, & Jasmalinda, 2020).

According to Chirino-Barceló & Molina (2011), hybrid learning is a knowledge and skill acquisition process (learner-centered) developed with an instructional design that integrates digital (internet and mobile), printed, recorded, and traditional face-to-face classroom activities in a way that planned, valuable pedagogical. Hybrid learning also facilitates students to direct their own learning process by choosing methods with available learning materials that best suit their individual characteristics and needs that are oriented towards achieving curriculum learning objectives. Marković et al. (2011) asserted that hybrid learning is a learning model that integrates innovation and technological advances through an online learning system with the interaction and participation of traditional learning models.

Learning designed with a hybrid learning approach is also possible to influence students' metacognitive awareness (Purmadi & Hadi, 2018). Hybrid learning has advantages because in addition to using a face-to-face approach, this approach also uses ICT, both mobile and non-mobile technology. This innovation can increase the effectiveness of teaching and learning (De-Marcos et al., 2010). The use of the internet must be integrated into the higher education system. The use of information and communication technology in learning

activities has an impact on the students learning process and outcomes. Computer-assisted learning can improve interactive and communicative aspects (Peterson, 2010). Hybrid Learning is an approach that seeks to incorporate the best benefits from "old" and "new" teaching methods so that the quality of learning developed is of optimal quality that better than just face-to-face quality or just online learning activities online (Mufidah, Salamah, Muthoharoh, & Irfan Islamy, 2019).

In addition to Hybrid learning, another factor that also affects the ability of MTA is enjoyment learning. One of the importances of fun learning is being able to speed up the process of teaching and learning activities. Meanwhile, the impact of learning that occurs in an unpleasant atmosphere will be able to cause the process of teaching and learning activities to be hampered and even possible to experience termination (Hwang, 2018).

Apart from implementing Hybrid learning and enjoyment learning, Kohnen (2010) says that the key to succeed in learning and work is knowing each person's unique learning or work style, accepting one's own strengths and weaknesses and as much as possible adjusting personal preferences in each learning, study or work situation. In following the learning process, each student has a different learning style from one student to another. Lecturers in teaching must pay attention to student learning styles. This is because in every teaching, its effectiveness will depend on the way or style of student learning, in addition to their personal nature and intellectual abilities (Thomas F. Hawk & Amit J. Shah, 2010).

The learning styles of students can be observed from the multiple

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intelligences they have and each student has their own dominant intelligence. Zulfa, et al (2019) said that only students who succeed in learning in class because they have a learning style is in accordance with the teaching style applied by the lecturer in the classroom. Conversely, students have difficulty in participating in classroom learning because they have other learning styles, which are not in accordance with the teaching styles applied in the classroom. Research conducted by Dettori (2015) resulted in a significant difference in learning styles between male and female students. Male students are more likely to have convergent learning styles, while female students are more likely to have divergent learning styles. Research by Bailey (2020) found that learning styles significantly influence learning outcomes.

A research regarding MTA was conducted by Elliott et al., (2011) who tried to find out the difference in MTA between the control group and the experimental group given treatment in the form of a metacognitive skills approach. The results of their research show that the metacognitive approach is proven to be able to increase MTA.

The development of Advance Mathematical Thinking is generally emphasized for advanced mathematics courses such as algebraic structures, real analysis, probability theory, and theoretical statistics (Mathematical Statistics). The questions answered by students were then analyzed with indicators (representation, abstraction, creative thinking, and evidence) (Kuswardi et al., 2020).

In previous studies, the improvement of MTA ability was still carried out by giving questions, which were more focused on results. Learning with assignments is still limited to space

and time which requires educators and students to be in the same space and time; thus, to get more accurate and up-to-date research results, researchers are interested in further researching about MTA through the application of Hybrid learning moderated by learning styles. In this study, both the variables studied and the MTA development process was developed (Dwijonagoro & Suparno, 2019).

Several research results conducted by Damo & Padagas (2020) found that the hybrid learning model has the potential to improve students' mathematical abilities and student learning outcomes. In teaching mathematics, a teacher in presenting learning with a hybrid learning model must pay attention to several things prerequisites which is the requirement to master and know the IT developing (Pavlidou, Dragicevic, & Tsui, 2021). In addition, the teacher must also have teaching skills, present face-to-face learning content, and have knowledge and skills in developing computer-based learning resources. In designing mathematics learning using a hybrid learning model, it is also necessary to set up thought that students can learn anywhere, anytime, and with anyone (for example, students can study with teachers, experts, friends, family, communities) through learning resources which varies such as textbooks, internet, CD room, radio, tape, TV, etc. The interesting thing in this hybrid learning system is that it combines two kinds of choices that will play a big role in the lecture process which is teacher (instructor-led) or student (learner-led).

Currently, the development of hybrid learning is very much, all of which comes from the combination of one or more models, methods, or media; thus, students will learn something

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different and new to analyze and study. This will spur students to think critically because of the demands for independent learning when running online classes (Malti et al., 2017).

The hybrid learning model in this study was chosen because it combines modified problem-based learning with the Science, Technology, Engineering, and Mathematics (STEM) approach and uses the E-Learning system in learning; where this hybrid learning model can provide opportunities for prospective teachers to increase creativity and representational skills in mastering concepts by applying the Project-Based Learning model and the STEM approach used by Laboy-Rush (2011) and combined with the use of the Edmodo application in learning for prospective teachers. Edmodo app is one of the social media applications that has more functions to help lecturers to manage a system that provides features to connect students and manage student activities easily. This research aims to test the effect of hybrid learning and enjoyment learning in improving Advance Mathematical Thinking of

prospective teacher students moderated learning style.

METHOD

The research approach used in this study is a quantitative approach (Sugiono, 2016). Quantitative research method aims to test the established hypotheses. The quantitative method is in the form of numbers derived from measurements using a scale on the variables in the study. Respondents in this study are students of the Mathematics Education Study Program at University X in Bandung City. The sample is determined by purposive sampling technique with the following criteria.

1. Student at University X;
2. Mathematics Education study program students;
3. Students who are in the semester of 2020/2021 receiving a multivariable calculus course.

The data in this study are obtained using a questionnaire with a Likert scale (5, 4, 3, 2, 1). The indicators of variable used in this study is displayed in Table 1.

Table 1. Indicators of variable

Variable	Dimension	Indicator
Advance Mathematic Thinking	Representation	- Uncovering mathematical ideas - Communicating the results of work in a certain way as a result of the interpretation of his mind, such as arithmetic symbol representation, language/verbal representation, and image or graphic representation.
	Abstraction	- Generalizing and generating/inducing special forms in mathematical concepts to be able to identify similarities - Synthesizing/combining parts of mathematical concepts to form a whole.
	Mathematical creative thinking	- Fluency: generating amounts of ideas in different categories - Originality: having new ideas - Elaboration: solving problems in detail
	Compiling	- Constructing proofs that have been obtained

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Variable	Dimension	Indicator
Hybrid Learning	mathematical proofs	from mathematical concepts - Validating the evidence that has been obtained
	Clarity of instruction	- Massage - Links
	Impact on learner	- Attitude - Achievement
	Feasibility	- Maturity - Independence - Motivation
	Goal Centered	- Objectivity - Currency - Authority - Congruence between content in the materials and the terminal and performance objectives
	Technical	- Audio and video quality - The delivery systems and media formats - Congruent between media and learning context
	Attention	Interesting
	Relevance	- Relevance with instructional - Relevance with actual service
	Satisfaction	- Satisfaction toward facilities - Satisfaction toward instructors
	Enjoyment Learning	The Enjoyment of Mathematic Learning
The Enjoyment of Teacher Support		- The teacher is encouraging - The teacher is friendly - The teacher is supportive -
The Enjoyment of student support		- The peers are nice - We form a tight group - We have common legends, such as running jokes - We lough a lot
Learning Style		
Visual Learning Style	- Learning according to visual activities - Neat and orderly - Good understanding of positions, shapes, numbers, and colors - Difficulty receiving verbal instructions	
Auditorial Learning Style	- Learn by listening - Weak in visual activity - Having a sensitivity to music - Good in oral activity	
Kinesthetic Learning Style	- Learning through physical activity - Physically oriented and lots of movement - Weak in verbal activity	

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The data analysis used a structural approach to the Equation Model (SEM) assisted by the smart PLS application. The stages of data analysis in this study are defined in the following.

Outer Model Analysis

Validity and Reliability Test

Validity and reliability tests are carried out to ensure that the measurement used is feasible to be used as a measurement (valid and reliable). Testing the validity and reliability can be perceived from explanation in the following.

- a. Convergent Validity is an indicator assessed based on the correlation between the item score/component score with the construct score, seen from the standardized loading factor that describes the magnitude of the correlation between each measurement item (indicator) and its construct. Individual reflexive measures are said to be high if the correlation is > 0.7 .
- b. Discriminant Validity is a measurement model with reflexive indicators assessed based on the crossloading of measurements with constructs of discriminant validity, namely comparing the value of the squareroot of average variance extracted (AVE), the instrument is declared valid if it has an AVE score of > 0.5
- c. Composite reliability is an indicator to measure a construct seen in the view of latent variable coefficients. In this measurement, if the value achieved is > 0.70 , it can be concluded that the construct has high reliability.
- d. Cronbach Alpha is a reliability test carried out to strengthen the results of composite reliability. A variable can be declared reliable if it has

Cronbach alpha value of > 0.7 . The Table 2 presents of the instrument testing in this study.

Table 2. Instrument testing

Test Instrument	Test used
Validity Test	Convergent Validity AVE
Reliability Test	Cronbach Alpha Composite Reliability

R-Square Test

R-square for the dependent construct is used to assess the effect of certain independent latent variables on the dependent latent variable which shows the presentation of the magnitude of the effect.

Inner Model Analysis

The Inner Model Analysis or commonly called the Structural Model is used to predict the causal relationship between the variables tested in the model. The analysis of the inner model in testing using Smart PLS is done by testing the hypothesis. In testing the hypothesis, it can be seen from the t-statistical value and probability value. To test the hypothesis, it uses statistical values; for alpha 5%, the t-statistic value used is 1.96, while the beta score is used to determine the direction of the influence of the relationship between variables. The criteria for acceptance/rejection of the hypothesis are:

$$H_a = t\text{-statistic} > 1.96 \text{ (p-value} < 0.05\text{).}$$

$$H_o = t\text{-statistic} < 1.96 \text{ (p-values} > 0.05\text{)}$$

RESULT AND DISCUSSION

Partial Least Square analysis in this study was carried out using the help of SmartPls software 3.2.9 version. According to Götz et al. (2010), in general, the evaluation of the model in

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the Partial Least Square analysis is the evaluation of the measurement model (outer model) and evaluation of the structural model (inner model).

Evaluation of the Measurement Model (Outer Model)

Validity test

Validity test is used to measure the validity of a questionnaire. In this

research, validity testing is carried out using convergent validity and AVE. The instrument is declared valid if the AVE value gains > 0.5 and the outer loading value is > 0.7. The outer model test results can be seen in Figure 1 and the results of the validity test are described in the Table 3.

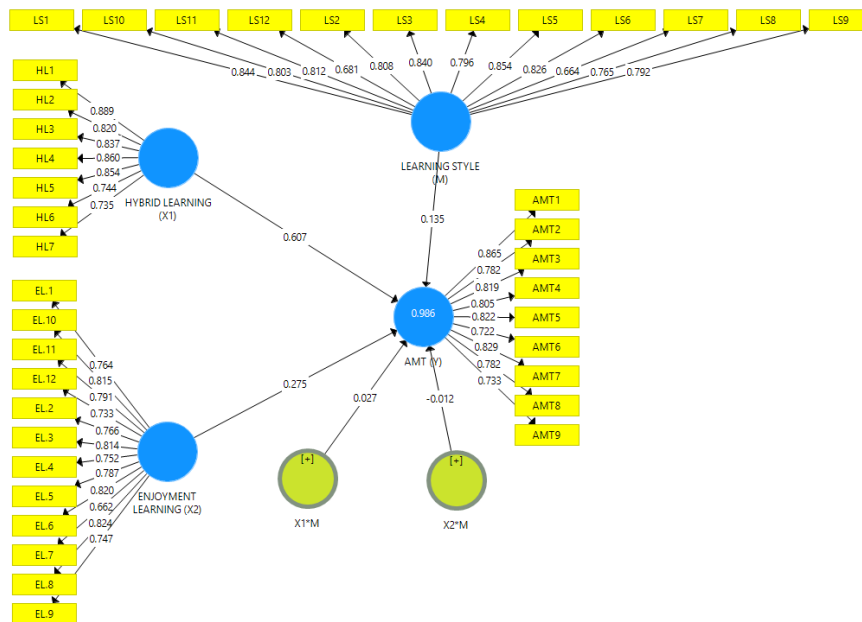


Figure 1. The outer model test results

Table 3. Convergent validity measurement value

Variable	Indicator	Outer Loading	VE	Result
Advance Mathematical Thinking	AMT1	0.865	.563	Valid
	AMT2	0.782		Valid
	AMT3	0.819		Valid
	AMT4	0.805		Valid
	AMT5	0.822		Valid
	AMT6	0.722		Valid
	AMT7	0.829		Valid
	AMT8	0.782		Valid
	AMT9	0.733		Valid
Hybrid Learning	HL1	0.889	.527	Valid
	HL2	0.820		Valid
	HL3	0.837		Valid
	HL4	0.860		Valid
	HL5	0.854		Valid

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Variable	Indicator	Outer Loading	VE	Result
Enjoyment Learning	HL6	0.744		Valid
	HL7	0.735		Valid
	EL.1	0.764		Valid
	EL.2	0.766		Valid
	EL.3	0.814		Valid
	EL.4	0.752		Valid
	EL.5	0.787		Valid
	EL.6	0.820		Valid
	EL.7	0.662		Invalid
	EL.8	0.824		Valid
	EL.9	0.747		Valid
	EL.10	0.815		Valid
Learning Style	EL.11	0.791		Valid
	EL.12	0.733		Valid
	LS1	0.722		Valid
	LS2	0.626		Invalid
	LS3	0.781		Valid
	LS4	0.721		Valid
	LS5	0.746		Valid
	LS6	0.745		Valid
	LS7	0.715	.554	Valid
	LS8	0.758		Valid
	LS9	0.744		Valid
	LS10	0.803		Valid
LS11	0.812		Valid	
LS12	0.681		Invalid	
Moderating Effect 1	Hybrid Learning * Learning Style	1.777	1.000	Valid
Moderating Effect 2	Enjoyment Learning (X2) * Learning Style (M)	1.235	1.000	Valid

According to the measurement results of the outer loading on the reflective indicator, it is known that there are 3 indicators that are not valid because they have an outer loading value of less than 0.7 (outer loading < 0.7), so that the researcher omitted this indicator.

Reliability Test

An indicator is considered reliable if it has a correlation value above 0.70. However, at the research stage of the

scale development stage, a loading of 0.50 to 0.60 is still acceptable (Ghozali, 2013). The results of the reliability test in this study can be seen in the Table 4.

Measurement of the Coefficient of Determination (R²)

The R-Square Coefficient determination (R-Square) test is used to measure how much the endogenous variable is influenced by other variables. Based on the data analysis carried out through the use of the smartPLS program, the R-

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Square value is 0,986 and R-Square Adjusted value is 0,985.

Based on the r-square value in the hybrid learning influence model on Advance Mathematical Thinking moderated by learning style, the r-square value is 0.986. These results

indicate that the hybrid learning variable is able to explain the Advance Mathematical Thinking variable by 98.6% while the remaining 1.4% is influenced by variables that are not explained in the study.

Table 4. Reliability test result

	Cronbach Alpha	Composite Reliability	Result
AMT (Y)	0.928	0.940	Reliable
Enjoyment Learning (X2)	0.939	0.947	Reliable
Hybrid Learning (X1)	0.919	0.935	Reliable
Learning Style (M)	0.946	0.953	Reliable
X1*M	1.000	1.000	Reliable
X2*M	1.000	1.000	Reliable

Table 6. Hypothesis test

	β	T-Statistics (O/STDEV)	P-Values	Result
Enjoyment Learning (X2) -> AMT (Y)	0.324	8.620	0.000	PS
Hybrid Learning (X1) -> AMT (Y)	0.444	5.187	0.000	PS
X1*M -> AMT (Y)	0.066	1.146	0.252	PS
X2*M -> AMT (Y)	-0.057	0.925	0.355	PS

PS: Positively Significant

Evaluation of the Structural Model (Inner Model)

Based on the data processing that has been done, the results can be used to answer the hypothesis in this study. Hypothesis testing in this study was carried out by looking at the t-statistics score and the p-values score.

Beside t-statistics and p-values, the hypothesis is also carried out by looking at Beta Score. Beta score describes the direction of the relationship accepting/rejecting the determined hypothesis based on criteria:

$H_a = t\text{-statistic} > 1.96$ (p-values < 0.05).

$H_0 = t\text{-statistic} < 1.96$ (p-values > 0.05)

The results of hypothesis testing obtained in this study through the inner model can be seen in Table 6.

Effect of Hybrid Learning on Advance Mathematical Thinking

The results of hypothesis testing show that the effect of hybrid learning on Advance Mathematical Thinking has a path coefficient value of 0.324, t-statistic value of 8.620, and p-value value of 0.000. The t-statistic value is greater than the t-table ($8.620 > 1.96$) and the p-value is 0.000 or smaller than the 5% alpha standard ($0.000 < 0.05$); a positive score indicates that there is a significant positive effect of hybrid learning on Advance Mathematical Thinking. In other words, better hybrid learning is able to improve Advance Mathematical Thinking or the first hypothesis (H1) is accepted. These results are consistent with the findings of Chirino-Barceló & Molina (2011)

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where hybrid learning has a significant positive effect on learning success.

Advance Mathematical Thinking (AMT) is an ability that includes representation, abstraction and connecting representations with abstractions, mathematical creative thinking, and compiling mathematical proofs (Suryana, 2012). Advance Mathematical Thinking can be improved through hybrid learning-based learning. As explained by Hung, Chang, & Lin (2016) e-learning that is suitable for school conditions in our country is blended learning, where one of the main problems of e-Learning learning is internet connection. Blended learning system is created as a solution to anticipate this problem by collaborating face-to-face learning with online learning.

Effect of Enjoyment Learning on Advance Mathematical Thinking

The results of hypothesis testing show that the effect of enjoyment learning on Advance Mathematical Thinking has a t-statistic of 5.187 and a p-value of 0.000. The t-statistic value is greater than the t-table ($5.187 > 1.96$) while the p-value is 0.000 or smaller than the 5% alpha standard ($0.000 < 0.05$) with a positive score indicating that there is a significant positive effect of enjoyment learning on Advance Mathematical Thinking. In other words, the better enjoyment learning can improve Advance Mathematical Thinking or the first hypothesis (H2) is accepted. These results are in accordance with the findings of Zazkis & Leikin (2010).

One of the strategies that can be used to develop AMT is the APOS strategy where this strategy is able to encourage students to be actively involved. The active involvement of

students in a discussion is one indication of enjoyment learning. Gilakjani & Ahmadi (2011) state that by listening to what others have found and discussing it, students are enabled to improve the strategies they find themselves. Thus, the interaction allows students to reflect which will ultimately encourage them to gain a higher understanding than before. Furthermore, research by Fouze & Amit (2018) found that AMT improvement can be done through the teacher's role in fostering enjoyment learning through completion divergent problem based on teacher scaffolding leveling.

Effect of Hybrid Learning on Advance Mathematical Thinking Moderated by Learning Style

The results of hypothesis testing the effect of hybrid learning on Advance Mathematical Thinking moderated by learning style has a t-statistic value of 5.187 and a p-value score of 0.252; the t-statistic value is smaller than t-table ($1,146 < 1.96$) while p-value is 0.252 or greater than standard alpha 5% ($0.252 > 0.05$) with a positive score indicates that the learning style is not able to moderate the relationship between hybrid learning and advance mathematical learning. In other words, without a learning style, the application of hybrid learning has been able to have a direct effect on improving Advance Mathematical Thinking or the third hypothesis (H3) is rejected. This result rejects the findings of Gurpinar et al., (2010).

In learning mathematics, the teacher provides opportunities for students to carry out activities of finding and investigating patterns and to determine relationships. Activities can be carried out through experiments to find sequences, differences, compari-

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sons, groupings, etc. and provide opportunities for students to find relationships between understanding one another. Mathematics material is increasingly difficult to learn. (Cheng, Ritzhaupt, & Antonenko, 2019) suggests that mathematics learning is often rated negatively by students and they have considerable difficulty in several mathematical processes such as reasoning, non-routine problem solving and proving.

AMT improvement needs to be done flexibly, one of which is through the application of hybrid learning; thus, this ability can be mastered by students maximumly. It causes a certain learning style tendency not able to affect the mastery of AMT. AMT improvement must integrate the three learning styles, both auditory visual and kinesthetic.

Effect of Enjoyment Learning on Advance Mathematical Thinking Moderated by Learning Style

The results of hypothesis testing the effect of enjoyment learning on Advance Mathematical Thinking moderated by learning style has a t-statistic of 0.925 and p-value of 0.355; the t-statistic value is smaller than the t-table ($0.925 < 1.96$) while the p-value is 0.355 or greater than the 5% alpha standard ($0.355 > 0.05$) with a negative score indicating that learning styles are not able to moderate the relationship between enjoyment learning and advance mathematical learning. In other words, without a learning style, the application of enjoyment learning has been able to have a direct effect on improving Advance Mathematical Thinking or the third hypothesis (H4) is rejected. This result rejects the findings (Cimermanová, 2018).

Mathematics in school can be viewed as a combination of visual

representations, including geometry and graphs, together with computation and symbolic manipulation; whereas, mathematics in college shifts towards formal frameworks, axiomatic systems and mathematical proofs.

Advance Mathematical Thinking is an ability that includes representation, abstraction, connecting representations and abstractions, mathematical creative thinking, and mathematical proving. The change from elementary thinking to advance mathematical thinking involves a significant transition from describing to defining, from convincing to logically proving based on a definition.

The learning method used is lecture. The lecture method is very suitable for the auditory type because the learning style is by listening. However, visual and kinesthetic learning styles are not suitable if they are not balanced with a variety of other learning methods that support their learning styles. Therefore, the learning style is not able to moderate the role of enjoyment learning on increasing student AMT.

Enjoyment learning can lead students to be able to understand mathematical objects and the relationship between one mathematical object and another. In its implementation, lecturers must encourage students to do transactive reasoning such as criticizing, explaining, clarifying, justifying, and elaborating an idea proposed whether initiated by students or lecturers.

CONCLUSION AND SUGGESTION

According to the results of hypothesis testing, it is known that enjoyment learning and hybrid learning have a significant positive effect on Advance Mathematical Learning. Meanwhile, the learning style in this

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study has not been able to moderate the relationship between hybrid learning and enjoyment learning on Advance Mathematical Thinking. Hybrid learning can be used as an alternative or learning solution in improving Advance Mathematical Learning. In addition to the application of hybrid learning, the improvement of AMT can be done from the role of lecturers as teachers in fostering enjoyment learning in delivering lectures.

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