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Development of Digital-Based Constructivistic Teaching Materials to Improve the Metacognitive Ability of Disaster Materials Students

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Abstract: This study aims to analyze students' metacognitive abilities and the effectiveness of digital-based constructivist teaching materials. It was done to improve students' metacognitive abilities. This study's method was an experiment with a quantitative approach. In this study, the pretest-posttest control group design was used. The ADDIE model was then used to create teaching materials. The MAI (Metacognitive Awareness Inventory) questionnaire instrument was used to assess students' metacognitive abilities. The treatment was provided to the experimental class by using digital-based constructivist teaching materials in the learning process. The aim is to improve students' metacognitive knowledge and skills. The independent sample t-test SPSS version 20.0 for windows was used to compare the two average values (pretest and posttest of the experimental class with the control class). The researchers then used the effect size test to determine the efficacy of digital constructivist teaching materials. It is for improving students' metacognitive abilities. The results of this study showed 1) From the total results of the validation assessment by experts and teachers of geography subjects, the final percentage of 86.5 percent was said to be feasible and valid to be tested. 2) As metacognition improves, so did the value of the metacognition test, which now had a gain index of 57.59%, which translates to "quite effective." Also, the average metacognition assessment showed good results. 3) Analysis of t-test results where the value of Sig. (2-tailed) for the analysis of posttest data was 0.000. The decision obtained was that H0 was accepted because 0.000 <0.05, then the data was significantly different between the control and experimental classes.

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Introduction

There have been many rapid changes in the order of life that exist in society until now. The rapid development of the industrial revolution 4.0 is marked by the ease with which it creates something new and intersects with advances in science and technology. So with the emergence of new life changes in society, it is overgrowing, one of which is also in the world of education. In addition, life has entered the 21st century where the use of technology in carrying out daily life has become an obligation, including in the world of education, to be able to adapt quickly (Yana, 2013).

A country will be prosperous when it can create quality and competitive human resources. The following human resources depend on the quality of implementing educational processes or activities in several schools and similar educational institutions that are carried out for all levels of Indonesian society. In the Program for International Student Assessment (PISA) survey 2020 reading ability results, Indonesia was ranked 6th from the bottom or 74th, an average of 377. Seeing the condition of education requires teachers to adapt more quickly and responsively to changes in 21st-century learning.

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Integrating technology for learning is a significant action by teachers in this era. Teachers must be able to choose the right technology with the material and learning strategies that will be planned. However, with the development of technology, a new theory has emerged which argues that to teach well, in addition to knowledge of content and pedagogic knowledge, a teacher must also have knowledge of technology and knowledge resulting from the combination of these three bits of knowledge (Mishra & Koehler, 2006).

The results of the combination of content, pedagogic and technological knowledge in question are Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK). Teaching by integrating technology is a demand for 21st-century learning. Learning in the 21st century actively plays various technological instruments as tools, processes, and resources (Partnership for 21st Century Learning, 2015). Learning processes and environments must allow equal access to quality learning tools, technologies, and resources. So, in the context of 21st-century learning, teachers need to master TPACK (Kereluik, Mishra, Fahnoe, & Terry, 2013). Teachers must be able to manage their role to support the transition to the changing era of the 21st century and not see it as a real threat to conventional learning systems. It is a challenge that excites, stimulates teachers to action, and it is massive. Adaptation to this educational trend guarantees individuals and society to develop a complete set of competencies, skills, and knowledge and unleash their full creative potential.

It causes the need to develop teaching materials that refer to a constructivist and digital-based approach that emphasizes students' prior knowledge so that the concepts and principles of geography become meaningful. Constructivism is one of the principles that must be considered in learning geography (Widodo, 2007). Constructivist-based textbooks have a character. The constructivist character invites students to be able to construct their thoughts and concepts through assimilation and accommodation. Students can understand the concepts they learn through their own learning experiences. Learning is a process of constructing knowledge based on the knowledge already possessed. The existence of textbooks is an essential part of supporting success in the learning process (Toharudin, 2010).

The rapid development of technology and information is one of the great potentials that educators can use to improve the quality of learning and create a learning environment that can meet students' needs and learning styles. Digital technology is believed to increase student retention and persistence, provide rich content, and be more suitable for 21st-century learning models (Mawarni & Muhtadi, 2017). William (2002) said that students' intelligence could be identified, assessed, and can be a means of improving meaningful learning so that students will be successful in their learning.

Implementing ancient and conventional learning and only assessing cognitive causes students' metacognitive abilities not to be trained. A learning process that occurs in disaster mitigation and adaptation has the potential to demand that students how to utilize a metacognitive strategy in the classroom learning process. Metacognitive abilities enable students to develop as independent students because they will become managers of themselves and assess their thoughts in their learning process. Metacognition consists of knowledge and metacognitive skills oriented to increasing students' awareness and thinking skills in controlling their learning (De Grave, et al., 1996). Educators can act as facilitators who can provide direction and guidance with accompanying questions so that students can realize the cognitive abilities that exist within them. O'Neil & Abedi (1996) also explained the importance of metacognition in solving some problems in the teaching and learning process.

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Implementing ancient and conventional learning and only assessing cognitive causes no increase in students' metacognitive abilities. A learning process that occurs in disaster mitigation and adaptation depends on how students use metacognitive strategies in the learning process in the classroom. This study aims to determine students' metacognitive abilities and to determine the effectiveness of digital-based constructivist teaching materials in improving students' metacognitive abilities.

Research Method

This study used a quantitative approach as pointed out by (Nana S. Sukmadinata 2010). Then, the method in this study was a quasi-experimental design because many factors and research subjects could not be controlled (Fraenkel & Wallen, 2009). The research design used in this study was a pretest-posttest control group design. The exploratory configuration used in this review was the pretest-posttest control group plan. The exploratory configuration used in this review was the pretest-posttest control group plan. The development model chosen in this study was the ADDIE development model, which consists of five stages: the analysis stage, design, development, implementation, and evaluation (Molenda, 2003).

The population of this study were students of class XI SMA, with a sample of two classes, namely XI MIPA 1 (Experimental Class) and XI IPA 3 (Control Class) which were taken using cluster random sampling technique. The treatment in the experimental group was learning using digital-based constructivist teaching materials, while the control group used electronic schoolbooks (BSE). Data collection techniques included administering a pretest to both the experimental and control classes, then treating the experimental class with digital-based constructivist teaching materials in the learning process. It was for improving students' knowledge and metacognitive skills. At the same time, the control class was treated with the use of books used at school. The research instrument in this study used the MAI (Metacognitive Awareness Inventory) questionnaire. The MAI questionnaire contained 52 positive questions used to assess students' metacognitive knowledge and skills. Hypothesis testing was carried out using Independent Sample t-Test using SPSS 20 software.

Results and Discussion

Development of teaching materials the results of the validation of the development of digital-based constructivist teaching materials by experts and geography teachers that have been developed reach a valid category with an average score of 88.3%. The assessment includes assessments carried out by validators 1 and 2 and teachers of geography subjects on 17 August Surabaya High School. So, regarding the accuracy of the concept of the material and others, the teaching material deserves to be tested.

Pretest analysis results, the mean result of the pretest score for the control class was 30.8, and the result class for the experimental class was 32.9, with a maximum value of 44 in the experimental class and a maximum value of 36 in the control class. Then the lowest class value data is 21 in the control class and 26 in the experimental class. These data show a difference in students' metacognitive abilities between the control and experimental classes, with several different value distributions from each class.

Table 1. Pree Test Result Recapitulation

Number	Class	n	Score			
			ideal score	minimum score	maximum score	avarage
1	control class	36	52	21	36	30,8

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2	experimental class	32	52	26	44	32,9

A normality test is conducted to determine whether the data is typically distributed. The normality test was carried out using SPSS 22.0 software using Kolmogorov Smirnov so that the results of the pretest normality test for the control and experimental classes were obtained.

Table 2. Normality Pre-Test

Class	*Asymp.Sig (2 Tailed)*	A	Decision	Description
Control class	.200*	0,05	Accept H0	Normal
Experimental class	0.078	0,05	Accept H0	Normal

The results of the normality test of the pretest data in the experimental and control class with a basic confidence level of 5% (α 0.05), the Asymp value Sig. (2-tailed) for the control class 0.200 > 0.05 and the Asymp value. Sig. (2-tailed) experimental class 0.078 > 0.05, the decision for each class was H0 was accepted, which means the data is typically distributed.

Furthermore, after that, a homogeneity test was carried out to determine whether the data was homogeneous or not before the t-test was carried out using Evene's test to determine the sample's homogeneity. A homogeneity test can be obtained based on a trimmed mean pretest value of (0.361) with the basis of consideration of the confidence level of 5% (α 0.05).

Table 3. Homogeneity Pre Test

Data Type	*Based on trimmed mean*	A	Decision	Description
Pre Test	0.361	0.05	Accept H0	Homogeneity

This hypothesis test helps determine whether the data is significantly different. The value seen in this test is the value of Sig. (2-tailed) were then compared with a 5% confidence level (α 0.05). If the value of Sig. (2-tailed) < 0.05, then the data is significantly different if the value of Sig. (2-tailed) > 0.05, then the data is not significantly different. Value Sig. (2-tailed) pretest in control and experimental classes obtained results of 0.038 with a confidence level of 5% (α 0.05). The decision obtained is that H0 is accepted, meaning that students' metacognitive abilities differ significantly between the control and experimental classes.

Post-Test Analysis Results

Based on the research conducted, the posttest data obtained in the control class after the research by the researcher, the researcher observed and was directly involved in the learning process of Basic Competence 3.7 Disaster Mitigation and Adaptation Materials in class XI SMA. The researcher took class XI MIPA 3 to be selected as the control class according to the direction of the Geography subject teacher for Class XI at SMA 17 August Surabaya. The result of the average value for the distribution of the control class is 37.5, while the average distribution for the experimental class is 45.9. Then the minimum value for the control class is 32, and the experimental class is 36. The maximum value for the control class is 44, and the maximum value for the experimental class is 51. After recapitulation, the data is then analyzed using SPSS 22.0, which will normality test was conducted for the posttest data of the control class and experimental class students. The purpose of this normality test was to determine the normality of the data to be studied.

Table 5. Post test normality

Class	*Asymp.Sig (2 Tailed)*	α	Decision	Description
Control class	.200*	0,05	Accept H0	Normal

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Experimental class	.200*	0,05	Accept H0	Normal

The normality test using SPSS 22.0 showed that the decision obtained was H0 was accepted for the control and experimental classes with a confidence level of 5% (α 0.05). Because of the value of Asymp.Sig (2-tailed) in the control class is 0.200, and the experimental class is 0.200 > 0.05, which means that the data that has been processed and conducted research results are normally distributed.

After the data is analyzed and processed, the data is normally distributed, then SPSS analysis will be carried out, namely the homogeneity test using Levene's test. The homogeneity test was carried out to determine the homogeneity of the post-test data for the control and experimental classes. Which later will get the results of the data being homogeneous or not after being analyzed using SPSS.

Table 6. Post-Test Homogeneity

Data Type	***Based on trimmed mean***	A	Decision	Description
Pre Test	0.572	0.05	Accept H0	Homogeneity

The results of the homogeneity test and the Based on the trimmed mean value on the Levene test was 0.572. The decision taken is that H0 is accepted because 0.572 > 0.05. So, the value in the result of the homogeneity of the data is accepted, and the data is homogeneous. After conducting an SPPS analysis, it can be concluded that the control class posttest data and experimental class posttest data came from homogeneous variants. After analyzing the posttest data and determining that the data is normal and homogeneous, a decision can be made to proceed with further analysis. The following SPSS analysis will perform additional tests, namely, the Independent Samples t-Test test for each control and experimental class studied.

Table 7. Post-Test Analysis Results

Data Type	***Asymp.Sig (2-Tailed)***	α	Decision	Description
Postest	0.000*	0,05	Accept H0	significantly different

This follow-up test, or Independent Sample t-Test test, is helpful to find out whether the control class and practical classes' posttest data are significantly different or vice versa, whether the data of the control and experimental classes do not have a difference. The results of the t-test were the value of Sig. (2-tailed) for the analysis of posttest data is 0.000. The decision obtained is that H0 is accepted because 0.000 <0.05, then the data is significantly different. It means the students in class XI, August 17, Surabaya City, who use digital-based constructivist teaching materials, outperformed students who use electronic books or textbooks provided by the school.

Metacognitive Ability Results

The average value of the N-Gain percentage in the experimental class is 57.59% which has a reasonably effective interpretation, and, in the control, class is 42.88% which has a less effective interpretation. So, the N-Gain in the experimental class has a higher and better interpretation than the control class. The N-Gain value indicates that students who use digital-based constructivist teaching materials in Basic Competence 3.7 Class XI Senior High School outperform those who use school-based materials in knowledge and metacognitive skills.

The increase in results after the analysis using SPPS shows the effectiveness of using digital-based constructivist teaching materials. Then this has also been supported by the analysis of the N-Gain value, which shows that the metacognitive knowledge and skills of

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students who use digital-based constructivist teaching materials have better results than students' metacognitive knowledge and skills using teaching materials used in SMA 17 August Surabaya. As a result, digital constructivist teaching materials effectively improve students' metacognitive knowledge and skills.

The effectiveness of constructivist-metacognitive-based teaching materials is also reflected in the positive responses of teachers and students to the teaching materials used. Teaching materials that can improve knowledge and metacognition skills are also "independent." It means that the teaching materials can be studied by students independently because they are systematic and complete, and there is a learning journal in it so that students can find out their weaknesses and strengths in learning. Students also have an independent responsibility to master the material.

Table 8. N-Gain Recapitulation

Number	Class	Pre Test	Post Test	Max Value	N Gain	N Gain %
1	control	30.86	40.33	52	0,42	42.88
2	experiment	32.91	44.19	52	0,57	57.59

Followed the effect size analysis obtained by using the effect size is 0.38. Then when viewed based on the effect size interpretation table, the effect size value obtained shows that the treatment carried out by researchers influences the metacognitive abilities of students of 0.38, which according to Dunst et al., 2014 is a moderately influential category that has a high category. Have results above 0.80, while those who get results in the low category are 0-0.20.

In conclusion, the ability to make geography learning using digital and constructivist-based media has a moderate effect on the results of the metacognitive abilities of students in class XI MIPA at SMA 17 August Surabaya City when constructivist-based digital teaching materials are used. Students can improve their metacognitive abilities using constructivist teaching materials based on digital flipbooks, such as declarative knowledge. It includes knowledge of facts, beliefs, opinions, generalizations, theories, hypotheses, attitudes about oneself or others, and world events.

Discussion

The development of constructivist teaching materials tested on class XI high school students was carried out because there needed to be teaching materials developed with digital-based constructivists in geography learning. Thus, this research is intended to fulfill the availability of teaching materials that can improve students' metacognitive abilities and align with student learning outcomes on the material on Disaster Mitigation. The digital-based constructivist teaching material is based on constructivism and a digital approach. It will make students more active and creative in learning, coupled with a digital blend that supports students learning practically and independently. In the content of teaching materials, there are several arrangements of material to be discussed and require student involvement to find a concept; questions and independent exercises will be done so that students can grow the concept of an attitude of independence in constructing their understanding. Teaching materials experts have assessed the product development of these teaching materials and subject teachers and have been tested on students. The results of several responses and suggestions from experts and subject teachers became material for product improvement before field trials were carried out.

The results of developing these teaching materials are digital teaching materials on the essential competencies of constructivist-based Disaster Mitigation. The teaching materials

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that have been developed are intended to make students more active and help them to assist them more easily understand the material presented by the teacher. This digital-based constructivist teaching material contains information that involves students constructing their knowledge and finding concepts, ideas, and ideas. For students, these teaching materials are packaged as attractively as possible using digitization. It is hoped that it can motivate students in the learning process in class, and students can be more active in class.

In the learning process, using digital-based constructivist teaching materials will supplement students in learning and can be used as a source of learning or even independent learning in the classroom; the results are so significant while the average distribution for the experimental class is 45.9 percent. Then the minimum value for the control class is 32, and the minimum value for the experimental class is 36. The maximum value for the control class is 44, and the maximum value for the experimental class is 51.

After the data was collected, the prerequisite test analysis was carried out, including the normality test, homogeneity test, and independent-sample t-test to answer several questions related to the research. Normality test of pretest data in the experimental and control class with a basic confidence level of 5% (α 0.05), the Asymp value. Sig. (2-tailed) for the control class 0.200 > 0.05 and the Asymp value. Sig. (2-tailed) experimental class 0.078 > 0.05 shows that both are typically distributed. Then after it was carried out for the homogeneity test, it could be obtained that the Based on trimmed mean pretest value was (0.361) with the basis of considering the confidence level of 5% (α 0.05). The decision obtained is that H0 is accepted because the value is Based on the trimmed mean 0.302 > 0.05, so it can be said that the pretest data for both the control and experimental classes come from homogeneous variants (2-tailed). The pretest in control and experimental classes obtained results of 0.038 with a confidence level of 5% (α 0.05), meaning that students' metacognitive abilities differ significantly between the control and experimental classes.

After obtaining the initial pre-test data, additional research was conducted during KD 3.7 on disaster mitigation and adaptation on 17 August Surabaya High School. Then, administer a post-test was done in the control and experimental classes. The aim is to determine the change after receiving a digital-based constructivist teaching material supplement. It can determine learners' metacognitive abilities. Then the minimum value for the control class is 32, and the minimum value for the experimental class is 36. The maximum value for the control class is 44, and the maximum value for the experimental class is 51. This result shows increased students' metacognitive abilities before being given supplementary teaching materials—digital-based constructivist.

The analysis performed using SPSS obtained the results of the t-test where the value of Sig. (2-tailed) for the analysis of post-test data is 0.000. The decision obtained is that H0 is accepted because 0.000 <0.05, then the data is significantly different. Based on an analysis of research data that has been carried out, the metacognitive abilities of students in the experimental group have different results than those of students in the control group. Then with this difference, the difference in the use of learning resources for students has a good influence on the learning process. Judging (2018) stated that the module developed with the constructivism approach is feasible based on validity, practicality, and effectiveness and can improve student learning achievement. It is also consistent with the findings of Sarah, Risnawati, and Zubaidah Amir (2018), who stated that the module developed using the Constructivism approach meets the validity criteria, an excellent category without revision. It is also suitable for learning (Sarah, Risnawati, & Amir, 2018). In conclusion, students in

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SMA XI August 17, Surabaya, who use digital-based constructivist teaching materials, outperform those who use electronic schoolbooks or textbooks provided by the school.

The metacognitive awareness study also discovered a significant relationship between metacognitive awareness and students' metacognitive knowledge and skills. Tumbel (2021) shows in his research that students who are capable and have high academic performance will also have better metacognitive awareness, which can be used to control cognitive processes and be aware of motivating learning activities. It is in line with the results of research by Peters (2020) that all metacognitive skills and abilities help make students and students become independent learners. In the end, they can encourage them to be themselves and become assessors of their thinking and learning. They will do this during the learning process. The thinking process leads to understanding how students learn, controlling the learning process by beginning to plan actions, determining appropriate learning strategies based on the problems at hand, monitoring learning progress and correcting errors, and analyzing self-determined concepts and learning strategies (Listiana, et al., 2019).

Metacognitive knowledge is one of the most important things for students because when students can monitor their learning process consciously, they will be more confident and more independent in learning (Parlan, Astutik, Su'aidy, 2019). Metacognitive awareness cannot stand alone; metacognitive awareness and metacognitive skills are part of metacognitive abilities that have an essential role in regulating and controlling one's cognitive processes by learning and thinking so that one's learning and thinking processes become more effective and efficient (Arifin & Saenab, 2019). It is also reinforced by the opinion of Livingstone (2017) that the intentional empowerment of students' metacognitive awareness in learning will have implications for the acquisition of other learning outcomes, such as cognitive learning outcomes. Empowering awareness of metacognitive abilities includes efforts to improve the quality of learning (Miller, 2019). According to Keiichi (2020), metacognition is critical for problem-solving. Thus, students who understand metacognition perform better than those who do not.

These digital-based constructivist teaching materials are also very relevant in the 21st-century learning process. The use of flipbook-based e-module media can generate student interest in the learning process and can also increase students' learning motivation. It is in accordance with research conducted by Gea (2019) and the results of research conducted by Searmadi (2018) found that using flipbook learning media in the learning process can improve student learning outcomes. Using learning media in the form of flipbook-based e-modules is an alternative for teachers to facilitate understanding concepts and foster student interest and motivation to learn. It is in accordance with Miharja's research (2020), which shows that with electronic-based teaching materials such as flipbooks, students are assisted to learn independently by observing the material that has been prepared as well as possible without being limited by the classroom.

Digital-based teaching materials consist of text and images and are published in digital form that can be read on computers or other electronic devices such as Android or tablets (Reynaldo, 2020). It is in accordance with the results of Adnan's research (2019), which revealed that the existence of technology and information-based learning provides an excellent opportunity for students to build knowledge based on their experiences of students. Students' ability to master the material must be supported by students' academic abilities. Students with high academic abilities will have a higher speed of thinking (Dehghani, 2021). The ability to master the material in the learning process will help students to improve their thinking skills. Therefore, constructivist-metacognitive-based teaching materials will be

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better able to improve students' metacognitive knowledge and skills if applied to the learning process. Based on the analysis results, it is stated that the control class with common metacognitive knowledge and skills can improve if it is given constructivist-metacognitive-based teaching materials. It is related to teaching materials that students can use by constructing their knowledge, and being independent, which can empower their metacognitive abilities and help students in their learning process. On the one hand, motivation is very influential on the process and student learning outcomes. Research conducted by Didik, et al. (2019) found that students' learning motivation was very good when using modules. Students also have excellent attention, interest, satisfaction, and search in using the module as teaching material.

In conclusion, using digital-based constructivist teaching materials is critical to increase students' metacognitive awareness in learning. Geography, in particular, enables students to be more independent in understanding important information that must be known, active in learning thinking skills for problem-solving, and knowledgeable about the best learning strategies to ensure quality learning.

Conclusion

This research showed that the developed digital-based Constructivist teaching materials were declared effective. It is based on and is based on an increase in the metacognitive ability of students in SMA 17 August Surabaya. The value marks an increase in the metacognition test with a gain index of 57.59%, which had a "quite effective" interpretation. The average metacognition assessment also showed good results. The average value of the N-Gain percentage in the experimental class was 57.59% which had a reasonably effective interpretation and in the control class was 42.88% which had a less effective interpretation. So, it can be concluded that the N-Gain in the experimental. Based on calculations and analysis to determine the effect of using teaching materials obtained using the effect size is 0.38. Then, based on the interpretation table of the effect size, the effect size value shows that the treatment carried out by the researcher influences the metacognitive abilities of students with a moderate effect category. Meanwhile, with the analysis of the T-test results of the t-test, the value of Sig. (2-tailed) for the analysis of posttest data is 0.000. The decision obtained is that H0 is accepted because 0.000 <0.05, then the data is significantly different between the metacognitive abilities of the control class and the experimental class.

Recommendation

The use of digital-based constructivist teaching materials is essential today in learning in the middle of the 21st century and in the development of the world that is entering the 4.0 era. Teachers must have skills in developing teaching materials and also combined with the ability to master technology to make learning meaningful. It is recommended that in learning activities, especially geography subjects, teachers can use these digital-based learning materials, which can improve students' knowledge and cognitive skills.

References

Adnan., Saenab, S., & Saleh, AR (2018). Unleash Students Motivation with Blended Knowledge Transfer Instructional Model. Proceedings of ICMSTEA 2016: International Conference on Mathematics, Science, Technology, Education, and their Applications, Makassar, Indonesia, 3rd –4th, 240–243

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E-ISSN: 2722-4627
pp. 1-11

Antika, R. (2015). Pembelajaran matematika kontekstual untuk meningkatkan literasi matematis dan motivasi belajar siswa SMP. (Tesis). Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Bandung.

Bonk, C. J., & Smith, G. S. (1998). Alternative instructional strategies for creative and critical thinking in the accounting curriculum. Journal of Accounting Education, 16(2), 261–293.

Dehghani, M. (2021). Relationship Between Students' Critical Thinking And Self-Efficacy Beliefs In Ferdowsi University Of Mashhad, Iran. Procedia Social And Behavioral Sciences, 15, pp. 2952-2955.

Didik, & et al. (2019). Development of Reproductive System Learning Module Based on Al-Quran/Hadith To Increase Students' Motivation and Learning Outcomes. Journal of Education, 11(1), 132–140

Gea, NFA, E. Saptaningrum., U. Kaltsum. 2019. The Effect of Problem Based Learning (PBL) Learning Model Assisted by Flipbook Maker on the Material of Wave Symptoms on the Learning Achievement of Class XI Students.

Judding, M. (2018). Pengembangan bahan ajar pendidikan agama islam berbasis pendekatan konstruktivisme pada materi berani hidup jujur kelas XI SMAN 2 Gowa.

Keiichi, Shigematsu. (2020). Metacognition in Mathematics Education. Mathematics Education In Japan. Japan: JSME

Kereluik, K., Mishra, P., Fahnoe, C., & Terry, L. (2018). What Knowledge Is of MostmWorth: Teacher Knowledge for 21 st Century Learning. Journal of Digital Learning in Teacher Education, 29(4)

Fraenkel, J. R., & Wallen, N. E. (2009). How to Design and Evaluate Research in Education (Sixth ed). New York: Mc Graw-Hill Book.

Fischer (2009) Berpikir Kritis. Sebuah Pengantar. Jakarta: Erlangga

Mawarni, S., & Muhtadi, A. (2017). Pengembangan Digital Book Interaktif Mata Kuliah Pengembangan Multimedia Pembelajaran Interaktif Untuk Mahasiswa Teknologi Pendidikan. Jurnal Inovasi Teknologi Pendidikan 4 (1). 84-96.

Molenda, M. In search of the ellusive ADDIE model. Pervormance improvement, 42 (5), 34-36. Submitted for publication in A. Kovalchick & K. Dawson, Ed's, Educational Technologi: An Encyclopedia. Copyright by ABC- Clio, Santa Barbara, CA, 2003.

Miharja, J., & Juniawan, EA (2020). Development of Integrated Multimedia Module on Human Excretory System Material to Improve Students' Analytical Ability in High School. BIOSPHERE, 2(5), 1-9

Partnership for 21st Century Skills (P21). (2009, Desember). Framework for 21st Century Learning. Retrieved Desember 20, 2015, from P21 Partnership for 21st Century Skills: http://www.p21.org/our-work/p21-framework

Parlan, Astutik, NAI and Su'aidy, M. (2019). Analysis of Metacognitive Knowledge and Metacognitive Awareness of Learners and Their Relationship with Learning Achievement. Journal of Chemistry Learning

Peters. (2020.) The Politics of Bureaucracy. London: Routledge hal. 299-381

Rinaldi, R. (2018). Metacognitive awareness. Journal of RAP (Actual Research on Psychology, Padang State University), 8(1).

Reynaldo, I. (2020). Development of Interactive Multimedia-Based E-Books Using Sigil Applications on Optical Instrument Materials for SMA/MA. UIN Raden Intan Lampung

Vol. 10 No. 1 : January 2023
E-ISSN: 2722-4627
pp. 1-11

Sarah, D., Risnawati, & Amir, Z. (2018). Pengembangan modul bebasis pendekatan konstruktivisme untuk memfasilitasi pemahaman konsep matematis siswa Sekolah Menengah Atas di Pekanbaru. Juring: Journal for Research in Mathematic Learning, 1(3), 199–206

Schraw, G., & Dennison, R. S. (1994). Assesing Metacognitive Awareness. Contemporarry Educational Psychology, 19 (5), pp. 460-475.

Searmadi, Bagus Putra & Rina Harimurti. (2018). Application of Flipbook Innovation as a Learning Media to Improve Learning Outcomes Introducing PHP Class XI RPL at SMK Negeri 2. ITEdu Journal. Volume 01 Number 02 Year 2016, 42-48

Willem, W.M. (2021). Practical Intelligence for School: Developing Metacognitive Sources of Achievement in Adolescence. Developmental Review 22: 162-210.

