

# Development of E-Module Based on the Discovery Learning to Improve the Student Creative Thinking Skills

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## ABSTRACT

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We are now in an era of very advanced technology. The world is entering the era of the industrial revolution 4.0 which is marked by increased communication, interaction and development of digital systems, artificial intelligence, and virtual. The industrial revolution 4.0 is also shown by the proliferation of computers and recording automation occurring in all fields. With the blurring of boundaries between machines, people and various resources. Through intelligence engineering and the internet of things. However, recently some researchers stated that the use of technology in education has not been maximized. This study aims to analyze the validity, practicality and effectiveness of discovery learning-based e-modules to improve students' creative thinking skills. The method used in this study is Research and Development with the ADDIE type. In the ADDIE technique, there are 5 stages consisting analysis, design, development, implementation, and evaluation. Data collection instruments include validity questionnaires, effectiveness tests and practicality questionnaires. The data analysis techniques used in this study is a qualitative analysis technique consisting of data reduction, data presentation and data inference. The results of the study based on the assessment of material experts obtained an average of 70.00. The results of the media expert's assessment obtained an average of 88.30. Student responses get an average of 80.12. The results of the paired sample test have a significant (2-tailed) value of 0.000. The conclusion of this study is that the developed e-module is valid based on a validity questionnaire, practical based on a practicality questionnaire and effective based on an effectiveness test.



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## A. INTRODUCTION

We are now in an era of increasingly advanced technology. The world is entering the era of the industrial revolution 4.0 which is marked by greater communication, interaction, and development of digital technology, as well as artificial intelligence and virtual reality (Lase, 2019). The industrial revolution 4.0 is also shown by the proliferation of computers and recording automation in all fields (Prasetyo & Trisyanti, 2018). With the increasingly blurred boundaries between machines, humans and various resources (Lase, 2019). Through intelligence engineering and the internet of things, the 4.0 industrial revolution itself occurred in the 2010s as the basis for the movement and communication of humans and computers (Risdiyanto, 2019). Currently it can be seen together that information and communication technology is used fully in almost all lines of human life (Wijaya et al, 2016).

To face the era of the industrial revolution 4.0, education is needed that is able to form a creative, innovative, and comprehensive generation (Lase, 2019). Education is becoming an

increasingly important need to ensure students have learning skills and new discoveries, are proficient in the application of technology, and can enter the world of work using life skills (Wijaya et al, 2016). Schools must adapt to these changing conditions in order to develop, so that their students can keep up with the times (Tucker, 2014). This will certainly be achieved, one of which is by optimizing the use of technological advances as educational facilities and infrastructure which are expected to be able to make graduates who meet the needs of today's era (Lase, 2019). Learning activities in schools must adopt these technological and information developments as learning media that are routinely used.

The teacher as the spearhead is the determinant of success in achieving educational goals. The progress of a country is in the hands of the teacher (Mahanal, 2014). The task of teachers in carrying out 21st century teaching and learning activities is very important to realize a quality future generation of the nation (Zubaidah, 2016). Teachers are required to master the skills and expertise to be able to adapt to the latest technology and respond to the challenges of globalization (Lase, 2019). However, the use of technology in education has not been maximized (Liesa-Orús et al, 2020). In an effort to meet the demands of the 21st century, gradually the use of media and learning material tools should switch to technology-based ones (Tucker, 2014).

How is it possible if targeting students to have 21st century skills if the teacher as a teacher is not ready (Risdianto, 2019). The blurry portrait of the education world of the Indonesian nation, including education in rural areas is still lagging behind in urban areas, starting from the quality of the teachers to the available facilities and infrastructure as well as the support of the surrounding environment (Budiana et al, 2015).

Education in the era of the industrial revolution 4.0 requires teachers to be able to adapt, and be willing to continue to learn new knowledge so that its quality can improve, and be able to get along with millennial generation students (Supandi et al, 2019). Mastery of technology by teachers is an obligation in order to achieve teacher performance professionalism (Budiana et al, 2015). The main effort that can be done is to increase the confidence of a teacher and to be involved and participate in the development process, namely the development of technology for learning to improve the quality of the learning process and student achievement (Budiana et al, 2015). Given the many benefits derived from the use of technology for teaching and learning activities, mastery of technology for prospective mathematics teachers is very important (Hamni, 2016). The ability of educators to integrate technology in the teaching and learning process will also significantly affect the success of students in achieving educational goals (Restiyani, 2015).

Curriculum reorientation in education units refers to learning based on the latest technology and information, such as the internet of things, big data, and computing, which should be a mandatory curriculum to produce graduates who are skilled in the field of information literacy and technological literacy to meet the needs of the 21st century. Lasse, 2019). The revitalization of the learning system including curriculum and learning media based on technology and communication needs to be realized immediately (Ghufron, 2018).

In the era of disruption, the teaching and learning process must be able to provide skills for long-term learning in the hope that students can adapt to the era of disruption and transition to a new era known as the Abundant Era which is rich in natural resources,

information, learning media, and learning resources. (Risdianto, 2019). The design of the learning process strategy will have a central influence on the success of learning in the 21st century (Zubaidah, 2016). The creativity and skills of teachers to plan interesting learning strategies are certainly very important (Zubaidah, 2016). Teachers must be able to integrate technology in learning activities according to the needs of students.

Based on observations at SMK Negeri 1 Giritontro, Wonogiri Regency, Central Java Province, the main learning media used is still based on printed books. The description of the material and the collection of questions available is very limited. The ability of teachers in Wonogiri to integrate technology in learning is also still low. There are no contextual questions from current mathematical problems that allow students to work on them with various solutions (open ended). Lack of providing opportunities for students to develop their creative thinking skills to improve.

In addition, other limitations of printed books cannot contain multimedia such as video, sound, and required learning support applications. Print books also do not refer to a particular learning method that is adapted to the characteristics of the material and students. As a solution to these obstacles, we need learning facilities that are in accordance with the times. Can improve 21st century skills and refer to specific learning methods. Integrated multimedia that is more representative and interactive.

The use of technology as learning multimedia will attract the focus and attention of students. Students' enthusiasm and interest in learning will grow as a result of using more interesting learning media, which will help them understand the material provided. (Setyadi & Qohar, 2017; Subkhan, 2016). The technology used to improve students' learning abilities is digital media in the form of video, images, text and animation (Hazra et al, 2013; Leow & Neo, 2014; Sadaghiani, 2012). Such diverse digital multimedia can be packaged into interactive electronic modules, or often referred to as e-modules

E-module is a technology-based educational product that can be considered as one of the right media to be used in the learning process (Aziz & Suparman, 2020). E-modules also have characteristics, namely in accordance with the development of science and technology, flexible, friendly to users, and making it easier for users to access information (Melvinasari & Suparman, 2019). Likewise for learning mathematics, it is necessary to combine mathematical and digital abilities (Geraniou & Jankvist, 2019). As a mathematics educator, you should not hesitate to use mathematical competence and digital competence simultaneously in teaching and learning situations (Geraniou & Jankvist, 2019).

The results of the e-module development can be used online and offline by students using smartphones. Indonesian society cannot be separated from smartphones, especially among teenagers (Kamhar & Lestari, 2019). Almost all students, especially high school level, already have an Android smartphone so that learning using Android applications can be carried out (Destiana, 2019).

Independent learning by utilizing smartphones as learning media has advantages in its use, namely teaching can be done repeatedly, wherever and whenever they want, and because smartphones are interesting objects, so they can increase students' motivation and absorption (Martha et al, 2018). The use of smartphones in the school environment can make it easier when looking for additional subject matter and help students find learning resources that can

be found on the internet, and make it easier for students to do assignments (Khodijah & Nurizzati, 2018).

Almost every student can use a smartphone to play games and watch videos (Batubara, 2017). Android-based learning multimedia is easy to learn independently outside of learning activities and outside the classroom (Batubara, 2017). The learning modules are structured and specialized with the aim that students can learn independently, not limited to the space and time of module users (Ministry of Education and Culture of the Republic of Indonesia, 2018; Liesa-Orús et al, 2020). It is necessary to develop more effective learning media that can be used at any time by students both online and offline.

The Law on the National Education System Number 20 of 2003 explains that teaching and learning activities are the interaction of educators with students using existing learning resources in a learning environment with the aim of being able to grow and develop the potential of students so that they can become human beings who believe and are pious, have noble character, stay healthy and have knowledge, have skills, think creatively, have independence and can become democratic citizens and be responsible. The purpose of education shows that the learning process is not just increasing scientific competence. The development of character and national identity is also contained in the law which contains strong foundations.

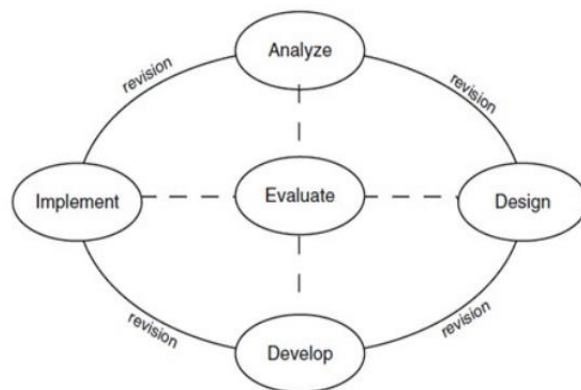
Ability and skills are also the goal of developing an educational orientation in Indonesia. Creative thinking abilities and skills are one of them. Because creative thinking is a high-level competency which is a continuation or development of basic competencies in line with Eryvnyck (1991) in the mathematical thinking cycle when it reaches an advanced level, creativity will play a very important role. Designing and producing new and original things, as well as positive and negative aspects that may arise during the process and implementation, is a representation of creative thinking skills (Marliani, 2015). One of the talents that must be developed in accordance with the times and needs of the 21st century is creative thinking.

The methods used in the learning process should also support the development of 21st century creative thinking skills. Students will be required to find something new as part of the process of applying discovery learning, and the process of finding something new requires creativity, so it is hoped that the discovery learning method and the syntax contained in it will improve students' creative thinking skills. This is in accordance with Schlenker's research in Trianto (2007) which states that discovery learning can improve scientific understanding, be productive when thinking creatively, and students will become more proficient in finding and evaluating information. Discovery learning is an appropriate learning method used in learning to increase students' skills in creative thinking skills. Based on the problem, the researcher was moved to carry out research with the title "Development of an discovery learning e-module to improve students creative thinking skills".

## **B. METHODS**

This type of research is development research using the ADDIE model. This model consists of five steps, that is first, analysis; second, design; third, development; fourth, implementation; and fifth evaluation, (Tegeh & Kirna, 2013). The products produced in this study are teaching materials in the form of e-modules based on Discovery Learning to improve students' creative thinking skills. This research will be conducted at SMK Negeri 1

Giritontro for 10th grade students. The development step is to test the product's feasibility, both for validity, practicality and effectiveness. The ADDIE model applies a systematic continuity approach. The main essence of a systematic approach is to divide the research planning process into several stages, to make the process into a logical sequence, then use the results of each stage as input for the next stage (Hlynka & Jacobsen, 2010). As shown in Figure 1.



**Figure 1.** ADDIE Model Development Design (Cahyadi, 2019)

The data collection techniques used in the research and development of this e-module are: observation, validity test questionnaires and practicality test questionnaires. The data collection instruments used were: test and non-test instruments. The data analysis techniques used in this study is a qualitative analysis technique consisting of data reduction, data presentation and data inference.

### C. RESULT AND DISCUSSION

The steps for the development of the E-Module in this study have been carried out using the ADDIE (Analyze, Design, Development, Implementation, Evaluations). As for a more detailed explanation of the steps, it is explained as follows:

#### 1. Analysis

Based on the findings of the researchers, SMK Negeri 1 Giritontro implemented the 2013 Revised 2017 Curriculum. During the Pandemic the mathematics subject at SMK Negeri 1 Giritontro was twice thirty minutes for one meeting. The Minimum Mastery Score for Mathematics at SMK Negeri 1 Giritontro is sixty. Observations at SMK Negeri 1 Giritontro show that the availability of modules that focus on creative thinking skills is still low. The existing modules have not facilitated students to improve their creative thinking skills. Another obstacle that arises during the pandemic is the distribution of modules to get to the hands of students. Not to mention the availability of modules in schools has not been able to facilitate all students. During the pandemic, teaching and learning activities at SMK Negeri 1 Giritontro must be carried out online, this situation makes students become accustomed to using technology or gadgets to access learning resources. So that during this research students are ready to use e-module learning resources that they can easily access with their gadgets.

## 2. Design

At the design stage, the researcher created an e-module based on the research findings. The designed e-module includes discovery learning as well as arithmetic sequences and series content for 10th grade students. The e-module consists of components such as the title page, e-module identity page, preface, and table of contents. In addition, the e-module presents the benefits of learning, a concept map contains an outline of the material to be achieved, a learning syntax with a discovery learning approach that is composed of achieving creative thinking skills, sequence formulas and arithmetic series containing formulas that are generally used to solve arithmetic sequences and series problems.

## 3. Development

Researchers carry out activities in the development stage to translate design specifications from the design stage into physical form, resulting in the development of prototype products in the form of discovery learning-based e-modules to improve creative thinking skills of arithmetic sequences and series, as shown in Figure 2 and Figure 4.

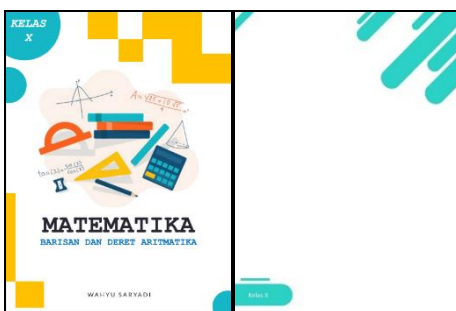


Figure 2. Cover and Background of the E-Module

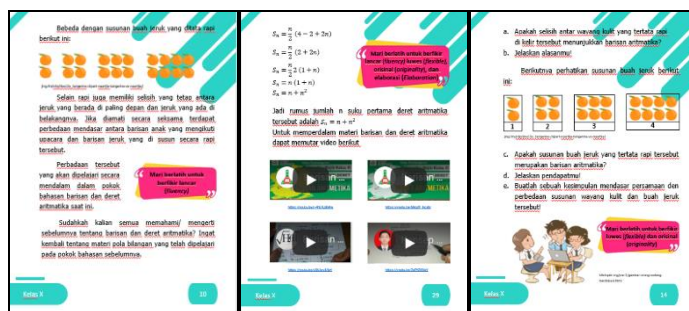


Figure 3. Contents Page

Figure 2 is a display of the cover and background of the e-module, and Figure 3 is a display of the contents of the e-module. To determine the validity of the material in the developed e-module, validation of material expert products was carried out by two validators, namely Nur Robiah Nofikusumawati Peni, S.Pd., M.Ed., Ph.D in Ed (Lecturer at Ahmad Dahlan University) January 21, 2022 and Yuliana, S.Si., M.Pd. (Lecturer at Widya Dharma University Klaten) on January 22, 2022. Furthermore, to determine the validity of the media aspect of the developed e-module, two validators were validated by media expert products, namely Dr. Kulsum Nur Hayati, M.Pd., M.Si (Development of Educational Technology Kemendikbudristek)

dated January 17, 2022 and Dr. Puguh Wahyu Prasetyo, S.Si., M.Sc (Lecturer at Ahmad Dahlan University) on January 18, 2022.

#### 4. Implementation

After the e-module is declared suitable for use, the e-module is implemented in small classes or small class practical trials. To find out the practicality of e-modules in small classes. After that, learning activities were continued using discovery learning-based e-modules in the experimental class, this trial was carried out for twelve face-to-face meetings including pre-test and post-test. After the small class trial was carried out, at this stage the learning activities were carried out face-to-face in the Arithmetic Sequences and Series material. This SMK Negeri 1 Giritontro, especially the 10th grade chosen as the research class, consists of two classes, namely TKJ 3 and TKJ 4 class students.

#### 5. Evaluation

The evaluation phase of the research was carried out by comparing the scores from the results of the creative thinking skills test in the form of valid pre-test questions with the scores from the results of the creative thinking skills test in the form of post-test questions that were already valid in the research class.

##### a. Material Validity Analysis

The following is material validity analysis, as shown in Table 1.

**Table 1.** Analysis of Material Validity

Validator	Total Score	Predicate
Nur Robiah	46	
Nofikusumawati Peni, S.Pd., M.Ed., Ph.D in Ed	$\frac{46}{60} \times 100 = 76,67$	A
Yuliana, S.Si., M.Pd	38	
	$\frac{38}{60} \times 100 = 63.33$	B
Difference in Total Validator Value 1 and 2		13,33
Total Value of Validator 1 and 2		140
Average		70
Predicate		B
Validity Level		Pretty good

Based on the material expert assessment score, the average score from the validator is seventy so that based on the discovery learning-based e-module validity assessment criteria developed, it includes the materially "valid" criteria because it meets the "B" assessment predicate from the material expert validator.

##### b. Media Validity Analysis

The following is media validity analysis, as shown in Table 2.

**Table 2.** Analysis of Media Validity

Validator	Total Score	Predicate
Dr. Kulsum Nur Hayati, M.Pd., M.Si	193 $\frac{193}{235} \times 100 = 82,13$	A
Dr. Puguh Wahyu Prasetyo, S.Si.,M.Sc	222 $\frac{222}{235} \times 100 = 94,47$	A
Difference in Total Validator Value 1 and 2		12,34
Total Value of Validator 1 and 2		176,60
Average		88,30
Predicate		A
Validity Level		Very Good

Based on the media expert assessment score, the average score from the validator is 176.60 so that based on the criteria for evaluating the validity of the discovery learning-based e-module that was developed, it includes the "valid" criteria in terms of media because it meets the "A" assessment predicate from the media expert validator.

#### c. Practical Analysis Results

The following is practical analysis, as shown in Table 3.

**Table 3.** Practical Analysis

Total Score	260,38	5207,69
Average Score	4,01	80,12
Predicate	A	
Practicality Level	Very Practical	

Furthermore, based on the results of the questionnaire response scores of large class or research class students in Table 4.17, the average practicality assessment score of 80.12 with the predicate "B" means that the e-module has been practical based on the practicality test of the large class or research class.

#### d. Effectiveness Analysis Results

The results of the t-test showed that the significant value (2-tailed) was  $0.000 < 0.05$ , so  $H_0$  was rejected so that there was a significant difference between mathematics learning outcomes in the pre-test and post-test data. The average pre-test score obtained by students is 37.69 while the average post-test score obtained by students is 71.15. The N-Gain value is 0.51 so that if viewed from the creative thinking skills the increase that occurs is included in the medium category. Therefore, based on the data obtained, it can be concluded that the e-module is effective in terms of students' creative thinking skills. In other words, there is an increase between the results of the creative thinking skills test in the form of pre-test questions before being given learning materials in the form of discovery learning-based e-modules with the results of creative thinking skills tests in the form of post-test questions after being given learning materials in the form of discovery learning-based e-modules.

The availability of modules at SMK Negeri 1 Giritontro is still very limited. Both in comparison with many learners, as well as the availability of types of subjects. The



module used is a government recommendation module, many of which are not comparable to students. If you have to lend one by one, it is still very limited so that not all students get learning modules. In addition, the module is quite large in size, heavy and troublesome when taken back and forth for each day according to the subject schedule.

The modules used are also still very general, not referring / facilitating teachers specifically teaching with certain learning methods. Meanwhile, the characteristics of students are aspects that must be adjusted to the learning methods and strategies that will be designed by the teacher. This limitation is a classic ongoing obstacle and is far from a solution if there is no real breakthrough. In accordance with the statement of Budiana et al (2015) which states that the blurry portrait of the world of education of the Indonesian nation, including education in rural areas, is still lagging behind with acceleration in urban areas, starting from the quality of teachers to the available facilities and infrastructure as well as the support of the surrounding environment.

Based on these various analyses, the researcher decided to develop an e-module based on discovery learning to improve the creative thinking skills of students. Considering that in the 21st century, human life has been disrupted by the rapid development of technology. Then it is necessary to develop learning media that is based on technology. In the hope of providing many conveniences, practicality and effectiveness in learning without reducing the essence of the validity of the media and material.

As stated by Risdianto (2019) who stated that in the era of disruption, the teaching and learning process must be able to provide skills for long-term learning in the hope that students can adjust to the era of disruption and transition to a new era known as the Abundant Era which is rich in natural resources, information, learning media, and learning resources. In line with the recommendations from Ghufroon (2018) stated that the revitalization of the learning system including curriculum and technology and communication-based learning media needs to be realized immediately.

E-Module is a very appropriate solution to be developed in response to the above limitations. In line with the results of research (Aziz & Suparman, 2020) which states that e-modules are technology-based educational products that can be considered as one of the right media to be used in the learning process. Strengthened by the results of research by Melvinasari & Suparman (2019) which states that e-modules also have characteristics that are in accordance with the development of science and technology, flexible, friendly to users, and make it easier for users to access information. Because e-modules can be distributed to an unlimited number of learners. Likewise, the condition of the learning infrastructure owned by students is very supportive of learning to use e-modules. In line with the results of research from Liesa-Orús et al (2020) which states that learning modules are compiled and specialized with the aim that students can learn independently not limited to space and time.

All students already have a smartphone that can be used at any time as a means of learning. Because almost every time in adolescence can not be separated from smartphones. In accordance with the results of research by Kamhar & Lestari (2019) which states that Indonesian people cannot be separated from smartphones, especially

among teenagers. It is possible for them to be able to open e-modules for learning in schools that are accompanied and facilitated by teachers as well as learning independently, repeating and deepening the material outside of learning hours. In line with the results of research by Martha et al (2018) which concluded that independent learning by utilizing smartphones as a learning medium has advantages in its use, namely teaching can be done repeatedly, anywhere and anytime they want, and because smartphones are objects of interest, so as to increase the motivation and absorption of students.

The use of this smartphone is also very helpful for the learning process of students if they need other learning resources or resource support that is not yet available. As the results of research by Khodijah & Nurizzati (2018) which concluded that the use of smartphones in the school environment can make it easier when looking for additional subject matter and help students find learning resources that can be obtained on the internet, and make it easier for students to do assignments. In line with the results of Batubara (2017) which concluded that Android-based multimedia learning is easy to learn independently outside of learning activities and outside the classroom.

The discovery learning method is very suitable to be applied to the condition of students who are still lacking in their creative thinking skills. Because this learning method greatly facilitates students to be active in learning. Thus, it can stimulate the creativity of students in the learning process. In accordance with the results of Rudyanto (2016) which states that discovery learning requires students to find new things, the process of finding new things requires creativity, so that the discovery learning method and the syntax in it can improve students' creative thinking skills. Reinforced by the statement of Geraniou & Jankvist (2019) that for mathematics learning, it is necessary to combine mathematical and digital skills. Today the government also recommends that learning be directed to be student-centered.

#### **D. CONCLUSION AND SUGGESTIONS**

Based on the results of the research above, conclusions can be drawn departing from the research objectives including: (1) the development of discovery learning-based e-modules to improve students' creative thinking skills is declared valid in material and media, practical and effective. The average assessment of the material validators is 70.00, predicate B with a fairly good level of validity. Based on the criteria used, the e-module is declared valid and can be used. The media validator's average assessment is 80.30 predicate A with a very good level of validity. The average practicality test result is 80.12, predictive A with a very practical level of practicality.

Likewise for the effectiveness test, the results of the paired sample test have a significance value (2-tailed) of  $0.000 < 0.05$ , then  $H_0$  is rejected so that there is a significant difference between the results of learning mathematics in the pre-test and post-test data. The average pre-test score obtained by students is 37.69 while the average post-test score obtained by students is 71.15. The N-Gain value is 0.51 so that if viewed from the creative thinking skills the increase that occurs is included in the medium category. Therefore, based on the data

obtained, it can be concluded that the e-module is effective in terms of students' creative thinking skills.

Judging from the results of the research that has been concluded, the researchers intend to provide suggestions. First, for researchers who will discuss further material on the development of discovery learning-based e-modules to improve students' creative thinking skills, they can be equipped with more sophisticated multimedia such as augmented reality and the like. For teachers, don't hesitate to develop IT-based learning media, because according to the demands of the times in the 21st century, media is needed according to the era. Finally, for the school, it is proven that the e-module developed can improve students' creative thinking skills, so it is appropriate to continue to facilitate teachers continuously to continue to develop similar and more modern learning media.

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### REFERENCES

- Aziz, S. N., & Suparman. (2020). Design of mathematical e-module based on inquiry learning model to stimulate the creative skills. *International Journal of Scientific and Technology Research*, 9(3), 4806–4812.
- Batubara, H. H. (2017). *Pengembangan media pembelajaran matematika berbasis android untuk siswa sd/mi*. 3(1), 12–27.
- Budiana, H. R., Sjafirah, N. A., & Bakti, I. (2015). Pemanfaatan teknologi informasi dan komunikasi dalam pembelajaran bagi para guru smpn 2 kawali desa citeureup kabupaten ciamis. *Dharmakarya*, 4(1). <https://doi.org/10.24198/dharmakarya.v4i1.9042>
- Cahyadi, R. A. H. (2019). Pengembangan Bahan Ajar Berbasis Addie Model. *Halaqa: Islamic Education Journal*, 3(1), 35. <https://doi.org/10.21070/halaqa.v3i1.2124>
- Destiana. (2019). *Pengaruh teknologi informasi berbasis android (smartphone dalam pendidikan industry 4.0*. 190–197.
- Geraniou, E., & Jankvist, U. T. (2019). Towards a definition of “mathematical digital competency.” *Educational Studies in Mathematics*, 102(1), 29–45. <https://doi.org/10.1007/s10649-019-09893-8>
- Ghufron, G. (2018). Revolusi industri 4.0: Tantangan, peluang, dan solusi bagi dunia pendidikan. *Seminar Nasional dan Diskusi Panel Multidisiplin Hasil Penelitian dan Pengabdian Kepada Masyarakat 2018*, 1(1), 332–337.
- Hamni, N. F. (2016). Instrumen Penelitian. *Journal Metode Penelitian*, 59–75.
- Hazra, A. K., Patnaik, P., & Suar, D. (2013). Relation of modal preference with performance in adaptive hypermedia context: An exploration using visual, verbal and multimedia learning modules. *2013 IEEE Fifth International Conference on Technology for Education (t4e 2013)*, 163–166. <https://doi.org/10.1109/T4E.2013.47>
- Hlyinka, D., & Jacobsen, M. (2010). What is educational technology, anyway? A commentary on the new AECT definition of the field. *Canadian Journal of Learning and Technology / La revue canadienne de l'apprentissage et de la technologie*, 35(2), 0–3. <https://doi.org/10.21432/t2n88p>
- Kamhar, M. Y., & Lestari, E. (2019). *Pemanfaat sosial media youtube sebagai media pembelajaran bahasa indonesia di perguruan tinggi*. 1(2009).
- Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2018). *Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia (Permendikbud) nomor 42 tahun 2018 Tentang Kebijakan Nasional Kebahasaan dan Kesastraan*. 27. [www.kemendikbud.go.id](http://www.kemendikbud.go.id)

- Khodijah, S., & Nurizzati, Y. (2018). Dampak penggunaan teknologi informasi dan komunikasi terhadap perilaku sosial siswa di man 2 kuningan. *Jurnal Edueksos*, VII(2), 161–176.
- Lase, D. (2019). Pendidikan di era revolusi industri 4.0. *SUNDERMANN: Jurnal Ilmiah Teologi, Pendidikan, Sains, Humaniora dan Kebudayaan*, 12(2), 28–43. <https://doi.org/10.36588/sundermann.v1i1.18>
- Leow, F. T., & Neo, M. (2014). Interactive multimedia learning: Innovating classroom education in a Malaysian University. *Turkish Online Journal of Educational Technology*, 13(2), 99–110.
- Liesa-Orús, M., Latorre-Coscolluela, C., Vázquez-Toledo, S., & Sierra-Sánchez, V. (2020). The technological challenge facing higher education professors: Perceptions of ICT tools for developing 21st century skills. *Sustainability (Switzerland)*, 12(13). <https://doi.org/10.3390/su12135339>
- Mahanal, S. (2014). Peran guru dalam melahirkan generasi emas dengan ketrampilan abad 21. *Seminar Nasional Pendidikan HMPS Pendidikan Biologi FKIP Universitas Halu Oleo*, 1(September), 1–16.
- Marliani, N. (2015). Peningkatan kemampuan berpikir kreatif matematis siswa melalui model pembelajaran missouri mathematics project(MMP). *Jurnal Formatif*, 5(1), 14–25.
- Martha, Z. D., Adi, E. P., & Soepriyanto, Y. (2018). E-book berbasis mobile learning. *Jurnal Kajian Teknologi Pendidikan*, 1(2), 109–114. <http://journal2.um.ac.id/index.php/jktp/article/view/3705/2775>
- Melvinasari, & Suparman. (2019). Design of mathematics module based on rme to improving the problem-solving ability. *International Journal of Scientific and Technology Research*, 8(11), 3918–3922.
- Prasetyo, B., & Trisyanti, U. (2018). Revolusi industri 4.0 Dan tantangan perubahan sosial. *IPTEK Journal of Proceedings Series*, 0(5), 22–27. <https://doi.org/10.12962/j23546026.y2018i5.4417>
- Restiyani, R. (2015). Profil Pemanfaatan Teknologi Informasi Dan Komunikasi (Tik) Sebagai Media Dan Sumber Pembelajaran Oleh Guru Biologi. *Edusains*, 6(1), 49–66. <https://doi.org/10.15408/es.v6i1.1100>
- Risdianto, E. (2019). Analisis pendidikan ndonesia di era revolusi industri 4.0. *Research Gate, April*, 0–16.
- Sadaghiani, H. R. (2012). Online relectures: An alternative to textbook reading assignments. *The Physics Teacher*, 50(5), 301–303. <https://doi.org/10.1119/1.3703549>
- Setyadi, D., & Qohar, A. (2017). Pengembangan media pembelajaran matematika berbasis web pada materi barisan dan deret. *Kreano, Jurnal Matematika Kreatif-Inovatif*, 8(1), 1–7. <https://doi.org/10.15294/kreano.v8i1.5964>
- Subkhan, E. (2016). *Sejarah & paradigma teknologi pendidikan untuk perubahan sosial*. Prenada Media.
- Supandi, A., Sahrazad, S., Wibowo, A. N., & Widiyanto, S. (2019). Analisis kompetensi guru: Pembelajaran revolusi industri 4.0. *Seminar Nasional Bahasa dan Sastra Indonesia (Prosiding SAMASTA)*, 1–6.
- Tegeh, I. M., & Kirna, I. M. (2013). Pengembangan Bahan Ajar Metode Penelitian Pendidikan dengan ADDIE Model. *Jurnal IKA*, 11(1), 16. <https://ejournal.undiksha.ac.id/index.php/IKA/article/view/1145>
- Trianto. (2007). *Model-model pembelajaran inovatif berorientasi Konstruktivistik*. Prestasi Pustaka.
- Tucker, S. Y. (2014). Transforming pedagogies: Integrating 21st century skills and web 2.0 technology. *Turkish Online Journal of Distance Education*, 15(1). <https://doi.org/10.17718/tojde.32300>
- Wijaya, E. Y., Sudjimat, D. A., & Nyoto, A. (2016). Transformasi pendidikan abad 21 sebagai tuntutan pengembangan sumber daya manusia di era global. *Prosiding Seminar Nasional Pendidikan Matematika 2016*, 1, 263–278.
- Zubaidah, S. (2016). Keterampilan abad Ke-21: Keterampilan yang diajarkan melalui pembelajaran. *Seminar Nasional Pendidikan dengan tema "Isu-isu Strategis Pembelajaran MIPA Abad 21, Desember*, 1–17.