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Effectiveness of TPACK-Based Productive Skills Teaching Materials to Improve Critical Thinking Ability

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Abstract: Productive skills are language skills that are very important for Indonesian Language and Literature Education students at Muria Kudus University to master. This research aims to develop TPACK-based productive skills teaching materials for Indonesian Language and Literature Education students at Muria Kudus University. This research used quasi experimental. The population of this research was all second-semester Indonesian language and literature education students who took productive skills courses. The samples in this study were class IIA as an experimental class using TPACK-based teaching materials and class IIB as a control class using lecture-based teaching materials. The sampling technique uses a random sampling technique. The data used were learning outcomes tests and self-efficacy questionnaires. Data collection techniques at the exploration stage used observation, interviews, and questionnaires. The testing stage uses an experimental method with requirements analysis data collection techniques. The research results explain that using TPACK-based teaching materials has proven effective in improving student learning outcomes.

Keywords: Effectiveness, teaching materials, TPACK, productive skills

1. Introduction

Education is an important issue in the development of a country. Developed countries include countries with high-quality education. Critical thinking skills are very necessary (Mardapi, 2020). Critical thinking skills are efforts to apply rational, high-level thinking activities, including analyzing, synthesizing, recognizing problems and solutions, concluding, and evaluating (Gunawan et al., 2019).

Productive language skills are writing and speaking. Writing skills as a very productive language skill need to be prioritized. Good writing skills are very much needed by society. Apart from that, good writing skills support a person's career. Good writing skills are acquired through repeated practice and require much time. Writing is one of the activities students must face in the learning process, especially for Indonesian language and literature subjects. Through writing activities, students can express their scientific and imaginative ideas. Therefore, schools where students receive education are expected to be able to provide learning about writing well using the right techniques so that students' potential and creative power can be channelled well, not just hidden potential (Hamdani et al., 2019). Writing skills are important productive skills and can help convey ideas to other people through written media (Ka et al., 2023). Apart from writing, another productive skill is speaking. Speaking skills are one of the language skills that every individual must have (Taufik & Solihah, 2022). Speaking skills are an important skill that students need to master (Darmuki et al., 2020).

Developing productive skills and critical thinking among PBSI Faculty of Teacher Training and Education, University Muria Kudus (FKIP UMK) students facing challenges. Lack of technology integration in learning and lack of teaching materials that support the development of these skills are some of the problems faced. Therefore, directed efforts are needed to develop teaching materials that combine Technology, Pedagogy and Content Knowledge (TPACK) and can also improve the productive skills and critical thinking abilities of PBSI students. Critical thinking is the ability to understand a problem more deeply and find ideas to overcome the problem (Nurul Shida et al., 2022). Critical thinking skills can cause someone to make good decisions (Zetriuslita et al., 2016). Critical thinking skills are basic problem-solving skills. This skill is very important for students to find the origin of problems and research and find the right solution to the problems they face. Critical thinking skills can be embedded in various sciences (Cloete, 2018).

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The problem is that the teaching materials used to learn productive skills must meet expectations. Students need teaching materials that can support learning productive skills and also improve students' critical thinking abilities. Teaching materials are something used by teachers or students to make things easier (Perdana et al., 2023). This research aims to test effectiveness TPACK-based teaching materials for PBSI FKIP UMK students. By paying attention to students' needs and challenges and utilizing technology's potential in the learning process, this research can provide an effective solution to improve the productive and critical thinking skills of PBSI FKIP UMK students. Thus, this research has high relevance in improving the quality of education in this study program and positively contributing to the development of education at the university level.

2. Literature Review

Teaching materials are materials or learning materials that are systematically arranged and used by teachers and students in the learning process at school (Björklund et al., 2020). Teaching materials are all used to assist teachers/instructors in teaching and learning activities in the classroom. The material in question can be written or unwritten material. In other words, teaching materials are learning tools or facilities that contain materials, methods, limitations and evaluation methods that are designed systematically and interestingly to achieve the expected competencies. Teaching materials will reduce the burden on teachers in presenting material (face to face), so that teachers have more time to guide and help students in the learning process (Candra et al., 2020).

TPACK explains how teachers think about how knowledge and technology can be integrated so that knowledge can develop. The essence of TPACK includes seven points. These include Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and finally, Technological Pedagogical Content Knowledge (TPACK) (Wang, 2016). Meanwhile, according to Aniq & Drajati (2019), provide an overview of TPACK by dividing seven knowledge, namely 1) Content Knowledge (CK), 2) Pedagogical Knowledge (PK), 3) Technological Knowledge (TK), 4) Pedagogical Content Knowledge (PCK), 5) Technological Content Knowledge (TCK), 6) Technological Pedagogical Knowledge (TPK), and 7) Technological Pedagogical Content Knowledge (TPACK).

The advantage of using TPACK is that it can develop a better learning environment. TPACK can determine the level of educator knowledge, namely 1) recognize, 2) accept, 3) adapt, 4) explore, and 5) progress. Educators can learn five criteria for designing learning with technology, including the ability to identify material, identify presentation options to modify content, and the ability to identify teaching learning strategies, the ability to choose appropriate computer equipment and be able to identify students; focused learning strategies measure TPACK by getting benefits such as profiles TPACK proficiency can describe the level of proficiency in each area of knowledge after being measured, TPACK can be developed according to the needs, goals and context of each individual.

Relevant research regarding the development of TPACK-based teaching materials has been conducted by Kurnianti et al. (2021), the application of the TPACK-based discovery learning model is proven to increase students' learning motivation in learning. In research conducted by Nurhadi (2021), the results on developing TPACK-based learning tools on two-variable linear equation systems were obtained. The conclusion is that the application of learning tools to a two-variable linear equation system based on TPACK is carried out following the lesson plan that has been prepared. The use of LKPD as a flip page e-book is one of the integrations of ICT in the material on systems of linear equations in two variables. A total of 23 students responded in the good category, while 1 (One) had a less good response. The results and teacher responses were 87.18% in the very good category.

Meanwhile, the results of observations of learning activities and daily assessments are good. The TPACK questionnaire measurements showed that Pedagogy Knowledge (PK) had a significant relationship with Pedagogy and Content Knowledge (PCK) and TPACK, and Content Knowledge (CK) was significant with TPACK. Research shows that developing teaching materials that include TPACK aspects is important for improving the learning process and can also create conditions that support the tasks of teachers and students.

3. Methodology

This research uses quantitative methods. The research design used in this research is quasi experiment. The population of this study were second-semester PBSI students who took productive skills courses. The sample in this study consisted of 32 students consisting of class IIA as an experimental class using TPACK-based learning methods totaling 16 students. Meanwhile, the control class (IIB), uses a control class using the lecture learning method with 16 students. Data collection techniques use needs analysis to develop and test teaching materials in class to determine the effectiveness of developing this technique in improving students' critical thinking skills.

4. Results

The learning model with TPACK-based teaching materials was carried out in the experimental group in class IIA, with 16 students. In comparison, the control group in class IIB, with 16 students, used the lecture method. Class IIA as the experimental group and class IIB as the control group were carried out using random sampling. The learning ability test results (post-test) of the two groups treated with different methods were compared so that there was an influence of the

application of the learning model with TPACK-based productive skills teaching materials on students' learning ability abilities.

Data on students' critical thinking abilities in learning productive skills courses was obtained from the results of written tests in the form of description questions after the learning process (post-test) on scientific thinking tools material with Basic Competencies, namely explaining the use of deductive scientific thinking and inductive thinking in acquiring knowledge. The description question consists of 6 (Six) questions which cover aspects of critical thinking according to Hidayati & Sinaga (2019), which include interpretation, analysis, inference, evaluation, explanation, and self-regulation. The results of the distribution of student learning outcomes through the learning model with TPACK-based teaching materials in the experimental group and the lecture method in the control group can be briefly seen in Table 1.

Table 1 - Distribution of ability learning results.

Value interval	Control class frequency	Experimental class frequency
45-52	3	0
53-60	2	2
61-68	2	3
69-76	3	4
77-84	4	3
85-92	2	3
93-100	0	1
Total	16	16

Table 1 shows the frequency of each value interval in the control group and experimental group. The highest frequency of the control class lies in the value 61 to 68 with a frequency number of 2 (Two). The highest frequency of the experimental group is in the interval value 77 to 84 with a frequency number of 3 (Three). Table 1 shows that the level of ability scores for the experimental group students' learning outcomes is higher than the ability of learning outcomes in control group students. A brief description of student learning ability can be seen in the Table 2.

Table 2 - Data on student learning abilities.

Statistical results	Control group	Experimental group
Average	65.71	75.82
Standard deviation	12.30	9.76
Variance	156.123	78.722
Minimum	45	58
Maximum	87	93
Median	63.60	76.25
N	16	16

Table 2 shows that the average ability test results for experimental group students are higher than those in the control group. The control group average was 65.71, while the experimental group average was 75.82. The greater the standard deviation, the more heterogeneous the data. Conversely, the smaller the standard deviation, the more homogeneous the data. The standard deviation of the control group is 12.30, and the standard deviation of the experimental group is 9.76. The variance for the control group was 156.123, while the experimental group was 78.722. This situation shows that the standard deviation and variance in the control class are higher than in the experimental class, meaning that the diversity (variability) level in the control group is greater (Punthai, 2014). These results indicate that the learning ability test results of experimental group students are better than those of the control group. Based on the table above, the average learning outcome ability score for the experimental class using the learning model with TPACK-based teaching materials is higher than the control class using the lecture method. A comparison of the average scores for each aspect of learning outcome abilities in the control group and the experimental group can be seen in Table 3.

Table 3 - Comparison of average ability values for learning outcomes.

Class	Interpretation	Analysis	Evaluation	Inference	Explain	Self-regulation
Experimental	83.025	82.026	77.358	75.779	83.158	58.937
Control	90.150	47.333	66.779	61.333	60.657	52.333

Table 3 shows the experiment tends to be higher than the control group. The experimental group excelled in five aspects: analysis, inference, evaluation, explanation and self-regulation. In contrast, the control group excelled in only one aspect of learning outcomes (interpretation aspect interpretation).

The ability of the control group's learning outcomes in the interpretation aspect was 90.150, higher than the experimental group's 83.025. The analysis aspect value in the control group was 47.333, much lower than the experimental group, 82.026. The evaluation aspect value in the control group was 66.779, while in the experimental group was 77.358. The inference aspect in the control group was also lower than the experimental group, namely 61.333 for the control group and 75.779 for the experimental group. The control group's explanation aspect value was 60.657, lower than the experimental group's 83.158. The value of the self-regulation aspect in the control group was 52.333, which was lower than the value in the experimental group, which only reached 58.937. The highest average aspect of critical thinking ability in the experimental group lies in the explanation aspect, while for the control group, it lies in the interpretation aspect. The lowest average aspect of learning outcomes in the experimental group lies in the self-regulation aspect, while for the control group, it lies in the analysis aspect. Based on the average difference in critical thinking ability between the experimental group and the control group for each aspect, the order from the largest difference to the smallest is the analysis aspect of 34.693, explanation of 22.501, inference of 14.446, evaluation of 10.579, interpretation of 7.125, and self-regulation of 6.604. Table 3 shows that the application of the learning model with TPACK-based teaching materials can improve student learning outcomes.

Testing assumptions as a prerequisite for analyzing the differences between two treatments using the t-test requires statistical testing of the prerequisites. T-test analysis requires analysis of prerequisite tests, namely the normality and homogeneity tests. The first condition that data can be tested for t is that the data must be normally distributed. The normality test aims to determine whether the control and experimental groups come from a normally distributed population. H0 states that the sample comes from a normally distributed population, and H1 states that the sample does not come from a normally distributed population. The normality test of the data from the ability test results for students in the control and experimental groups used the Kolmogorov-Smirnov test with $\alpha = 0.050$ assisted by the SPSS application. The normality test decision, if the Sig. from the normality test is greater than the set α level value, namely 0.050 (Sig. >0.050). If the data value is Sig. from the normality test is greater than α (sig > 0.050), then H0 is accepted, so it can be said that the data is normally distributed. Table 4 shows that the value (Sig.) > 0.05, so the H0 test decision is accepted, and it can be concluded that the data in the control and experimental classes are normally distributed.

Table 4 - Results of normality test result ability.

Class	Kolmogorov Smirnov	KS_{Table}	N	Sig.	Results	
					Description	Decision
Control	.106	.226	16	.808	Sig > 0.05	Normal
Experiment	.076	.220	16	.454	Sig > 0.05	Normal

The second condition that must be met before a t-test is that the data must be homogeneously distributed. The homogeneity test determines whether the variance between the control and experimental classes is homogeneous or heterogeneous. Homogeneous means that the data between the experimental and control classes have the same variance or are homogeneous. The homogeneity test of learning outcomes was carried out using Levene's test with $\alpha = 0.05$ and assisted by the SPSS application. The variance between the control class and the experimental class was declared homogeneous if the significance value shown was more than 0.05 (sig> 0.05) and was declared heterogeneous if the significance value shown was less than 0.05 (sig< 0.05). H0 states that each class has the same variance (homogeneous). H1 states that each class does not have the same variance. The results of the homogeneity test data on student learning abilities can be seen briefly in Table 5.

Table 5 - Results of the homogeneity test of student learning outcomes.

Homogeneity test	N	df1	df2	F_{Count}	F_{Table}	Sig.	Decision Ho test
Critical thinking ability	74	1	70	3.783	3.874	.052	Accepted

Table 5 shows that the Fcount price is 3.883, and the Ftable (0.05) (1) (72) price is 3.974. The results of these calculations show that Fcount < Ftable (0.05) (1) (72) and the significance value for the homogeneity test is more than 0.05. These calculations show that H0 is accepted so that the learning outcome ability values in the control and experimental classes are homogeneous. The requirements for research hypothesis testing for data student learning ability have been fulfilled, namely that the data comes from a normally distributed population with homogeneous variance so that parametric research hypothesis testing via the t-test can be carried out.

Hypothesis testing in this research was carried out using the t-test assisted by the SPSS 16 program. The two-sample t-test aims to compare whether the two data (variables) are the same or different. The prerequisite test results show that the data from the ability test results are normal and homogeneous, so the prerequisites for carrying out the t-test have

been fulfilled. The significance level (α) = 0.05 is the criterion used in making hypothesis decisions. H0 is rejected if the significance probability (Sig) < α (0.05). It means that if the probability significance (Sig) is < 0.05, then the null hypothesis (H0) is rejected, and conversely, if the probability significance (Sig) is > 0.05, then the null hypothesis is accepted. H0 in this study states that there is no difference between applying the learning model with TPACK-based productive skills teaching materials and applying the lecture method on learning outcomes abilities. In contrast, H1 states that there is a difference between applying the learning model with TPACK-based productive skills teaching materials. The application of the lecture method varied presentations on student learning outcomes abilities. The results of the analysis of the effect of implementing the learning model on student learning outcomes through the t-test can be briefly seen in Table 6.

Table 6 - T-test results of the influence of the TPACK model on learning outcomes.

Variable	N	df	T_{Count}	T_{Table}	Sig.	Description	Decision Test H_o
Learning outcomes	74	72	4.485	1.993	.00	Sig > 0.01	Rejected

Table 6 shows the results of the test decision that the significance is less than 0.05, namely 0.00 < 0.05. Based on these results, it can be decided that H0, which states that there is no real difference between the application of learning models with TPACK-based productive skills teaching materials and the application of lecture methods with varied presentations on students' learning outcomes abilities, is rejected and accepts H1 which states that there are significant differences. There is a very real difference between the application of learning models with TPACK-based productive skills teaching materials and the application of lecture methods with varied presentations on student learning outcomes. The data shows that applying the learning model with TPACK-based productive skills teaching materials really affects students' learning outcomes because the significance value is less than 0.01, namely 0.00 <0.01.

Based on the results of this research, lecturers should match student learning needs and learning strategies. The choice of learning style that lecturers will use is determined by the characteristics of the learning material and learning objectives to be conveyed, the ability to meet student learning needs, and the ability to maximize student learning potential (Hardika et al., 2018). According to DeCoito & Richardson (2018), one type of teaching can't be considered better for all educational purposes, of course, each teaching style is only suitable for certain learning styles, but these styles can also be combined to help students achieve their learning goals.

5. Discussion

Implementing and applying TPACK in learning can provide solutions for lecturers to overcome problems in the learning process by utilizing digital technology in teaching and learning activities to create effective and meaningful teaching and learning activities for students (Kartal & Çınar, 2022). The results of previous research by Syarifah & Yanuarto (2023) show that applying TPACK in the learning process is effective. Student learning outcomes are one indicator of research success. Before TPACK was applied in the learning process, student learning outcomes were classified as low or less than optimal. On the other hand, when TPACK was applied in learning, student learning outcomes increased and were more optimal. Indeed, in the learning process, technology can support the learning process and attract students' attention. Students' learning motivation also increases because of the new atmosphere during the learning process.

The validation results of the TPACK learning tool were deemed feasible and effective in increasing student learning motivation. Based on the discussion of TPACK-based production skills learning materials for PBSI in Semester 2 (Two), it was deemed successful and improved the critical thinking skills of PBSI students. The results of other research, one of which was conducted by Liando et al. (2023), stated that developing TPACK-based LKPD subject-based learning using the guided inquiry method can increase student independence and learning outcomes. Meets the criteria of being valuable, practical and effective. The TPACK learning model can potentially improve students' critical thinking and metacognitive abilities.

TPACK is a method that can be applied in the current education system. However, to be able to apply TPACK in learning, someone must have educational material that supports the application of TPACK (Koh, 2019). Based on several previous studies, such as Kurnianti et al. (2021), it is confirmed that learning by applying the TPACK method has a big influence on motivation because the TPACK design requires teachers to adapt their pedagogical and content knowledge in leading learning and utilizing technology to develop students' understanding. So that students can more easily understand the material and have the opportunity to utilize technology that can stimulate students' learning motivation. Apart from that, applying TPACK in learning has several other benefits, including encouraging students to solve problems in academic topics and training literacy skills to solve problems. The TPACK method can be integrated into a model to train students to explore new knowledge independently while utilizing teacher guidance (Angraini et al., 2023).

This research found areas for improvement related to lecturers' commitment to implementing the TPACK-based productive skills learning model during the classroom learning process. This learning model requires more thorough preparation from the lecturer when compared to the lecture learning model. Apart from that, there are shortcomings in

the learning process, where students often need a competitive atmosphere. As a result, some students can dominate learning in class, even though, in the end, all students participate actively in learning. This research reveals the power of discussing social interactions in learning and students' needs to improve critical thinking skills and help build a comprehensive understanding of concepts for students. This research found that the use of TPACK-based teaching material learning models by lecturers in productive skills courses positively affected students' understanding of productive skills and increased student competence in improving critical thinking skills.

6. Conclusion

The research results show that applying a learning model with TPACK-based productive skills teaching materials using the lecture method has a very significant impact on students' learning outcomes. Thus, implementing the TPACK learning model with appropriate teaching materials can increase the learning effectiveness and critical thinking abilities of PBSI Faculty of Teacher Training and Education, University Muria Kudus students. TPACK-based learning can improve students' critical thinking and metacognitive abilities. In the learning process, it is necessary to pay attention so that the competitive atmosphere does not harm some students. Lecturers can look for ways to ensure the active participation of all students in TPACK-based learning.

Further research can examine the impact of implementing TPACK in a broader context, involving more subjects, and see how digital technology can be used effectively in learning. This research provides valuable insight into the potential of the TPACK-based learning model in improving the critical thinking skills of PBSI Faculty of Teacher Training and Education, University Muria Kudus students. Hopefully, these findings can become a basis for developing more effective and meaningful education in the future.

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Conflict of Interest

The authors declare no conflicts of interest.

References

Angraini, E., Zubaidah, S., & Susanto, H. (2023). TPACK-based Active Learning to Promote Digital and Scientific Literacy in Genetics. *Pegem Journal of Education & Instruction/Pegem Egitim ve Ögretim*, *13*(2).

Aniq, L. N., & Drajati, N. A. (2019). Investigating EFL teachers' perceptions on their TPACK development: how EFL teachers view seven domains on TPACK framework. *Leksika: Jurnal Bahasa, Sastra dan Pengajarannya*, *13*(2), 95-101.

Björklund, C., van den Heuvel-Panhuizen, M., & Kullberg, A. (2020). Research on early childhood mathematics teaching and learning. *ZDM*, *52*, 607-619.

Candra, R., Rahayu, E. S., & Putra, N. M. D. (2020). Development of Science Module SETS Approach to Strengthen Cognitive Learning Outcomes of Elementary School Students. *Journal of Primary Education*, *9*(3), 248-257.

Cloete, M. (2018). The impact of an integrated assessment on the critical thinking skills of first-year university students. *Accounting Education*, *27*(5), 479-494.

Darmuki, A., Hariyadi, A., & Hidayati, N. A. (2020). Peningkatan Minat dan Hasil Belajar Keterampilan Berbicara Menggunakan Metode Mind Map pada Mahasiswa Kelas IA PBSI IKIP PGRI Bojonegoro Tahun Akademik 2019/2020. [Increased Interest and Learning Outcomes in Speaking Skills Using the Mind Map Method in Class IA PBSI IKIP PGRI Bojonegoro Students for the 2019/2020 Academic Year] *KREDO: Jurnal Ilmiah Bahasa dan Sastra*, *3*(2), 263-276.

DeCoito, I., & Richardson, T. (2018). Teachers and technology: Present practice and future directions. *Contemporary Issues in Technology and Teacher Education*, *18*(2), 362-378.

Gunawan, G., Harjono, A., Hermansyah, H., & Herayanti, L. (2019). Guided Inquiry Model Through Virtual Laboratory To Enhance Students'science Process Skills On Heat Concept. *Jurnal Cakrawala Pendidikan*, *38*(2), 259-268.

Hamdani, M., Prayitno, B. A., & Karyanto, P. (2019). Meningkatkan kemampuan berpikir kritis melalui metode eksperimen. [Improve critical thinking skills through experimental methods]. In *Proceeding Biology Education Conference: Biology, Science, Enviromental, and Learning* (Vol. 16, No. 1, pp. 139-145).

Hardika, H., Aisyah, E. N., & Gunawan, I. (2018, October). Facilitative learning to improve student learning creativity. In *3rd International Conference on Educational Management and Administration (CoEMA 2018)* (pp. 186-189). Atlantis Press.

Hidayati, Y., & Sinaga, P. (2019, December). The profile of critical thinking skills students on science learning. In *Journal of Physics: Conference Series* (Vol. 1402, No. 4, p. 044075). IOP Publishing.

Ka, C., Juhari, M. I., Azid, N., Andika Bagus, N. R. P., Rizky, E. W., Purwantono, & Zainuddin, N. A. (2023). Development of Task-Based Instructional E-Module for Data Processing Unit of Information Technology Courses. *Journal of Technology and Humanities*, *4*(1), 1-13. https://doi.org/10.53797/jthkkss.v4i1.1.2023

Kartal, B., & Çınar, C. (2022). Preservice mathematics teachers' TPACK development when they are teaching polygons with geogebra. *International Journal of Mathematical Education in Science and Technology*, 1-33.

Koh, J. H. L. (2019). TPACK design scaffolds for supporting teacher pedagogical change. *Educational Technology Research and Development*, *67*(3), 577-595.

Kurnianti, D., Nugroho, A. A., & Sugiyono, T. (2021). Peningkatan motivasi belajar tema 9 melalui model discovery learning berbasis tpack pada peserta didik kelas iv semester 2 sd negeri pandean lamper 02 semarang. [Increasing motivation to learn theme 9 through the tpack-based discovery learning model in class IV students semester 2 of SD Negeri Pandean Lamper 02 Semarang]. *JURNAL HANDAYANI PGSD FIP UNIMED*, *12*(1), 74-82.

Liando, N. V. F., Tatipang, D. P., & Wuntu, C. N. (2023). TPACK Framework Towards 21st Century's Pre-Service English Teachers: Opportunities and Challenges in Application. *Edumaspul: Jurnal Pendidikan*, *7*(1), 1799-1815.

Mardapi, D. (2020). Assessing Students' Higher Order Thinking Skills Using Multidimensional Item Response Theory. *Problems of Education in the 21st Century*, *78*(2), 196-214.

Nurhadi, M. (2021, February). Analysis The Ability of Thinking Abstractly of Mathematics And Self-Efficacy Through Tpack. In *Journal of Physics: Conference Series* (Vol. 1764, No. 1, p. 012122). IOP Publishing.

Nurul Shida, Ahmad, N., & Sapari, J. (2022). Improving Problem Solving Skills Using Critical Thinking Learning Strategy in Integral Calculus. *Asian Pendidikan*, *2*(2), 52-64. https://doi.org/10.53797/aspen.v2i2.6.2022

Perdana, F. A., Zakariah, S. H., Alasmari, T., & Rassy, R. P. (2023). Development of learning media in the form of electronic books with dynamic electricity teaching materials. *Journal of Educational Technology and Learning Creativity*, *1*(1), 1-6.

Punthai, B. (2014). Introduction to educational research methodology. *Ramkhamhaeng University Printing House*.

Syarifah, Z. A., & Yanuarto, W. N. (2023). Eksplorasi Pembelajaran Matematika Berbasis TPACK. *Proximal: Jurnal Penelitian Matematika dan Pendidikan Matematika*, *6*(2), 208-214.

Taufik, I. N., & Solihah, D. S. (2022). Critical Discourse Analysis of Pantun in Elementary School Textbook. *JENTERA: Jurnal Kajian Sastra*, *11*(2), 410-426.

Zetriuslita, Z., Ariawan, R., & Nufus, H. (2016). Students' critical thinking ability: Description based on academic level and gender. *Journal of Education and Practice*, *7*(12), 154-164.