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Mathematics Communication Skills Using E-Learning-Based Problem Based Learning In Term Of Learning Styles

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Abstract

This research aims to determine mathematics communication skill patterns through an *E-learning-based Problem Based Learning* model reviewed from learning styles. This *mixed-method* research applied a *sequential explanatory* design. The subjects consisted of 32 AMNI Maritime University Semarang students, from the transport management department, based on three learning styles: visual, auditory, and kinesthetic. The data were collected using a mathematics communication skill test, learning style questionnaire, documentation, and interview. The findings showed that visual and auditory typed students' mathematics communication skills had reached accurate writing skills. They could also conclude and answer the given problems accurately. On the other hand, the visual and kinesthetic typed students could state the daily problems by writing the information. However, they were less capable of writing them into mathematics notation. The students with auditory and kinesthetic learning styles could not completely illustrate the given problems.

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INTRODUCTION

Baroody in Asikin & Junaedi (2013) argues that mathematics is a communication meant to share ideas, accurately and briefly. The mathematics learning process in higher-level education still has many problems concerning its characteristics, abstract object, leveled concept and principle, and procedure. They require many manipulations that make students difficult. Learning mathematics in higher education implies the importance of communication skills to be taught to be actively involved in learning.

Yaniawati (2010) defines *e-learning* as learning activities that use electronic devices or media. *E-learning*, as learning media, uses electronic devices (LAN, WAN, or the Internet) to share learning content, interact, or guide (Isjoni et al., 2008). *E-learning* aims to break students' limits in learning due to space and time that hinder the learning process Hafid (2016).

A *collaborative learning* concept is needed to promote e-learning. *Collaborative learning* is an activity to collaborate (cooperate) in a certain condition (Anthanasios, 2015). Alberta (2006) showed that *video conference* could significantly facilitate learning activity and collaborative discussion. Gough (2006) found that *video conference* had a greater potential to be applied in schools and higher education institutions. It could improve students' communication skills and allow them to learn and interact with educators anywhere without attending the classroom.

When it is applied properly, *the video conference* has an excellent role (Karen, 2007). One of *the video conference software* is *Google Meet. Google Meet* is a feature in *Google* to promote the online learning process. Dara Sawitri (2020) shared several benefits of *Google Meet* applications. They were such as guaranteed securities and various features in it. There are benefits of using *Google Meet* (Karen, 2007): (1) better interactivity, (2) quick real-time, (3) user-simultaneous communication, (4) providing a solution for remote communication, and (5) larger participant involvement in learning activities.

Green and Shulman, quoted by Tandililing (2011), argue that mathematics communication skills are (1) the main power of students to formulate mathematics concepts and strategies, (2) the key of students' success toward mathematics exploratory and investigation approach and solution, (3) the ways for students to communicate, gain, share, find, assess, and revise information or ideas to ensure their parents. Qohar (2011) states that mathematics communication skill is needed to understand correct mathematics ideas. Poor mathematics communication skill lowers other mathematics skills. Mathematics communication deals with how students understand the mathematics concept and communicate in mathematics. It could be seen from how students write the understood symbols through mathematics (Zeutriuslita, 2018). This skill could be reached when students have excellent mathematics communication skills.

Learning style is the student's way of understanding the learned knowledge. Every student had a different learning tendency. Some of them learned by seeing pictures while others learned by listening to others' explanations or discussions. Some of them preferred to have activities by moving their bodies or manipulating objects or practices. These learning style differences make them having different skills to manage and solve problems. According to De Porter & Hernacki (2015), learning style is an individual's ways to receive, understand, and process the information. The group learning styles are divided into three types: visual, auditory, and kinesthetic learning styles. Jeanete & Neleke (2016) explain that visual learning style is how individuals look, observe, and see. Auditory learning is learning by listening. Kinesthetic learning style is learning by moving, working, or touching.

To improve mathematics communication skills, reviewed from learning styles, will need supportive learning models. One of them is *a problem-based learning* model. According to Mawarti (2018) and Indriani (2019), PBL utilizes contextual problems to train students to think critically, solve problems, and understand concepts. Winter (2001) explains that PBL is a learning model to improve problem-solving, communication, and self-assessment. On the other hand, Setyaningsih (2014), Zulfah (2018), Atiningsih (2018), and Purnomo (2015) argue that problem-based learning uses problems as the initial step. It is then continued by finding out the concept and solving the problems by helping each other construct new knowledge. Daryanto (2014) argues that problem-based learning is a challenging learning model to "know hot to learn" and to determine the solution of real-world problems.

From the background of the study, this research aims to (1) find out the effectiveness of mathematics communication skills taught by *E-learning-based problem-based learning*, and (2) to describe the mathematics communication skills taught by *E-learning-based problem-based learning*.

METHOD

The method of the research is a mixed method. This method combines quantitative and qualitative methods to be used in research activity, so the obtained data will be more comprehensive, valid, reliable, and objective research (Sugiyono, 2013). The design was a *sequential explanatory* design. *Explanatory sequential* design collects and analyzes quantitative data. Then, they are followed by collecting and analyzing them qualitatively.

This research population consisted of the undergraduate students of AMNI Maritime University in the academic year of 2019/2020. The sampling technique was *purposive sampling*. It is a method to randomly collect the data without considering the population's strata from the whole transport management classes (Sugiyono, 2013).

The data were analyzed quantitatively and qualitatively. The quantitative data was used to find out the *E-learning-based problem-based learning* model effectiveness. The data were obtained from the student mathematics communication skill test.

The qualitative data was used to describe students' mathematics communication skills reviewed from the learning styles. The qualitative data were obtained from learning-style questionnaire, interview, and documentation. Learning style questionnaire was used to collect learning style data of the students. The interview was used to analyze mathematics communication skills based on learning styles. The applied documentation had a purpose to collect the complementary data. It was in the form of students' mathematics communication skill test portfolio, learning activity photo, and interview.

RESULTS AND DISCUSSION

In this research, two classes were obtained, the class A as the control group and class B as the experimental group. The applied model for the control group was *an E-learning-based problem-based learning* model assisted by *Google Groups.* Meanwhile, the experimental group was taught by *E-learning-based problem based learning* assisted by *video conference.* Before the classes were intervened, they were tested in terms of normality and homogeneity. The normality test was purposed to find out whether the data were normally distributed or not.

Based on the normality test, it was obtained $sig = 0.129 > 0.05$ for the experimental group. On the other hand, the control group obtained $sig = 0.155 > 0.05$. It means H_0 is accepted. The mathematics communication skill test data were from a normal distribution. Then, a homogeneity test was conducted. It had the purpose of finding out the existence of variance difference between the two samples. Based on the homogeneity test, it was obtained $sig = 0.187 > 0.05$. Then, H_0 is accepted. It meant both groups were homogeneous. Then, the test of mathematics communication skill average equality was conducted. The test used a t-test to determine the similarity or equality of both groups' mathematics skills Based on the results, assisted by SPPS, the score was $sig = 0.722 > 0.05$. Thus, H_0 , meaning that both groups' mathematics communication skills were equal. Then, the quantitative and qualitative data were analyzed.

The qualitative data analysis aimed to find out the applied model's effectiveness toward mathematics communication skills. *E-learning-based problem-based learning* model assisted by *video conference* is deemed effective to improve mathematics communication skills when it meets four criteria: (1) mathematics communication skill reaches the minimum passing grade 75%, (2) the average of students' mathematics communication skills taught by the applied model could surpass the actual minimum standard, 71, (3) the proportion of the students' mathematics communication skills taught by the applied model could reach better results than those taught by *E-learning-based problem-based learning* assisted by *Google groups,* (and 4) the average of students' mathematics communication skills taught by the applied model was better than those taught by *E-learning-based problem-based learning* assisted by *Google groups.*

In the first criterion, it is mathematics communication skill reaches the minimum passing grade 75%. A one-party proportion test tested the first criterion. The result showed z_{count}= 1.96. Based on the Z-table distribution, it was obtained z_{table} = 1,64 with significant level 0.05. Thus, when it was $z_{count} > z_{table}$, then it would be H_o. It meant it would be denied, or it would accept H_1. It means the mathematics communication skill has reached the classical accomplishment is higher than 75%. Thus, it could be said that the requirement of the first effectiveness was met.

The second criterion was the average mathematics communication skill of students surpassing Minimum Actual Standard = 71. The actual minimum standard was obtained from the initial communication skill test average results added by a fourth standard deviation. On the criterion, the t-test used was a party t-test. It resulted in t_{count} = 6,219. Based on the t-table distribution, it was obtained t_{table} = 1,695 with a significant level of 0.05. Thus, when it was $t_{count} > t_{table}$ it would be H_0. It meant it would be denied, or it would accept H_1. It meant the average score of mathematics communication skill was higher than 71. Thus, it could be said that the requirement of the second effectiveness was met.

The third criterion showed that the students' mathematics communication skills taught by the applied method were better than those taught by the *E-Learning-based problem-based learning* model assisted by *Google Groups.* The proportional difference test of this criterion resulted *in* z_{count} = 2,391. Based on the Z-table distribution, it was obtained z_{table} = 1,64 with significant level 0.05. Thus, $z_{count} > z_{table}$ meaning that H_0 was denied or accepting H_1. It meant mathematics communication skills of the students' proportions taught by the applied method were better than those taught by *the E-Learning-based problem-based learning* model assisted by *Google Groups.* Thus, it could be said that the requirement of the third criterion was met.

The fourth criterion showed that the students' mathematics communication skills taught by the applied method were better than those taught by the *E-Learning-based problem-based learning* model assisted by *Google Groups.* On the fourth criterion, the variance test is produce t_{count} = 2,317. Based on the t-table distribution, it was obtained t_{table} = 1,673 with a significant level of 0.05. Thus, when it was $t_{count} \geq t_{table}$, then it would be H_0. It meant it would be denied, or it would accept H_1. The mathematics communication skills of the students taught by the applied method were better than those taught by the *E-Learning-based problem-based learning* model assisted by *Google Groups.* Thus, it could be said that the requirement of the fourth criterion was met.

Based on those criteria, all of the effectiveness of the requirements had been met. Therefore, *E-learning-based problem-based learning* was effective in improving mathematics communication skills.

The qualitative data analysis was used to describe students' mathematics communication skills reviewed from the learning styles. Thirty two students of B class-transport management on AMNI Maritime University were categorized into three categories. They were visual, auditory, and kinesthetic learning styles. Based on the questionnaire, there were eight visual typed students, 11 auditory typed students, and 13 kinesthetic typed students. Two students were taken for each leaning style as the representatives, two students described in Table 1. They consisted of highest scored student and lowest scored student. Here are the analysis of students' mathematics communication skills reviewed from learning styles.

Table 1. The analysis results of students' mathematics communication skills were reviewed from learning styles.

Learning Style	Subjects	Mathematics Communication Indicators			Skil
		1	2	3	4
Visual	V – 1	M	KM	M	M
	V – 2	M	KM	M	M
Auditory	A – 1	KM	KM	M	M
	A – 2	KM	KM	M	M
Kinesthetic	K – 1	KM	KM	KM	KM
	K – 2	KM	KM	KM	KM

From the table, the visual typed students met indicator number 1, 3, and 4. Meanwhile, the auditory typed students were good at indicator numbers 3 and

4. On the other hand, the kinesthetic typed students had not been able to meet all indicators.

The visual typed students had met three indicators. They were describing mathematics ideas into written or visual forms. However, they could not state the daily events into mathematics symbols or language. On the other hand, they could solve written problems and communicate the problems' conclusions based on the questions. Thus, it could be concluded that they were excellent since they could master three indicators from four mathematics communication skill indicators.

This finding is contrary to Yudi Anggara's theory (2019). He explains that visual typed students could use mathematics symbols accurately. Based on the finding, the visual typed students could not state the daily events into mathematics symbols.

The auditory typed students had met two indicators. They were describing mathematics ideas into written or visual forms. However, they could not state the daily events into mathematics symbols or language. On the other hand, they could solve written problems and communicate the problems' conclusions based on the questions. Thus, it could be concluded that they could master two indicators from four mathematics communication skill indicators.

This finding is contrary to Novi Auliana (2017) and Ary Herlina (2016). She explains that auditory typed students could use mathematics symbols from the questions. Based on the finding, the auditory typed students could not state the daily events into mathematics symbols. According to Ary Herlina (2016), auditory typed students could post mathematics questions in written or spoken modes. However, based on the findings, the students could not describe their mathematics ideas into written or visual modes.

The kinesthetic typed students had met one indicator. This student was not able to describe mathematics ideas into written or visual forms. He also could not state the daily events into mathematics symbols or language. This student could not solve written problems and communicate the problems accurately based on the question. Thus, this student was deemed having lower mastery since he could not meet all indicators.

This finding is contrary to Triana, Rizki, and Moh. Syukron. Triana (2017) explains that kinesthetic typed students could master the indicator of describing mathematics ideas visually. However, based on the findings, the student could not describe their mathematics ideas into written or visual modes. Rizky's finding (2018) found that kinesthetic typed students could write recognized and questioned information. However, based on the finding, kinesthetic typed students could not write the recognized and the questioned information. According to Triana (2017), kinesthetic typed students could write the answer orderly and solve problems well. This finding showed kinesthetic typed student could not write the answer orderly and solve problems well. Moh. Syukron (2020) explains that kinesthetic typed student could write a relevant conclusion to the problems correctly. However, the finding showed the student could not write the relevant conclusion to the problems correctly.

CONCLUSION

From the analysis and discussion, the descriptions of mathematics communication skills reviewed from learning styles were varied. The mathematics communication skill characteristics of the students' learning styles were: the visual typed students could illustrate into figures with consistent graphics to the problems; the auditory typed students could complete the problems in a written manner with systematic solution stages and accurate answer, and the kinesthetic typed student could write the conclusion, but he was not accurate to write the answers.

REFERENCE

Alberta. (2006). Video-conferencing research community of practice research report. Edmonton: Alberta Education.

Ary, Herlina, K, HM. 2016. Deskripsi Kemampuan Komunikasi Matematika Siswa Ditinjau Dari Pemahaman Konsep Dan Gaya Belajar Siswa Kelas VIII SMP. Prosiding Seminar Nasional, 2(1): 198 – 206.

Asikin, M. & Junaedi, I. 2013. Kemampuan Komunikasi Matematika Siswa SMP Dalam Setting Pembelajaran RME (*Realistic*

Mathematics Education). *Unnes Journal of Mathematics Education Research*, 2(1): 204-213

Athanasios Drigas, Georgia Kokkalia and Miltiadis D. Lytras. (2015). *ICT and collaborative co-learning in preschool children who face memory difficulties*. Computers in Human Behavior. Elsevier Ltd. (pp. 645 - 651)

Atiningsih, S.M. 2018. Penerapan Model Problem Based Learning untuk Meningkatkan Tanggung Jawab dan Kemampuan Koneksi Matematika Peserta Didik Kelas XI. *Journal of Medives*,2(1): 77 – 86.

Dara, S. 2020. Penggunaan Google Meet Untuk Work From Home Di Era Pandemi Coronavirus Disease 2019 (Covid-19). Jurnal Pengabdian Masyarakat, 2(1): 13-21.

Daryanto. 2014. *Pendekatan Pembelajaran Saintifik Kurikulum 2013*. Yogyakarta: Penerbit Gava Media.

De Porter, B & M. Hernacki. (2015). *Quantum Learning*: Membiasakan Belajar Nyaman dan Menyenangkan. Bandung : Kaifa.

Gough, M. (2006). Video conferencing over ipconfigure, secure,and troubleshoot. Syngress Publishing, Inc: Canada.

Indriani, M.N., Isnarto, & Mariani, S. 2019. The Implementation of PBL (Problem Based Learning) Model Assisted by Monopoly Game Media in Improving Critical Thinking Ability and Self-Confidence. *Journal of Primary Education*, 8(2): 200 – 208.

Isjoni, Ismail, & Mahmud. 2008. ICT Untuk Sekolah Unggul. Yogyakarta: Pustaka Pelajar.

Jeanete Ophilia P & Neleke Huliselan. 2016. Identifikasi Gaya Belajar Mahasiswa. Jurnal Psikologi Undip, 15(1): 56-63.

Karen Hyder, Ann Kwinn, Ron Miazga, and Matthew Murray. (2007). The eLearning Guild's Handbook on Synchronous e-Learning

Karen Hyder, Ann Kwinn, Ron Miazga, and Matthew Murray. (2007). The eLearning Guild's Handbook on Synchronous e-Learning

Mawarti, S., Masrukan., Asikin, M. 2018. The Effectiveness of Problem Based Learning with Authentic Assesment towards Students' Mathematical Problem Solving Ability at 11th grade of Tran Nhan Tong Senior High School in Ho Chi Minh City, Vietnam. *Unnes Journal Of Mathematics Education*, 7(2): 114 – 121.

Moh, Syukron, M. 2020. Komunikasi Matematis dalam Pemecahan Masalah Matematika Ditinjau dari Gaya Belajar. *Jurnal Pendidikan Matematika*, 8(2): 241 – 252.

Mufida, Mamluatul. 2015. Analisis Kemampuan Komunikasi Matematis Pada Model PBL dengan Pendekatan Saintifik berdasarkan Gaya Belajar Siswa Kelas VIII. Semarang: SKRIPSI UNNES.

Novi, Auliana. 2017. Analisis Kemampuan Komunikasi Matematis Siswa Pada Materi Statistika Ditinjau Dari Gaya Belajar Visual, Auditorial, Kinestetik (VAK). *Jurnal Simki-Techsain*, 1(6): 1 – 8.

Purnomo, D.J., Asikin, M., & Junaedi, I. 2015. Tingkat Berpikir Kreatif pada Geometri Siswa Kelas VII Ditinjau dari Gaya Kognitif dalam Setting Problem Based Learning. *Unnes Journal of Mathematics Education*, 4(2):109-115.

Qohar, A. 2011. Mathematical Communication: What And How To Develop It In Mathematics Learning?. *Proceeding of International Seminar and the Fourth*

R. Hafid, H. 2016. Pengembangan Dan Implementasi E-Learning Menggunakan Moodle Dan Vicon Untuk Pelajaran Pemrograman Web Di SMK. Jurnal Pendidikan Vokasi, 6(1): 43-53.

Rizki, Wulandari. 2018. Kemampuan Komunikasi Matematis Siswa Ditinjau dari Gaya Belajar dalam Menyelesaikan Soal Materi Lingkaran Kelas VIII-A MTs Assyafi'iyah Gondang Tulungagung. Skripsi: Institut Agama Islam Negeri Tulungagung.

Setyaningsih, T.D., Agoestanto, A., & Kurniasih, A.W. 2014. Identifikasi Tahap Berpikir Kritis Siswa Menggunakan PBL dalam Tugas Pengajuan Masalah Matematika. *Jurnal Kreano*,5(2): 180 – 187.

Sugiyono, 2013.*Metode Penelitian Pendidikan. Bandung*: Alfabeta.

Tandililing, E. 2011. The Enhancement of Mathematical Communication and Self Regulated Learning of Senior High School Students Through PQ4R Strategy Accompanied by Refutation Text Reading.

Proceeding of International Seminar and the Fourth National Conference on Mathematics Education.

Triana, Jamilatus Syarifah. (2015). Analisis Kemampuan Komunikasi Matematis Tertulis Ditinjau Dari Gaya Belajar Pada Siswa Kelas XI MIPA 1 SMA Batik 1 Surakarta Tahun Pelajaran 2015/2016. Skripsi: Universitas Sebelas Maret Surakarta.

Winter, et al., 2001. Strategic information management plans: the basis for systematic information management in hospitals. International Journal of Medical Informatics 64 (2001) 99–109.

Yaniawati, P. (2010). *E-learning*: Alternatif Pembelajaran Kontemporer. Bandung: Arfino Raya.

Yudi Anggara, P., Susanto., & Suharto. 2019. Analisis Komunikasi Matematis Siswa Dalam Menyelesaikan Soal Persamaan Linear Satu Variabel Ditinjau Dari Gaya Belajar. *Jurnal Kadikma*, 10(1):126-135.

Zeutriuslita, Wahyudin, & Dahlan, J.A. 2018. Association Among Mathematical Critical Thinking Skill, Communication, and Curiosity Attitude as The Impact of Problem Based Learning and Cognitive Conflict Strategy (PBLCCS) in Number Theory Course. *Infinity*,7(1): 15 – 24.

Zulfah, Fauzan, A., & Armiati. 2018. Pengembangan Lembar Kerja Peserta Didik Berbasis Problem Based Learning untuk Materi Matematika Kelas VII. *Jurnal Pendidikan Matematika*, 12(2): 33 – 46.