Journal of Engineering Science and Technology
Special Issue on ISCoE2022, Jan (2022) 141 - 153

THE USE OF ANIMATION MEDIA TO INCREASE STUDENTS' MATHEMATICS CONNECTION ABILITIES IN VOCATIONAL ENGINEERING EDUCATION

DEDI ROHENDI*, TATANG PERMANA

Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229 Bandung, Indonesia
*Corresponding Author: dedir@upi.edu

Abstract

Mathematics essentially contributes to engineering. However, most engineering students had difficulties utilizing mathematics principles, especially determining mathematics concepts in solving a technical problem. The purpose of this study is to increase students' mathematics connection abilities by using animation media in the learning process. This study was a quasi-experiment that involve a pre and post-test. The samples of 110 vocational engineering students. The initial abilities of the student are based on the pre and post-tests scored by employing an essay test. To prove the data hypothesis was analysed using the ANOVA test. The results indicated a statistically significant that animation media increase students' mathematics connection abilities from pre to post-test; however, no significant difference was found between the post-test. Similarly, in this sample, animation media learning has a significantly larger effect on low-ability students than the high-ability students. Furthermore, learning methods significantly interact with the main effect of animation media with a full reversal at the post-test and partial reversal at the delay test. These results are explained concerning element interactivity and expertise reversal effects. Some implications of these findings are also discussed.

Keywords: Animation, Engineering students, Mathematical modeling, Mathematics principles, Vocational education.

1. Introduction

Mathematics is a structured and interrelated science between topics and topics. One material can be a prerequisite for other materials. Similarly, a concept is needed to explain other concepts. Students who can solve a problem in mathematics, but must have sufficient mathematical connection skills. Mathematics is one of the essential areas of knowledge among other science subjects. Mathematics also contributes to other disciplines [1]. Many difficulties in daily life are solved using a variety of mathematical concepts [2, 3]. As a result, mathematics must be taught at all educational levels [2, 4]. Mathematical concepts are also used to solve problems in science, humanity, and technology. But, the learning process in mathematics has faced numerous obstacles. Students still regard mathematics as one of the most challenging and despised courses [1].

Learning mathematics from primary to higher education level seems still not fully optimized. Student-centred methods and innovative media in learning are not yet optimally implemented. Students still have difficulty applying mathematics concepts in their real-life problems [5]. Topics and concepts in mathematics are connected and affect one another. Other fields, such as engineering, social sciences, and economics, use mathematics concepts in universities. When an applied concept is converted into a mathematical model, it is likely to be solved.

Engineering mathematics course is taught in vocational engineering education. That is the reason for the need in upgrading the curriculum in vocational engineering education [6, 7]. Engineering mathematics plays an important role in resolving engineering problems. Thermodynamics, engineering and fluid mechanics, kinematics, automotive, production and design, modelling and simulation, and numerous other courses require mathematical concepts. Mathematical connection ability is the competency to find interrelated topics in mathematics and other subject matters. Concepts and operations are also connected in mathematics. For example, a theorem connects to another theorem; a theory connects to another theory; a topic connects to another topic, or between branches of mathematics.

A student who has mathematical connection ability could relate mathematics concepts to another. It means that learning one mathematical concept becomes a prerequisite before learning other mathematical concepts. For example, before learning the concept of sets. Before studying limits, sets, numbers, functions, and others have to be understood. To enhance students' mathematical connection ability, students need to solve mathematical connection problems. Students must be given more opportunities to solve mathematical connection problems to improve their mathematical connection abilities. Students with mathematical connection skills can explain the interconnections between concepts both in mathematics and outside of mathematics, including in everyday life. According to connectivity theory, every concept, principle, and skill in mathematics is closely linked to one another. Mathematics is a continuous science that cannot be split into various branches. For instance, branches of mathematics such as algebra, geometry, trigonometry, and statistics are inextricably linked, and learning mathematics also entails studying its branches [8].

Mathematics contributes to engineering fields, such as integrals, differential equations, trigonometry, etc. For example, it is used to calculate Groundwater Retention Estimates [9]. Learning mathematics for engineering vocational education students to solve many technical problems [10, 11]. For example the rate of depletion of the thickness of the brake, the hot object being cooled, and the volume change of the workpiece being turned. In solving this case there are still difficulties, especially in making the mathematical model. Therefore, visual media is needed to solve the case. Mathematical concepts are needed in engineering vocational education, to assist in solving engineering cases. Several studies on the mathematical abilities of vocational education students [12, 13]. Basic math skills are very necessary for technical vocational education students. They must have a strong mastery of mathematics because many engineering materials require mathematical concepts. The mathematical connection ability of vocational education students using animated multimedia will be examined in this study. Mathematical connection abilities include understanding problems, making plans, creating mathematical models, implementing solutions, and re-checking solutions.

Learning objectives that can be achieved using animated multimedia are [14]:

(i) multimedia in the learning process will increase efficiency, and motivation, facilitate active and experimental learning, and be consistent through student-centred learning. thus, learning is much better;
(ii) efficient in achieving learner goals. multimedia is also expected to be able to improve students' understanding of the material.
(iii) learning becomes more effective,
(iv) low-cost, learning materials are digital [14].

In general, the benefits of using multimedia animation are that learning is more interesting and interactive, time is more effective, the quality of student learning increases and is flexible, and students' learning attitudes can be improved.

The characteristics of learning multimedia are:

(i) convergent media, for example combining audio and visual elements,
(ii) interactive in accommodating user responses,
(iii) independent by providing convenience and completeness of the content so that users can use it individually.

Learning multimedia also functions:

(i) responds to users quickly and as often as possible,
(ii) provides opportunities for students to be able to control their learning speed,
(iii) students can follow a sequence in a coherent and controlled manner,
(iv) provides opportunities for user participation in the form of responses, answers, choices, decisions, trials, and others.

Therefore, abstract learning can attract students' interest in learning and provide new experiences in interacting through multimedia learning, this research was carried out.

The purpose of this study was to find out:

(i) Can learning animation multimedia improve the mathematics connection skills of vocational education students in terms of overall and based on school origin?
(ii) How are student learning activities in learning with animated multimedia reviewed as a whole and based on school origin?

2. Method

The study's objective was to determine engineering vocational education students' mathematical connection ability by employing multimedia animation. The problem posed is an engineering application that requires a mathematical concept. The research method is quasi-experimental, with a one-group pre and post-test design. The research sample was 110 engineering vocational students which included the total sample.

The samples were categorized into three groups based on their school of origin: vocational high schools, senior high schools, and others (Madrasah Aliyah). Table 1 displays the classification of 110 samples based on their school of origin.

Table 1 depicts that the 110 students in this study came from senior high school (40), vocational high school (50), and other high schools (20) (Madrasah Aliyah). The connection abilities of vocational engineering students were then quantitatively measured based on pre and post-test results.

Table 1. Samples based on school origin.

No.	School Origin	N
1	Senior High School (SHS)	40
2	Vocational High School (VHS)	50
3	Other High School (Other)	20
	Total	**110**

This study's data consists of the results of a pre and post-test for students' mathematical connection abilities. The pre-test assesses students' initial mathematical connection ability before the learning process, while the post-test assesses students' mathematical connection ability after learning with animation media. The t-test or the difference before and after learning with animation media is used to measure the increase in students' mathematical connection abilities. Two-way ANOVA was used to compare students' mathematical connection abilities after and before learning with animation media. Comparisons were made for all students and based on school origin. Data processing uses SPSS version 21 to aid in the calculation process. Analysis of variance/ANOVA was carried out on the final test results to see the difference between groups of students with animation media and the origin of school, both viewed as a whole, and based on the group (SHS, VHS, other). Furthermore, to facilitate the calculation of both the average analysis, standard deviation, t-test, Scheffe test, and analysis of variance, SPSS version 21 for Windows was used, namely the General Linear Model Univariate (GLM) procedure. Detailed information on how to use SPSS is reported in previous studies [15].

The hypothesis testing criteria for the normality test is to accept the hypothesis if the significance (p-value) is greater than the significance level used, for example, 5%. Likewise, the homogeneity test, t-test, Scheffe test, and ANOVA accept the hypothesis if the significance (p-value) is less than the 5% significance level. After collecting data, simple statistical data processing was carried out to determine the improvement of students' mathematics abilities after the teaching and learning process with animation media.

Questionnaires use for students' activities who implement animation media. The questionnaire was developed using a Likert scale with 4 options, namely: Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS). Aspects revealed in the questionnaire included the visual aspects of multimedia, the clarity of students listening to the material on multimedia, the activeness of students asking concepts in animated media, the mental aspects of solving problems to complement mathematical connection abilities, and emotional aspects related to students' comfort using animated media. The results of observations of students are then made a percentage.

3. Results and Discussion

3.1. Animation multimedia used in this research

Multimedia animation used in this study has been developed by researchers. The multimedia is created with the learning needs of technical vocational education students in mind. Engineering application material in multimedia must be completed using mathematics. Calculations of brake thickness reduction, radioactive atomic mass decay, and workpiece temperature reduction are some examples. Figure 1 provides an illustration of the media used.

The interface design display is shown in Fig. 1. This facilitates user navigation between menus. The main menu is displayed first, followed by the next menu.

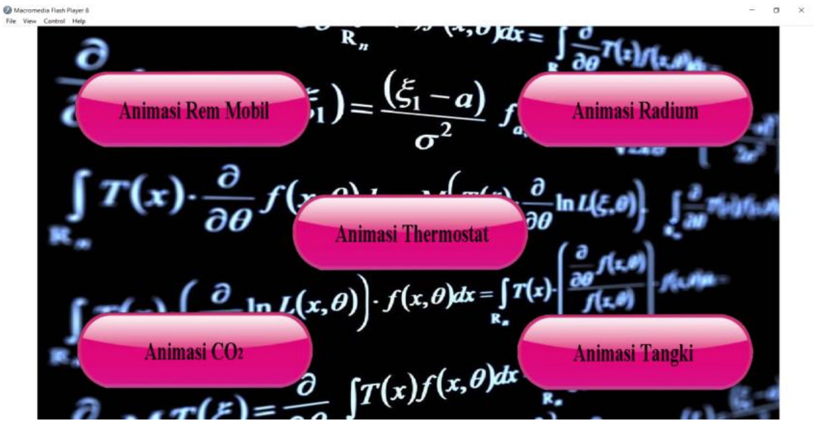

Fig. 1. Interface display.

The stage of implementing multimedia animation is carried out in engineering mathematics lectures. Implementation is carried out online with the Zoom platform for technical vocational education students. The learning process uses animated multimedia as shown in Fig. 2.

Figure 2(a) is an animation of a tank filled with brine. Into the tank is poured salt water at a rate of 2 gallons. The tank flows at the same rate. Students are asked to make a mathematical model of the water animation. This animation's result is a differential equation.

Undeniably, students need other knowledge to obtain mathematical modelings, such as chemical concepts. This animation trains vocational engineering students in gaining mathematical connection abilities. Figure 2(b) is an animation of a heated radioactive atomic mass. The initial mass is known, after the heating process, there is a reduction in mass. Each student determines the mass one at a time. This animation explains how atomic mass decay works. This animation ends with a mathematical model of atomic mass decay.

(a) (b)

Fig. 2. Implementation of multimedia animation.

After being deemed feasible by media and material experts, the animation multimedia in learning is subsequently implemented, with enhancements based on the suggestions and recommendations results. The next stage is to introduce the media to vocational engineering students. After implementing the animation multimedia, a questionnaire is distributed to discover the students' responses. Students at the beginning have to answer the pre-test. Furthermore, students learn material using the animation multimedia and at the end, a post-test is carried out. The evaluation determines whether the animation multimedia affects the mathematical connection abilities of vocational engineering students. Table 2 depicts students' learning outcomes and mathematical connection abilities before and after learning through animation multimedia.

Table 2. Pre and post-test results.

	Pre-test			Post-test	
School	**N**	**Mean**	**St. deviation**	**Mean**	**St. deviation**
SHS	40	63.42	8.053	66.73	6.91
VHS	50	68.05	9.29	68.47	8.29
Other	20	71.26	4.88	71.92	4.87
Total	110	66.95	8.64	68.47	7.45

Note: SHS = Senior high school, VHS = Vocational high school, Other = Other school

The two groups' pre- and post-tests are normally distributed and homogeneous. Two-way ANOVA is used to compute the average difference test for pre and post-test results. Table 3 shows the results of an ANOVA data analysis to observe differences in students' mathematical connection abilities when using animation multimedia, both in terms of students' abilities from school and the tests (pre and post-test). The p-value=0.00<sig=0.05 for the student's school origin factor, meaning that the hypothesis of the mathematical connection ability of the high school, vocational, and other SM students is significantly different. There is a significant distinction between the three mathematical connection ability results. Factor test p-value=0.019 < sig=005. It suggests that students' mathematical connection abilities differ after using multimedia animation. The pre-test mathematical connection ability differs significantly from the post-test. Nevertheless, there was no significant interaction between students' mathematical connection abilities based on school origin and tests, according to Table 4.

Table 3. Two-way ANOVA.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1416.5	5	283.3	4.7	0.000
Intercept	884080.9	1	884080.9	14665.0	0.000
group	1188.6	2	594.3	9.8	0.000
test	101.6	1	101.6	1.6	0.019
group * test	101.6	2	50.8	0.8	0.432
Error	12900.9	214	60.2		
Total	1022871.5	220			
Corrected Total	14317.5	219			
a. R^2 = 0.099 (Adjusted R^2 = 0.078)					

The Scheffe test was used to determine the differences between the three groups of students based on their school of origin. The results of Table 4 show that the hypothesis "mathematical connection ability of the group from students after learning to use multimedia animation" is accepted. This means that high school students are different from vocational school and are significantly different from other high school students in their mathematical connection abilities.

Table 4. Differences in abilities based on school origin.

Scheffe						
(I) Origin of students' school	**(J) Origin of students' school**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
SHC	VHC	-3.192^*	1.16	0.03	-6.06	-0.32
	Other	-6.52^*	1.50	0.00	-10.22	-2.81
VHC	SHC	3.19^*	1.16	0.03	0.32	6.06
	Other	-3.32	1.45	0.08	-6.90	0.26
Other	SHC	6.52^*	1.50	0.00	2.81	10.22
	VHC	3.32	1.45	0.08	-0.26	6.90
Based on observed means. Mean Square (Error) = 60.29. The significant level = 0.05.						

Figure 3 presents the average difference between the groups. Figure 3 reveals that there is no interaction between students' mathematical connection abilities although their mathematical connection abilities in the post-test were higher than in the pre-test for all schools. The mathematical connection abilities of high school students differed significantly from those of vocational students and students from other schools. Figure 3 also demonstrates that school students' mathematical abilities are higher than those of vocational and other school students based on the pre and post-test. The ability of students to make mathematical connections is better than in previous studies using animated multimedia-assisted learning. This is based on the results of the t-test in Table 5.

Figure 4 reveals that there is no interaction between students' mathematical connection abilities although their mathematical connection abilities in the post-test were higher than in the pre-test for all schools. The mathematical connection abilities of high school students differed significantly from those of vocational students and students from other schools. Figure 4 also demonstrates that school students' mathematical abilities are higher than those of vocational and other school students based on the pre and post-test. The ability of students to make mathematical connections is better than in previous studies using animated multimedia-assisted learning. This is based on the results of the t-test in Table 5.

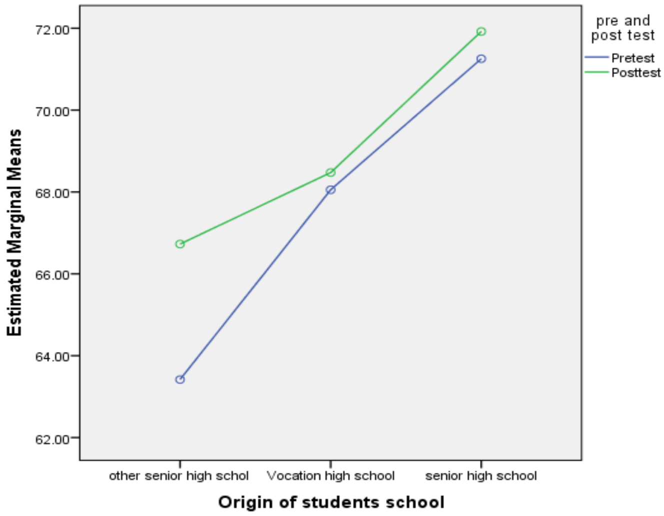

Fig. 3. Interaction of students' abilities based on their school of origin and test.

Table 5. T-test pre and post-test.

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Dev	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre and post-test	1.52	2.96	0.283	-2.08	-0.96	5.36	109	0.000

Based on Table 5, the mathematical connection abilities of vocational engineering students differ significantly (sig = 0.000-0.005). Students' mathematical connection abilities have improved after learning with technical mathematics application media. Then, students' mathematical connection abilities are based on indicators revealed in Fig. 4.

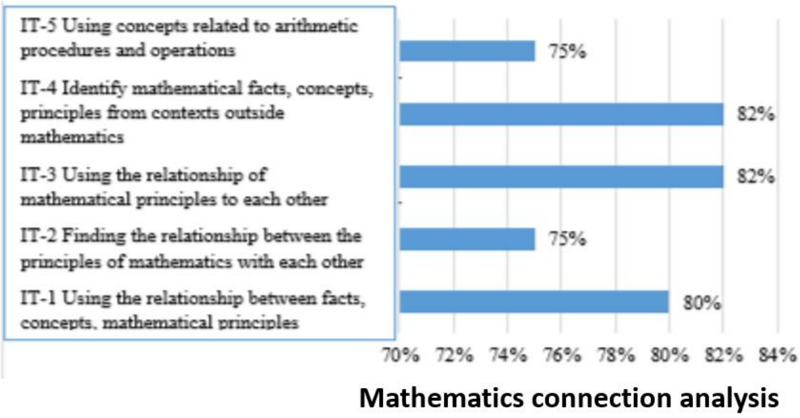

Fig. 4. Student indicators in question 1.

Figure 4 displays the result of the answers to question 1 (IT-1): The percentage of vocational engineering students who can integrate the relationship between facts, concepts, and math principles in solving problem 1 (the volume of oil) is 80%. It means that 88 students out of 110 were able to deduce the facts from the question, namely, the volume of oil at t = 0 is 3000 mL, the volume of oil after 4500 km of use is 2950 mL in t = 10 months, and the condition asked is the volume of oil after 12 months of use (or 5000 km). They can also determine the mathematical principles that will be used to solve the problem, specifically the principle of the differential equation for variable separation.

During the implementation of animation multimedia lectures, observations are conducted on students' learning activities to see their activities in learning through animation multimedia. The observation results are then displayed in a table based on the learning process indicators and a percentage is calculated. Table 6 shows that 83 of 110 students use the menus in activity 1 for the visual aspect. Overall student learning activities involving animation multimedia increased by 1.4% from activity 1 to activity 2. Listening to material from animation multimedia, solving problems or completing connection tests, enjoying learning with media, and responding to lecturer questions are the most common activities. It is possible to say that lectures with animation multimedia boost student learning activities.

Based on the overall findings of the study, a pre-test was administered to determine the student's initial abilities before learning using animation multimedia. After the learning process with animation multimedia was completed, students were given a post-test. Following that, data processing results using a t-test reveal that students' mathematical connection abilities improve after learning using technical mathematics application media. As a result, it is possible to conclude that learning to use animation multimedia improves students' mathematical connection skills. Furthermore, it is well known that the percentage value of the student response questionnaire demonstrates a positive attitude toward learning through the use of animation multimedia.

According to the findings of these studies, the use of animation multimedia in engineering mathematics learning can improve student learning outcomes; specifically, the ability of students' mathematical connections. It demonstrates how animation multimedia can help students understand the concepts of engineering applications in particular, as well as other concepts in general. The reason for this is that students can better explore the concepts they are learning with animation multimedia. It is here that the benefits of media, particularly animation multimedia, are demonstrated. Li [9] states that teaching and learning activities will be more effective and accessible when visually aided. The results showed that the knowledge gained through hearing was only successfully absorbed by students by 11%, while the knowledge gained through seeing or using the sense of sight was successfully absorbed by 83%. Additionally, we can only memorize 20% of what we hear, but 50% of what we see and hear.

Table 6. Student learning activities.

No	Aspects	Indicators	Act1	Act2
1	Visual	Using the menu contained in the animation media	85%	88%
		Observing the animation presented on the animation media	75%	80%
		Following the animation media steps	80%	80%
2	Listening	Listening to the material presented on animation media	83%	83%
		Listening to the steps of mathematical modeling on animation media	80%	80%
3	Oral	Asking questions about the material on animation media	78%	80%
		Doing tasks similar to exercises on animated media	78%	80%
		Answering problems in animation media	80%	80%
4	Mental	Solving a problem or completing a mathematical connection test	83%	83%
		Responding to the lecturer's questions	80%	83%
5	Emotional	Enjoy learning with animation media	83%	83%
		Interest in opening material on animation media	78%	80%
		Average	80.3%	81.7%

Mathematics application media engages the sense of sight more and allows students to strengthen material comprehension [16-25]. It can demonstrate the steps of acquiring concepts to form mathematical modeling to train students to be more capable. Animation is shown later as the originator of the theory, and previously animated images were displayed, forcing students to deduce the meaning of the images they saw. According to Rutledge and Côté [26], media serves a specific purpose: clarifying, facilitating, and creating exciting learning messages that lecturers will convey to students to motivate their learning and streamline the learning process. Media can assist students in the learning process, according to the previously described function. The learning process with media becomes more interesting because the parts of mathematical modeling that are difficult to observe can be seen with media. Learning is not boring because the material message can be effectively delivered.

The primary consideration for lecturers in the teaching and learning process is the use of media. The use of media benefits learning by making it more interesting, encouraging student learning motivation, and providing variety. Learning becomes more two-way, communicative, and engaging with this media. Students are more engaged in teaching and learning activities because they listen to lecturers' descriptions and make observations, demonstrate, and so on.

Students will benefit from learning through the use of animated media. The advantages of animation media also motivate students to learn more about the subject. Three media characteristics indicate why the media is used and what the media can do that the lecturer cannot, but the fixative feature is the most dominant. This characteristic describes the ability of the media to record, store, preserve, recommend, or reconstruct an event or object. This feature is critical for lecturers because events or objects recorded using existing media formats can be used at any time and even transferred into other formats. Events that happen only once can be recorded and rearranged for learning purposes.

4. Conclusions

The results indicated a statistically significant that animation media increases students' mathematics connection abilities a whole seen by students. There is a significant difference between the mathematical connection ability results based on the student's school origin, meaning that the student's mathematical connection ability at the general high school, vocational school, and other schools is significantly different after using multimedia animation. Also, there is no interaction between students' mathematical connection abilities, although their mathematical connection abilities in the post-test were higher than in the pre-test for all schools. The mathematical connection abilities of high school students differ significantly from those of vocational students and students from other schools. Nevertheless, there was no significant interaction between students' mathematical connection abilities based on school origin and tests. Students' learning activities involving animation multimedia also increased. It is possible to say that lectures with animation multimedia boost student learning activities.

Acknowledgments

We would like to thank the Department of Mechanical Engineering Education, Faculty of Technology and Vocational Education, Universitas Pendidikan Indonesia, for allowing them to conduct this research. The Annual Work Plan and Budget Assignment Fund for Research and Community Service Institute, Universitas Pendidikan Indonesia, Fiscal Year 2021, with the Rector's Decree Number: 835/UN40/PT.01.02/2021, is funding this research.

References

1. Patton, J.R.; Cronin, M.E.; Bassett, D.S.; and Koppel, A.E. (1997). A life skills approach to mathematics instruction: Preparing students with learning disabilities for the real-life math demands of adulthood. *Journal of Learning Disabilities*, 30(2), 178-187.

2. Utubaku, R.U.; and Aniah-Betiang, E. (2011). Mathematics for daily living: Implications for the society. *Journal of Educational and Social Research,* 1(2), 83-88.
3. Adolphus, T. (2011). Secondary school in rivers state, Nigeria. *International Journal of Emerging Sciences,* 1(2), 143-152.
4. Salman, M.F. (2005). Teachers' identification of the difficult levels of topics in the primary school mathematics curriculum. *Journal of Mathematical Association of Nigeria,* 30(1), 20-28.
5. Awofala, A.O.A.; Akinoso, S.O.; Adeniyi, C.O.; Jega, S.H.; Fatade, A.O.; and Arigbabu, A.A. (2024). Primary teachers' mathematics anxiety and mathematics teaching anxiety as predictors of students' performance in mathematics. *ASEAN Journal of Science and Engineering Education,* 4(1), 9-24.
6. Rosina, H.; Virgantina, V.; Ayyash, Y.; Dwiyanti, V.; and Boonsong. S. (2021). Vocational education curriculum: Between vocational education and industrial needs. *ASEAN Journal of Science and Engineering Education,* 1(2), 105-110.
7. Maryanti, R.; and Nandiyanto. A.B.D. (2021). Curriculum development in science education in vocational school. *ASEAN Journal of Science and Engineering Education,* 2(1), 151-156.
8. Noto, M.S.; Priatna, N.; and Dahlan, J.A. (2019). Mathematical proof: Learning obstacles preservice teachers on transformation geometry. *Journal on Mathematics Education,* 10(1), 117-126.
9. Li, D. (2021). Deep learning technology-based on intelligent teaching in social psychology courses. *International Journal of Emerging Technologies in Learning,* 16(24), 40-56.
10. Juandi, D.; and Tamur, M. (2021). The impact of problem-based learning toward enhancing mathematical thinking: A meta-analysis study. *Journal of Engineering Science and Technology,* 16(4), 3548-3561.
11. Rasul, M.S.; Zahriman, N.; Halim, L.; Rauf, R.A.; and Amnah, R. (2018). Impact of integrated STEM smart communities program on students scientific creativity. *Journal of Engineering Science and Technology,* 13, 80-89.
12. Erdik, C. (2019). Investigation of mathematics teachers' opinions about problem posing. *Journal on Mathematics Education,* 10(1), 1-20.
13. Minor, L.C.; Onwuegbuzie, A.J.; Witcher, A.E.; and James, T.L. (2002). Preservice teachers' educational beliefs and their perceptions of characteristics of effective teachers. *The Journal of Educational Research,* 96(2), 116-127.
14. Pujiyono, W.; Hananto, M.W.; and Suheri, S. (2006). Membangun aplikasi game sokoban berorientasi objek pada ponsel dengan teknologi Java 2 micro edition (J2ME). *Telkomnika (Telecommunication Computing Electronics and Control),* 4(2), 127-138.
15. Afifah, S.; Mudzakir, A.; and Nandiyanto, A.B.D. (2022). How to calculate paired sample t-test using SPSS software: From step-by-step processing for users to the practical examples in the analysis of the effect of application anti-fire bamboo teaching materials on student learning outcomes. *Indonesian Journal of Teaching in Science,* 2(1), 81-92.

16. Husnah, A.U.; Hidayat, M.A.; and Jannah, M. (2021). The journey of a math: As a mathematics learning innovation. *Indonesian Journal of Multidiciplinary Research,* 1(1), 129-136.
17. Akinoso, S.O. (2023). Motivation and ICT in secondary school mathematics using unified theory of acceptance and use of technology model. *Indonesian Journal of Educational Research and Technology,* 3(1), 79-90.
18. Ajenikoko, G.A.; and Ogunwuyi, O.J. (2022). A mathematical model for estimating the end-of-life of power transformers: From literature review to development analysis. *ASEAN Journal of Science and Engineering*, 2(3), 285-294.
19. Maryanti, R. (2021). Assessment of mathematical abilities of students with intellectual disabilities during the covid-19 pandemic. *Indonesian Journal of Community and Special Needs Education*, 1(2), 47-52.
20. Marasabessy, R. (2021). Study of mathematical reasoning ability for mathematics learning in schools: A literature review. *Indonesian Journal of Teaching in Science,* 1(2), 79-90.
21. Maryati, W.E.; Retnowati, E.; and Thoe, N.K. (2022). Learning mathematics formulas by listening and reading worked examples. *Indonesian Journal of Teaching in Science,* 2(1), 61-74.
22. Camenda, D.Y.; Gaba, C.A.; Lacord, N.; Natango, D.; Pabl, A.; and Abusam, H. (2021). How difficult is 1+1? A phenomenological study of high school students struggling in mathematics. *ASEAN Journal of Science and Engineering Education*, 1(2), 111-116.
23. Omolafe. E.V. (2021). Primary educators' experts' validation of the developed mathematics mobile application to enhance the teaching of mathematics in Nigeria primary schools. *ASEAN Journal of Science and Engineering Education*, 2(1), 157-166.
24. Serra, E.J.P.; Senope, N.J.R.; and Lariosa, C.M. (2021). Potholes in the implementation of printed module in mathematics and feedbacks of learners in Lambayong national high school during covid-19 pandemic. *ASEAN Journal of Science and Engineering Education*, 2(1), 177-182.
25. Wijaya, H.; Maryanti, R.; Wulandary, V.; and Irawan, A.R. (2022). Numerical minimum competence assessment for increasing students' interest in mathematics. *ASEAN Journal of Science and Engineering Education*, 2(3), 183-192.
26. Rutledge, R.G.; and Côté, C. (2003). Mathematics of quantitative kinetic PCR and the application of standard curves. *Nucleic Acids Research*, 31(16), 1-6.