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Mathematical Connection Communication Learning Model and Information Technology for Students

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Abstract: One of the successes of student learning outcomes depends on the way of communication between students and teachers using information technology media, combined with learning mathematical connections through communication will produce new innovations. The purpose of this research is to find out the Mathematical Connection Communication Learning Model and Information Technology for Students. This research method Analysis method of this research was analyzed using a quantitative method approach where the analysis used was descriptive statistics and hypothesis testing with partial least squares (PLS). The sources of information were 30 students majoring in mathematics. The results of this study increase the value of the Mathematical Connection Communication Learning Model and the Use of Information Technology will increase Student Learning Outcomes both in terms of comprehensive understanding abilities, critical and analytical thinking skills and the ability to be creative and innovative.

Keywords: Learning Models; Communication; Mathematical Connections; Information Technology; Students

Introduction

Education is the key to the progress of a nation. The world has proven that whoever cares more about education, he will be born as a nation that is strong in all respects and is able to crawl and stand up to become a world leader (Setioko, 2021). Of the many sciences that make a major contribution to the progress of a nation's culture and knowledge, one of them is mathematics (Deswita et al., 2020). The historical heritage of highly cultured countries shows that the role of mathematics is important. We can see this from the great mysteries of ancient constructions such as pyramids, rotators, leaning towers and several large cultural monuments which also show the great role of mathematics in schools (Irianto & Al-Amin, 2020). The purpose of learning mathematics is not only towards student achievement but also towards mathematical competence, namely communication and relations (Alfrida et al., 2022). The increase in the mathematical communication abilities of the experimental class students was more than the control class's mathematical communication abilities, and the increase in the mathematical connection abilities of the experimental class students was more than the mathematical connection abilities of the control class (Khoadah et al., 2019). From this explanation, connection capacity is not only a skill that is taught and used in mathematics, but more than that, networking skills are skills for dealing with problems in everyday life.

Not all students who are good at math are good at connecting mathematics, because in fact when students understand a mathematical concept, they are still confused about applying this concept in real life (Pamungkas, 2020). Students have deficiencies, this can be seen from the number of students who perceive mathematics as a difficult and unpleasant subject. Because they have not found the meaning of learning mathematics, students still think that mathematics is just counting, dealing with numbers, and cannot be applied to solving many problems in life (Almanthari et al., 2020). Mathematics as a school subject has certain characteristics and characteristics (Royani & Usuludin,

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2019). One characteristic of mathematics is its abstract object. To understand mathematical objects or abstract concepts, students need basic learning skills (Cevikbas & Kaiser, 2020). There are five basic math skills that become standard in learning mathematics, namely problem solving, mathematical reasoning and proof, mathematical communication, mathematical skills. connections and mathematical representations. Mathematics has a relationship between one concept and another. To be able to solve problems, an understanding of the relationship between mathematical concepts is required. Mathematical relationship skills are needed (Lutfiani, 2023) and (Gehlot et al., 2022). Mathematical connections are intended to help students connect one concept to another in mathematics and other subjects.

Currently, the development of information technology, especially in Indonesia, is growing (Firdaus et al., 2022). Information and communication technology can make it easier for us to learn and get the information we need from anywhere, anytime and from anyone. In the world of education, the development of information technology is starting to have a positive impact because the development of information technology in the world of education is starting to experience significant changes. Currently distance and time are not a big problem in acquiring knowledge, many applications have been created to make it easier for you.

Technology is an activity or study that uses scientific knowledge for practical purposes in industry, agriculture, medicine, commerce, science and other fields. It can also be interpreted as a method or process for dealing with a technical problem based on scientific research, including the use of electronics, chemical processes, manufacturing, and sophisticated machinery and others (Nuryana, 2019). Conventional learning systems in schools are currently considered less effective, the concepts of brain power, intelligence and creativity have developed rapidly with advances in technology and communication. These developments have an impact on strengthening those who want to overcome the weaknesses and vulnerabilities that exist in conventional learning systems. The teacher is the only informant waiting in his (teacher-centric) domain. The need for awareness of the importance of change and enlightenment in education should encourage every teacher to always develop his capacity. This change is absolute. According to the author, this is because teachers have to apply and or use many innovations.

However, in reality, mathematics is currently considered the most difficult subject or subject compared to other subjects. These results prove that elementary school students' mathematical connection abilities in solving math problems are still low (Kenedi et al., 2019). Even though in fact it is not as difficult as one might imagine if one pays attention to that actually understanding concepts is one of the skills or competencies and mathematics is expected to be achieved in learning mathematics (Malmia et al., 2019) and (Paroqi et al., 2020). Understanding mathematical concepts makes sense if learning mathematics is aimed at developing the ability to make mathematical connections between different ideas, to understand how mathematical ideas relate to one another (Aledya, 2019). Others to develop a deep understanding of mathematics and use it in contexts outside of mathematics (Attard & Holmes, 2022). Then the factors that often affect student errors when completing mathematics include conceptual error factors (students do not understand the questions being tested), serious error factors (not drawing conclusions to determine the final answer), for questions not using mathematical formulation rules) and operational factors. (Fajriah et al., 2020) and (Yaniawati et al., 2020) error factors (inaccuracy in determining the results of addition, subtraction, division and multiplication) (Deng et al., 2020). Then that actually the jigsaw type cooperative learning model can improve students' mathematical communication skills in the material of the Two-Variable Linear Equation System. (Pratiwi, 2019).

It is hoped that with the application of the mathematical connection communication learning model and information technology it can improve student learning and can be applied so that it is no longer considered difficult and fun later. Can run Linear programming material is provided to help students improve their mathematical representation abilities. Meanwhile, from the three subjects, it was found that the subjects tended to meet the indicators of symbol representation ability compared to the indicators of image representation and verbal representation (Mataheru et al., 2021). Representations help convey mathematical ideas from the abstract to the concrete. This greatly affects the completion of abstract form problems in general. In addition, good presentation is the basis for understanding a problem for planning problem solving. (Mataheru et al., 2021) that with the presence of information technology, many media have appeared so that they can be used properly and change learning methods like this, bringing new breakthroughs in learning, especially mathematics because it is believed that learning mathematics which is difficult and frightening will be made interesting and fun by using gadgets in the learning process. (Hakim & Sari, 2019).

Previous research related to the mathematical connection learning model of communication and information technology still has an important role. Information technology is a technology used to process data, collect, compile, store, and manipulate data. In these various ways to produce relevant, quality,

accurate and timely information, which can be used for personal, commercial and government information as well as strategies for making decisions (Asmawi et al., 2019). Then the role of information systems in human activities today is very important. The information system has become the main facilitator of various activities, including in the field of education, even in terms of formality. Multimedia computer technology is a new era in global modern affairs which has developed rapidly in recent years (Tarigan, 2022). The results of other studies show that the mathematical communication abilities of students who study using problem-based learning models are better than students who learn in the conventional way, there is a correlation between students' mathematical relationship abilities with the abilities of students themselves who use problem-based learning models (Maulidia et al., 2020). Then, from the results of other studies, it is known that high-ability students can master three indicators, namely connecting pictures with mathematical ideas, expressing everyday events in language or mathematical symbols and explaining situational ideas and mathematical relationships with pictures (Nurul et al., 2019). Students who are able to master two indicators, namely connecting pictures to mathematical ideas, expressing everyday events in language or mathematical symbols and explaining situational ideas.

Method

Methods the analysis of this research uses a quantitative method approach where the analysis used is descriptive statistics and hypothesis testing with partial least squares (PLS). The variables involved in this study are the Mathematical Connection Communication Learning Model and Information Technology as endogenous variables and information technology towards students as exogenous variables. The analysis tool uses Structural Equation Modeling-Partial Least Square, and the sampling technique uses random sampling. Data using primary data the number of respondents is 30 students. The data collection method uses indirect communication tools that use questionnaires and documentation, while the collection technique uses questionnaires and documentation.

It is important that this research is carried out because some students or other people consider learning mathematics and information technology as a support in this learning considered difficult when in fact it is not, this is in accordance with research (Sciati et al., 2021) that the higher students' mathematical communication skills, the ability to communicate mathematics, and the ability to understand mathematical concepts, the better the ability to solve mathematical problems during class learning (Adjie et al., 2020). Furthermore, it can and often helps improve student learning outcomes and makes learning more meaningful. (Suciati et al., 2022). Then information technology provides many contributions such as the Geogebra Application which can also be combined with various learning models, approaches and theories in learning mathematics so that learning becomes more interesting and fun for students. With the results of this research, students will be able to understand and no longer assume that mathematics is not difficult with the support of various applications of existing information technology.

Results and Discussion

Partial Least Square

This analysis is a multivariate statistical analysis that estimates the influence between variables simultaneously with the aim of predictive studies, exploration or development of structural models, Hair et al (2019). Evaluation of the model in PLS consists of evaluating the measurement model, evaluating the structural model and evaluating the goodness and fit of the model.

Evaluation of Measurement Models

The measurement model in this study consists of a reflective and formative measurement model in which the Mathematical Connection Communication Learning Model variables, Information Technology are measured reflectively and Student Learning Outcomes are measured formatively. In Hair et al (2021), the evaluation of the reflective measurement model consists of a loading factor ≥ 0.70 composite reliability ≥ 0.70 ---- cronbach's alpha ---- and average variance extracted (AVE ≥ 0.50) as well as an evaluation of the validity discriminants, namely Fornell and Lacker criteria and HTMT (Heterotrait Monotrait Ratio) below 0.90 ---- cross loadings ----. The evaluation of the formative measurement model is seen from the significance of the outer weight and there is no multicollinearity between the measurement items as seen from the outer VIF below 5. (see Table 1).

Based on table 1. Outer Loading above, all items fall into the valid category, this can be seen from the Loading Factor value which is greater than 0.70. therefore no items should be omitted and the analysis can proceed.

The Variable Mathematical Connection Communication Learning Model is measured by three valid items where the outer loading value lies between 0.745 – 0.798 which shows that the three measurement items are strongly correlated in explaining student learning outcomes. The variable reliability level of the Mathematical Connection Communication Learning Model is acceptable with a composite reliability value of

0.880 above 0.70 and convergent validity as indicated by AVE 0.595 > 0.50. Among the two valid measurement items, the Mathematical Connection Communication Learning Model looks more strongly reflected by KKM1 (LF=0.745), namely the ability to connect concepts and reality, KKM2 (LF=0.774), namely conveying mathematical reasoning and KKM3 (LF=0.874), namely the ability to convey the reason behind solving the problem.

Table.1 Initial Outer Loading

Variable	Item	Loading Factor	Information
Mathematical Connection Communication	KKM1	0.892	Valid
	KKM2	0.927	Valid
	KKM3	0.873	Valid
Information Engineering	TI1	0.775	Valid
	TI2	0.844	Valid
	TI3	0.982	Valid
Student Learning Outcomes	HM1	0.755	Valid
	HM2	0.829	Valid
	HM3	0.831	Valid

Table 2. Outer Loading, Composite Reliability and Average Variance Extracted

Variable	Item	Indicator	Outer Loading	Composite Reliability	AVE
Mathematical Connection Communication	KKM1	Connecting Mathematical Concepts with Real World situations	0.745	0.880	0.595
Information Engineering	KKM2	Convey mathematical reasoning Clearly and Precisely	0.774		
	KKM3	Explains the reasoning behind the Steps in the solution	0.874		
	TI1	Ability to operate learning technology	0.791	0.886	0.661
Student Learning Outcomes	TI2	Ability to analyze and solve technical problems	0.852		
	TI3	Ability to utilize information technology in learning	0.823		
Variable	HM1	Increased knowledge and understanding	0.797	0.905	0.657
	HM2	Ability to apply concepts and theories in real situations	0.800		
	HM3	Ability to think critically and analytically in solving problems (Problem Solving)	0.847		

The Information Technology variable is measured by three valid items where the outer loading value lies between 0.745 – 0.798 which shows that the two measurement items are strongly correlated in explaining student learning outcomes. The level of reliability of Information Technology variables is acceptable with a composite reliability value of 0.886 above 0.70 and convergent validity as indicated by AVE 0.661 > 0.50. Among the two valid measurement items, Information Technology looks more strongly reflected by TI 1 (LF=0.791), namely the Ability to Operate Learning Technology TI 2 (LF=0.852), namely Ability to Analyze and Solve Technical Problems, and TI 3 (LF= 0.823) Namely the ability to utilize information technology in learning.

Student Learning Outcomes Variable is measured by three valid items where the outer loading value lies between 0.745 – 0.798 which shows that the two measurement items are strongly correlated. The reliability level of the Language Proficiency variable is acceptable with a composite reliability value of 0.905 above 0.70 and the convergent validity indicated by AVE 0.657 > 0.50. Among the three valid measurement items, Student Learning Outcomes appear to be more strongly reflected by HM3 (LF=0.847), namely Increased Knowledge and Understanding HM2 (LF=0.800), namely the ability to apply concepts in the real world and HM1 (LF=0.797), namely the ability to think critical and analytical in solving problems.

Table 3. Hypothesis Testing

Hypothesis	Path Coefficient	p-value	95% Path Coefficient Confidence Interval		f square
			Lower Limit	Upper Limit	
H1. Mathematical Connection Communication Learning Model --> Student learning outcomes	0.365	0.000	0.168	0.547	0.209
H2. Use of Information Technology--> Student Learning Outcomes	0.493	0.000	0.326	0.664	0.383
H3. Mathematical Connection Communication Learning Model --> Information Technology--> Student Learning Outcomes	0.355	0.007	0.114	0.622	0.129

Based on the results of testing the hypothesis above, it is known as follows: The first hypothesis (H1) is accepted, namely there is a significant influence of the Mathematical Connection Communication Learning Model with path coefficient (0.365) and p-value (0.000 < 0.05). Any changes to the Mathematical Connection Communication Learning Model will improve Student Learning Outcomes. Within the 95% confidence interval, the influence of the Mathematical Connection Communication Learning Model in improving Student Learning Outcomes lies between 0.168 to 0.547. Even so, the existence of the Mathematical Connection Communication Learning Model in improving Student Learning Outcomes has a moderate influence at the structural level (f square = 0.209). The Need for an Intense Mathematical Connection Communication Learning Model, Student Learning Outcomes will increase to 0.547. The first hypothesis (H2) is accepted, namely that there is a significant effect of the use of Information Technology with a path coefficient (0.493) and a p-value (0.000 < 0.05). Any changes to the Use of Information Technology will improve Student Learning Outcomes. Within the 95% confidence interval, the influence of the use of information technology in improving student learning outcomes is between 0.326 and 0.664.

Even so, the existence of the use of information technology in improving student learning outcomes has a moderate effect at the structural level (f square = 0.383). The need for intense Information Technology will increase Student Learning Outcomes to 0.664. The first hypothesis (H3) is accepted, namely that there is a significant influence of Mathematical Connection Communication Learning Models, Information Technology with path coefficient (0.355) and p-value (0.000 < 0.05). Any changes to the Mathematical Connection Communication Learning Model and the Use of Information Technology will improve Student Learning Outcomes. Within the 95% confidence interval, the influence of the Mathematical Connection Communication Learning Model and the Use of Information Technology in improving Student Learning Outcomes lies between 0.114 to 0.622. Even so, the existence of the Mathematical Connection Communication Learning Model and the Use of Information Technology in improving Student Learning Outcomes has a moderate influence at the structural level (f square = 0.129). The Need for a Mathematical Connection Communication Learning Model and the Use of Technology.

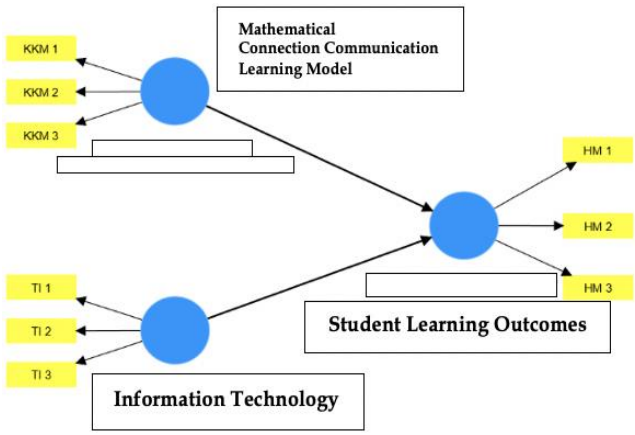

Figure 1. Path Coefficient dan P-value

The Mathematical Connection Communication Learning Model and the Use of Information Technology have a direct influence on Student Learning Outcomes. These results indicate that any changes to the Mathematical Connection Communication Learning Model and the Use of Information Technology will more strongly improve Student Learning Outcomes.

Model Goodness and Fit Evaluation

PLS is a variance-based SEM analysis with the aim of testing model theory that focuses on predictive studies. Therefore, several measures were developed to state that the proposed model is acceptable, such as R square, Q square, SRMR, PLS predict, Hair et al (2019) and Goodness of Fit Index (GoF Index), Sarstedt and Henseler (2013) as well as examination robustness of the

model by testing the linearity of the relationship between variables, Hair et al (2019), Sarstedt et al (2019), endogeneity and heterogeneity of the sample model with Fimix PLS, Hair et al (2019) (see Table 4).

Table 4. R squares

	R Square	Q square
Student Learning Outcomes	0.454	0.424

The statistical measure R square describes the magnitude of the variation in the endogenous variables that can be explained by other exogenous (endogenous) variables in the model. According to Chin (1998) the qualitative interpretation of R square is 0.19 (low effect), 0.33 (moderate effect), and 0.66 (high effect). Based on the processing results above, it can be said that the magnitude of the influence of the Mathematical Connection Communication Learning Model and the Use of Information Technology is 45.4% (moderate effect).

Q square describes a measure of prediction accuracy, namely how well each change in exogenous (endogenous) variables is able to predict endogenous variables. This measure is a form of validation in PLS to state the predictive relevance of the model. A q square value above 0 indicates that the model has predictive relevance, but in Hair et al (2019) the Q square interpretation values qualitatively are 0 (low effect), 0.25 (moderate effect), and 0.50 (high influence). Based on the processing results above, the Q square value of the Student Learning Outcomes variable is 0.454 > 0.50 (Moderate prediction accuracy).

Conclusion

Based on the above tests, it can be seen that the Variables of the Mathematical Connection Communication Learning Model and the Use of Information Technology have a significant influence, each increase in the value of the Mathematical Connection Communication Learning Model and the Use of Information Technology will increase Student Learning Outcomes both in terms of comprehensive understanding abilities, critical thinking skills and analytical and creative and innovative abilities.

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Author Contribution
In this study, H; the authors hope that later there will be results which will then be used as a reference in the learning process or further research. With these results, the authors can contribute related to student interest in the Mathematics Education course.

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In terms of funding, the author uses personal funds, but later, when it is published, I hope that this research can be submitted for funding or that the research fee will be charged by my campus or will be included in research costs from the Indonesian government.

Conflicts of Interest
Then in this study no one felt disadvantaged, all purely with existing data and in accordance with existing research procedures.

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