JURNAL PENDIDIKAN DAN PENGAJARAN
Volume 56 Nomor 2 2023, 324-336
E-ISSN: 2549-2608; P-ISSN: 2301-7821
DOI: https://doi.org/10.23887/jpp.v56i2.65175

Scientific Approach E-Book on Science Content for VI Grade Elementary School Students

Selvia Arfat[1*], Alexander Hamonangan Simamora[2], I Komang Sudarma[3]

[1,2,3] Department of Education, Psychology and Guidance, Ganesha University of Education, Singaraja, Indonesia
*Corresponding author: selvia88@gmail.com

Abstrak

Pemanfaatan teknologi masih kurang dalam pembelajaran terutama dalam penggunaan bahan ajar berbasis digital yang mengakibatkan terbatasnya bahan ajar yang dapat digunakan siswa dalam pembelajaran. Penelitian ini bertujuan untuk mengembangkan e-book dengan pendekatan saintifik konten IPA untuk Kelas VI dan menganalisis validitas dan keefektifan e-book dengan pendekatan saintifik untuk konten IPA di Kelas VI. Penelitian ini merupakan penelitian pengembangan dan menggunakan teknik pengumpulan data yaitu angket, pretest dan posttest. Pengumpulan data menggunakan angket dan tes. Teknik analisis data menggunakan analisis kualitatif, kuantitatif dan statistik inferensial. Hasil penelitian ini adalah hasil validasi oleh ahli materi pembelajaran diperoleh 95% dengan kualifikasi sangat baik, hasil validasi oleh ahli desain pembelajaran diperoleh 94,64% dengan kualifikasi sangat baik, hasil validasi oleh ahli media pembelajaran diperoleh 95,31% dengan kualifikasi sangat baik. Hasil review uji coba individu diperoleh 98,33% dengan kualifikasi sangat baik, hasil review uji coba kelompok kecil diperoleh 96,66% dengan kualifikasi sangat baik. Hasil uji keefektifan e-book dengan pendekatan saintifik menunjukkan adanya perbedaan yang signifikan pada hasil pembelajaran konten IPA sebelum dan sesudah menggunakan bahan ajar e-book. Hal ini menunjukkan bahwa e-book dengan pendekatan saintifik efektif digunakan karena desain penyajian materi dengan pendekatan saintifik, tampilan yang menarik, dan kepraktisan dalam pembelajaran sehingga dapat memotivasi siswa dalam belajar IPA.

Kata Kunci: *Pengembangan, E-book, Saintifik, Hannafin and Peck.*

Abstract

The use of technology is still lacking in learning, especially in the use of digital-based teaching materials which results in limited teaching materials that can be used by students in learning. This study aims to develop e-books with a scientific approach to science content for Class VI and to analyze the validity and effectiveness of e-books with a scientific approach to science content in Class VI. This research is development research and uses data collection techniques, namely questionnaires, pretest and post-test. Data collection is using questionnaires and tests. Data analysis techniques are using qualitative analysis, quantitative and inferential statistics. The results of this study are the results of validation by learning content experts obtained 95% with very good qualifications, validation results by learning design experts obtained 94.64% with very good qualifications, validation results by learning media experts obtained 95.31% with very good qualifications. The results of the individual trial review obtained 98.33% with very good qualifications, the results of the small group trial review obtained 96.66% with very good qualifications. The results of the effectiveness test of e-books with a scientific approach show significant differences in the results of learning science content before and after using e-book teaching materials. This shows that e-books with a scientific approach are effectively used due to the presentation design of material with a scientific approach, an attractive appearance, and practicality in learning so that they can motivate students in learning science.

Keywords: Development, E-book, Scientific, Hannafin and Peck.

History:
Received : April 03, 2023
Revised : April 04, 2023
Accepted : July 04, 2023
Published : July 25, 2023

Publisher: Undiksha Press

1. INTRODUCTION

The development of information technology and the world of entertainment in the industrial era 4.0 is increasing rapidly. Today children can be called as "Digital Natives". According to previous study digital native is an individual born after adopting digital technology (Irving, 2006). This predicate is given to all categories of children who have grown up using technology such as the internet, computers and mobile devices. Today's children prefer to play with electronic devices and the internet because it provides many

interesting and entertaining things. There is no longer the time to use traditional methods such as lectures, 21st century teachers must be able to create interesting and entertaining learning processes so they are not inferior to increasingly sophisticated times (Bosica et al., 2021; Smaldino & Lowther, 2017). This is in accordance with the opinion of previous study which states that digital technology has now begun to be used in educational institutions as a means to support learning, either as an information tool (ie as a means of accessing information) or as a learning tool (ie. as a means of supporting learning activities and assignments) (Khalid, 2011; Robandi et al., 2019). Along with advances in science and technology, teachers in Indonesia are required to direct students' thinking levels to a higher level. One of the things that teachers can do to improve the quality of students is to use teaching materials to support the teaching and learning process, because teaching materials can help students more easily understand learning material (Ayuningtyas et al., 2018; Fırat & Laramee, 2018; Istri Aryani & Rahayuni, 2016). With the development of teaching materials to increase students' understanding of learning concepts, teaching materials are developed to overcome difficulties in learning. The development of teaching materials is very important in learning, so that the more interesting the teaching materials used, the more interesting the students' interest in these teaching materials (Bansa & Asrini, 2020; Suwartono & Aniuranti, 2019). From this explanation it can be concluded that teaching materials are an important part of the implementation of education. Through teaching materials, the teacher will find it easier to carry out learning and students will be more helpful and easier to learn. The role of a teacher in designing or compiling teaching materials greatly determines the success of the teaching and learning process (Abdullah, 2017; Frolova & Rogach, 2021). A teacher will be more detailed in providing learning material to his students and achieve all predetermined competencies through teaching materials.

The 2013 curriculum is one of the curricula currently being implemented in Indonesian education. The purpose of the 2013 curriculum is to organize meaningful learning, students are expected to be able to think critically, and be able to improve and use their knowledge to study something in learning (Elvianasti et al., 2021; Narut & Supradi, 2019). The 2013 curriculum refers to the competence and character of students, which aims to encourage students to make observations, ask questions, reason, and also communicate, so that learning is not teacher-centered (Agustini et al., 2020; Yildirim, 2017). Therefore, the teacher plays an important role in creating a meaningful learning process. This activity step is also called the scientific approach or scientific approach. According to previous study the stages of the scientific approach are very important to be applied in a lesson content, where the content of this lesson is prioritized for conducting experiments or observations, namely learning science (Akkus et al., 2007).

In fact, the use of technology is still lacking in learning, especially in the use of digital-based teaching materials which results in limited teaching materials that can be used by students in learning. In the learning process, the teacher's creativity in developing teaching materials in the teaching and learning process is still lacking, because the teacher only uses teaching materials in the form of printed textbooks which are less attractive to students (Baran et al., 2011; Sailer et al., 2021). Based on the results of interviews and observations with teacher in grade VI at SD Negeri 2 Banyuning found that the teaching materials used by students are still limited to printed books. Class VI students experience difficulties in learning, especially science learning which requires higher-order thinking skills such as building concepts, principles through steps in the form of: observing, formulating problems (asking), submitting (hypotheses), collecting data with techniques, analyzing, making conclusions and communicate the concepts or principles that have been discovered. This has a direct impact on the value of the science content of students who are still below the KKM, around 23 students.

In order to develop good and appropriate teaching materials, it is necessary to pay attention to the characteristics of learning styles and learning tools owned by students. Based on the results of distributing a questionnaire on student learning styles and student learning facilities in a total of 26 students, there were 17 students with a visual learning style, 6 students with an audio learning style, and 3 students with kinesthetic learning styles. In addition, from the results of the distribution of learning facilities questionnaires owned by students, all students are sufficient to use cellphones and laptops. Based on the results of the distribution of the questionnaire, the selection of the use of teaching materials can be in the form of digital-based teaching materials. Digital teaching materials that suit the needs of class VI students at SD Negeri 2 Banyuning are teaching materials in the form of e-books. According to previous study digital teaching materials in the form of e-books have the characteristics needed by students in learning science such as students being able to teach themselves with teaching materials developed (Self Instructional), the subject matter of one competency unit or sub-competence being studied is contained in one teaching materials as a whole (Self Contained), teaching materials can be used alone without depending on other teaching materials (Stand Alone), have high adaptive power to the development of science and technology (Adaptive), and make it easier for readers to get information as clearly as possible (User Friendly) (Uygarer & Uzunboylu, 2017).

The developed e-book refers to science learning content in accordance with a scientific approach. In the Science e-book that will be developed, students will be invited to observe what is beneficial for fulfilling students' curiosity so that the learning process has high significance, asking questions, gathering information, socializing and reasoning information, and communicating (Suryaningtyas et al., 2020; Tinja et al., 2017). The use of science e-books with a scientific approach can increase student learning motivation so that science learning outcomes increase. The results of research conducted by previous study explain that science e-books based on a scientific approach can improve student learning outcomes because students understand science material better by using innovative teaching materials (Ormancı & Çepni, 2020). In addition, the results of other research explained that science e-books based on a scientific approach had a significant impact on student learning motivation because the presentation of the e-book attracted students' attention (Diarta et al., 2021). Based on the explanation above, it is necessary to develop an innovative teaching material for science learning in Class VI of SD Negeri 2 Banyuning in the form of digital e-book teaching materials with a scientific approach. In addition to increasing student motivation and learning outcomes, digital teaching materials in the form of e-books are expected to help students achieve learning objectives in natural science content which refers to process skills and scientific methods.

2. METHODS

This study used the Hannafin and Peck development model. This model consists of a needs assessment phase, a design/design phase, a development and implementation phase (Hannafin & Peck, 1988). The development procedure chart is shown in Figure 1.

Based on Figure 1, the operational steps start from the needs assessment, design, development and implementation phases, as well as the evaluation and revision process at each stage. The first step before developing a learning product is to conduct a needs analysis. This needs analysis was carried out to find out whether this e-book is really needed by schools, especially by SD Negeri 2 Banyuning. In the design phase, activities are carried out in the form of continuation of the determination of ideas and analysis of targets that have been carried out during the needs analysis phase. Then next stage includes the activities of making media and evaluating the media.

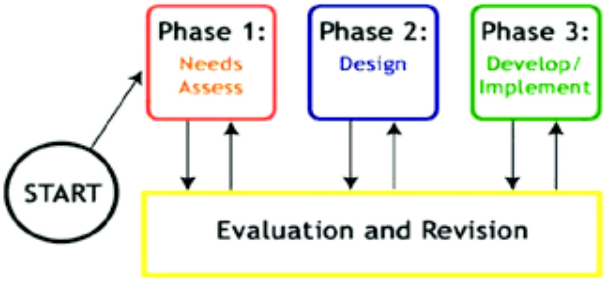

Figure 1. Chart of Hannafin and Peck Development Procedures

Product validation in the development of this study consisted of: (a) trial design, (b) trial subjects, (c) data types, (e) data collection methods and instruments, and (e) data analysis methods and techniques. Product trial summary is shown in Table 1.

Table 1. Product Trial Summary

No.	Variable	Data Collection Methods and Instruments	Data source	Nature of Data	Data Analysis Method
1.	Product Validity	Questionnaire	1.Content Expert 2.Design Expert 3. Media expert 4. 3 Students 5. 9 Students	Quantitative	Descriptive Quantitative
2.	Product Effectiveness	Test	Students	Quantitative	T-test Statistic

The development of e-book media on class VI science content must be tested for its validity and effectiveness. This development review was carried out by 3 (three) experts. The first is content expert review, instructional design expert review, and instructional media expert review. After carrying out validation by experts, it is continued by carrying out product trials. Product trials will be carried out in three stages. The first stage is individual trials, the second stage is small group trials and the third stage is field trials. This development research uses two methods in data collection, namely questionnaires and tests. The instrument grids are shown in Table 2, Table 3, Table 4, and Table 5.

Table 2. Grid of Learning Media Expert Instruments

No	Aspect	Indicator	Amount items
1	Design Cover	a. Images reflect the contents of the e-book b. Compatibility of lines and colors c. The suitability of the character or character with the target/story d. The suitability of the background image with the character/figure e. Suitability of font, color, spacing, and font size f. Accurate placement of objects, text, and images	6
2	Text Design	a. Appropriate type, color, spacing, and font size b. The accuracy of the sentences used c. Background color compatibility with text	5

No	Aspect	Indicator	Amount items
		d. Balance between text and images	
3	Visual Design	a. Compatibility of the image with the material b. Suitability of the image with students characteristic c. The quality of the images presented in the e-book	3
4	Audio	a. Clarity of narrative voice in e-books b. Accurate use of sound effects c. Accurate use of backsound	3
		Total	**17**

Table 3. Grid of Learning Design Expert Instruments

No	Aspect	Indicators	Amount items
1	Curriculum	a. Clarity of learning indicators b. Clarity of competencies to be achieved c. Clarity of learning objectives	3
2	Material	a. Clarity of learning design b. Clarity of study instructions c. Accurate use of language d. Storyline clarity e. Conformity of character values with material	5
3	Evaluation	a. Availability of learning evaluation b. The suitability of the questions with the material c. Clarity of evaluation instructions	3
		Total	**11**

Table 4. Grid of Material/Content Expert Instruments

No	Aspect	Indicators	Amount items
1	Curriculum	a. Clarity of learning indicators b. Clarity of competencies to be achieved c. Clarity of learning objectives	3
2	Material	a. Clarity of learning design b. Clarity of study instructions c. Accurate use of language d. Storyline clarity e. The breadth and depth of the material f. Conformity of character values with material	6
3	Language	a. Clarity of use of language b. Language suitability with student characteristics	2
4	Evaluation	a. Availability of learning evaluation b. The suitability of the questions with the material c. Clarity of evaluation instructions	3
		Total	**14**

Table 5. Individual and Small Group Test Instruments

No	Aspect	Indicators	Amount Items
1	Curriculum	a. Clarity of Learning Indicators b. Clarity of Competencies to Be Achieved c. Clarity of Learning Objectives	3
2	Material	a. Clarity of Learning Design b. Clarity of Study Instructions c. Accurate Use of Language d. Storyline Clarity e. The Breadth and Depth of the Material f. Conformity of Character Values with Material	6
3	Language	a. Clarity of Use of Language b. Language Suitability with Student Characteristics	2
4	Evaluation	a. Availability of Learning Evaluation b. The Suitability of The Questions with The Material c. Clarity of Evaluation Instructions	3
		Total	**14**

This development research uses several data analysis techniques, quantitative descriptive analysis and inferential statistical analysis. Quantitative analysis techniques are used to test the design and validity of the product being developed. Quantitative analysis of the results of calculations in the form of numerals which are processed and used in processing assessment data from content experts in the field of study, learning product design experts, learning media experts, students and teachers in the field of study Inferential statistical analysis is used to determine the effectiveness of the product on the results learning to class VI students at SD Negeri 2 Banyuning before and after using e-book teaching material products. The test data will use the pre-test and post-test on the material being tested.

3. RESULTS AND DISCUSSION

Result

The results of the research will be divided into three parts, namely 1.) the process of developing e-book teaching materials, 2.) the validity of the results of developing e-book teaching materials, and 3.) the effectiveness of developing e-book teaching materials on natural science material in VI grade of SD Negeri 2 Banyuning.

Teaching Materials Development Process

In developing this teaching material, the main software/application used is Flip PDF Corporate. In addition, there are several other software/applications to support the development of teaching materials such as Microsoft Office Word for designing materials, Canva and Corel Draw for designing images and Filmora for editing videos and making animations. Then proceed with making Storyboards that can be used as the main reference for product developers and are very useful for developing e-book teaching materials. Next, design an assessment instrument. The instruments made were instruments for learning design experts, teaching content experts, learning media experts, instruments for individual tests and small group tests.

The cover of the e-book provides initial information about the material/content to be studied and the objectives of the teaching materials. In addition there are several navigation

buttons, namely navigation buttons to open pages and sound buttons that can be turned off or on, and increase or decrease the volume. The cover of the e-book is shown in Figure 2.

Figure 2. Initial View/Cover of the E-book

In the learning instructions display, users are given information about the learning instructions for this e-book teaching material, starting from the pictures of the menus to the functions of each navigation button in this e-book teaching material. User competency display page is show in Figure 3.

Figure 3. Competency Display

Figure 4. Display of Learning Materials

On the learning material display page, learning material is presented that can be listened to and studied by users. The preparation of material for this e-book teaching material is carried out by balancing the composition of text, images, animation and video while always paying attention to the principles of e-book design. Learning material display is show in **Figure 4**.

Teaching Media Validity

The learning design expert test was assessed using a questionnaire. The score used in this questionnaire is a scale score of 4. Based on the results of the calculations that have been carried out, it is known that the percentage score of e-book teaching material feasibility from learning design experts is 94.64%. Then it will be converted into a conversion table with an achievement rate of 90-100%. It can be concluded that the percentage score of the achievement level of 94.64% is in very good qualification. The learning media expert test was tested. The score used in this questionnaire is a scale score of 4. Based on the results of the calculations that have been carried out, it is known that the percentage score for the feasibility of e-book teaching materials from learning media experts is 95.31%. Then it will be converted into a conversion table with an achievement rate of 90-100%. It can be concluded that the percentage score of the achievement level of 95.31% is in very good qualification. Learning content expert test score used in this questionnaire is a scale score of 4. Based on the results of the calculations that have been carried out, it is known that the percentage score of e-book teaching material eligibility from learning content experts is 95%. Then it will be converted into a conversion table with an achievement rate of 90-100%. It can be concluded that the percentage score of the achievement level of 95% is in very good qualification. Furthermore, suggestions and comments were given by learning content experts as follows.

After going through the revision stage based on input and assessments from experts, the product is then tested on students. In the individual trial stage, 3 (three) students were selected from class VII students of SMP Negeri 3 Singaraja as the subject of the trial consisting of 1 (one) student with low learning outcomes, 1 student with moderate learning outcomes, and 1 student with high learning outcomes. Based on the results of the calculations that have been carried out, it is known that the percentage score for the eligibility of e-book teaching materials in individual trials is 98.33%. Then it will be converted into a conversion table with an achievement rate of 90-100%. It can be concluded that the percentage score of

the achievement level of 98.33% is in very good qualification. Then the small group trials were aimed at 9 class VII students of SMP Negeri 3 Singaraja with different learning outcomes, 3 students with high learning outcomes, 3 students with moderate learning outcomes, and 3 students with low learning outcomes. Based on the results of the calculations that have been carried out, it is known that the percentage score for the eligibility of e-book teaching materials in the small group trial is 96.66%. Then it will be converted into a conversion table with an achievement rate of 90-100%. It can be concluded that the percentage score of the achievement level of 96.66% is in very good qualification.

The Effectiveness of Teaching Materials

The effectiveness of the development of e-book teaching materials is carried out by the test method. Multiple choice test questions are used to collect data on student learning outcomes before and after using e-book teaching materials. The goal is to be able to find out the level of effectiveness of using e-book teaching materials on increasing learning outcomes which is done by using a t-test for correlated samples. The initial stage is the prerequisite test which consists of the normality test and homogeneity test. The result of normality test is show that the 5% significance level indicates that the results are significant > the Shapiro Wilk table. It can be concluded from the table that the pretest and posttest data samples are normally distributed. Homogeneity test is carried out to find out that 2 or more groups of sample data come from populations that have the same variation. The results of the homogeneity test calculation above obtained a significance of 0.889. If the significance value is more than 0.05, then the data distribution is homogeneous. Then the results of calculating the t-test shows a significance value (2-tailed) of 0.000 <0.05, so it can be concluded that there is a significant difference between the science learning outcomes of class VI students at SDN 2 Banyuning before and after applying e-book teaching materials with a scientific approach.

Discussions

Judging from the aspect of learning design, based on the results of a review from learning design experts on e-book teaching materials with a scientific approach, this e-book obtained a very good assessment qualification with a percentage of 94.64%. This achievement was achieved because e-book teaching materials based on this scientific approach can attract students' attention in learning. This can be seen from the learning design and the description of the presentation of the material as well as the clarity of the instructions for working on the questions on this e-book teaching material based on a scientific approach that is easy to understand. In accordance with the opinion of previous research which said that learning design has an important role in the design of learning preparation because a good teaching and learning process must be well planned (Winayarti et al., 2012). The clarity of the lesson plans, study guides, learning strategies and the accuracy of examples in clarifying a material and also the availability of assessments in the e-book are used to measure the extent to which students understand the material in the e-book. Other research argues that learning strategies are tools or media, and learning strategies are said to be appropriate if they are in accordance with the tendency of competence as the totality of learning outcomes to be developed (Hartono et al., 2021; Sari, 2017).

In terms of the aspect of learning media, based on the results of a review from learning media experts on teaching materials based on a scientific approach, this obtained a very good assessment qualification with a percentage of 95.31%. The results of this qualification are due to several aspects of the assessment, including text, choosing the type of font and writing color with the right background because students can read writing easily and clearly. In accordance with the opinion of previous research that with the availability of

media such as learning videos that are clearer and more interesting, the learning process is more interactive, time and energy efficiency, improves the quality of learning outcomes, learning can be done anywhere and anytime, and fosters a positive attitude towards learning processes and materials. learning (Setyaningrum & Waryanto, 2017). Other research also revealed that the delivery of learning materials through the use of teaching materials in which elements such as text, images, sound, video and animation are integrated in which appropriate use of effective material in clarifying the material presented and can increase students' interest and motivation in the learning process (Islam et al., 2022).

Based on the results of the validation by subject content experts, it was obtained that the score was very good, namely 95%. The very good qualification score was obtained through various aspects tested in the subject content expert test, namely, aspects of material content, language aspects, presentation feasibility aspects, and evaluation aspects. Previous research revealed that a coherent presentation of material would be more interesting and easier for students to understand (Purwoko et al., 2020). The suitability of the material with pictures or videos in e-books can encourage students to learn and make abstract concepts easier to become more concrete and easy to understand. Associating learning material with real life and according to student needs, of course, will increase learning motivation and be able to make learning process activities more effective, efficient and fun (Irawan, 2019; Rizki & Listiara, 2015). The effectiveness test of e-book teaching materials is used to see which e-book teaching materials are applied effectively to students. This is in line with the discussion regarding the effectiveness of e-book teaching materials in influencing the learning process (Fathoni & Marpanaji, 2018; Rokhim et al., 2020). Then according to other studies explaining the effectiveness test is an effort made to determine the involvement of the developed e-book teaching materials (Putra & Suharjana, 2018). Test the effectiveness of using the test method conducted on class VI students at SD Negeri 2 Banyuning. The number of students in class VI is 28 students. To see the knowledge of students, a pretest was carried out to get scores from students. Then it is continued with the implementation of e-book teaching materials with a scientific approach and after completion it is continued with the posttest to find out student scores after using e-book teaching materials. The results of the pretest and posttest were then processed using a correlated sample t-test. This is in line with previous research which argues that using digital teaching materials designed with approaches or models in the learning process can help students in learning because it can stimulate students' thinking patterns in learning activities and understand the material well (Wen et al., 2020). In addition, with the existence of these digital teaching materials, students can access learning materials without being limited by space and time. This is because the development of digital teaching materials aims to create more efficient learning so that it is not limited to conventional learning which is only in class.

This research has implications that the application of e-book teaching materials with a scientific approach to science content can improve student learning outcomes and provide teachers with new knowledge about the use of digital teaching materials. This can be seen from the impact felt by students and teachers. Students more easily understand the material through activities using e-book teaching materials. In addition, students' interest in learning increases with the existence of e-book teaching materials with this scientific approach in the delivery of material. In addition, students can interact directly with e-book teaching materials because this media is equipped with material and quizzes to work on and feedback is given immediately after students answer the quiz, so students can find out the results. Teachers find it easier to convey material with the help of e-book teaching materials. So that the atmosphere in the learning process is more fun and the delivery of material becomes more interesting. The suggestions that can be given are as follows. There are lots of innovative digital teaching materials that can be applied in the classroom. For students to be able to

utilize e-book teaching materials in the learning process and can implement the knowledge gained in the learning process. The use of teaching materials can help students in the learning process. To other researchers so that this research can be used as a reference or reference and be able to further refine the shortcomings of the research that has been developed.

4. CONCLUSION

The design for the development of e-book teaching materials with a scientific approach to science content for class VI students at SD Negeri 2 Banyuning for the 2022/2023 academic year uses the Hannafin and Peck development model, with 3 stages, namely the needs analysis stage, the design stage and the development and implementation stages so that the development carried out more structured and in accordance with the learning design. Results of validity tests conducted on experts. In the test of learning media experts, learning design experts, learning content experts were included in the very good category. The results of testing the effectiveness of problem-based learning-oriented e-book products through the pretest and posttest methods obtained an average posttest score obtained by class VI students that was greater than the applicable KKM score, therefore the use of e-books in research was effective for use.

5. REFERENCES

Abdullah, R. (2017). Pembelajaran Dalam Perspektif Kreativitas Guru Dalam Pemanfaatan Media Pembelajaran. *Lantanida Journal*, *4*(1), 35. https://doi.org/10.22373/lj.v4i1.1866.

Agustini, K., Santyadiputra, G. S., & Sugihartini, N. (2020). Visualizing the stages of the educational research methodology into animation infographics for vocational students. *Jurnal Pendidikan Vokasi*, *9*(3), 317–327. https://doi.org/10.21831/jpv.v9i3.22017.

Akkus, R., Gunel, M., & Hand, B. (2007). Comparing an inquiry-based approach known as the science writing heuristic to traditional science teaching practices: Are there differences? *International Journal of Science Education*, *29*(14), 1745–1765. https://doi.org/10.1080/09500690601075629.

Ayuningtyas, A., Honggowibowo, A. S., Pujiastuti, A., Retnowati, N. D., & Indrianingsih, Y. (2018). Pendampingan Pembuatan Bahan Ajar Bagi Guru Sekolah Dasar Islam Terpadu (SDIT) Salsabila Al Muthi'in Berbasis Multimedia dengan Menggunakan Microsoft Power Point. *KACANEGARA Jurnal Pengabdian Pada Masyarakat*, *1*(1), 1. https://doi.org/10.28989/kacanegara.v1i1.265.

Bansa, Y. A., & Asrini. (2020). The Use of ICT in Teaching: Lecturers' Perceptions, Obstacles, and Expectations. *Journal of Physics: Conference Series*, *1464*(1). https://doi.org/10.1088/1742-6596/1464/1/012037.

Baran, E., Correia, A. P., & Thompson, A. (2011). Transforming online teaching practice: Critical analysis of the literature on the roles and competencies of online teachers. *Distance Education*, *32*(3), 421–439. https://doi.org/10.1080/01587919.2011.610293.

Bosica, J., Pyper, J. S., & MacGregor, S. (2021). Incorporating problem-based learning in a secondary school mathematics preservice teacher education course. *Teaching and Teacher Education*, *102*, 103335. https://doi.org/10.1016/j.tate.2021.103335.

Diarta, F., Tiara, Kantun, S., & Sari, D. E. (2021). The effectiveness of the digital books' usage to improve the XII IPS 3 class students' motivation at SMAN Pakusari Jember. *IOP Conference Series: Earth and Environmental Science*, *747*(1), 012101. https://doi.org/10.1088/1755-1315/747/1/012101.

Elvianasti, M., Lufri, L., Asrizal, A., & Rikizaputra, R. (2021). Implementasi Pendekatan Saintifik dalam Pembelajaran IPA di Indonesia : Suatu Meta-Analisis. *EDUKATIF : Jurnal Ilmu Pendidikan*, *4*(1), 390–398. https://doi.org/10.31004/edukatif.v4i1.1819.

Fathoni, M. I., & Marpanaji, E. (2018). Pengembangan e-book interaktif mata pelajaran teknologi informasi dan komunikasi (TIK) untuk SMK kelas X. *Jurnal Inovasi Teknologi Pendidikan*, *5*(1), 70–81. https://doi.org/10.21831/jitp.v5i1.17149.

Fırat, E. E., & Laramee, R. S. (2018). Towards a survey of interactive visualization for education. *Computer Graphics and Visual Computing, CGVC 2018*, 91–101. https://doi.org/10.2312/cgvc.20181211.

Frolova, E. V., & Rogach, O. V. (2021). Particularities of students perceptions of the digitalization of education: Comprehending the experience of online learning in a pandemic environment. *Perspektivy Nauki i Obrazovania*, *51*(3). https://doi.org/10.32744/pse.2021.3.3.

Hannafin, & Peck. (1988). *The Design Development and Evaluation of Instructional Software*. Macmillan Publishing Company.

Hartono, A. A., Prasida, T. A. S., & Prestiliano, J. (2021). Perancangan Board Game Edukasi Menggunakan Mekanik Hand Management tentang Pemahaman Spesifikasi Gadget. *Nirmana*, *19*(2), 98–108. https://doi.org/10.9744/nirmana.19.2.98-108.

Irawan, R. (2019). Pengembangan Media Pembelajaran Sejarah Berbasis Audio Visual Situs Batu Paha Untuk Meningkatkan Kesadaran Sejarah Siswa Kelas Xi Ips Di Sma Negeri 1 Wera. *JUPE : Jurnal Pendidikan Mandala*, *4*(5). https://doi.org/10.36312/jupe.v4i5.839.

Irving, K. E. (2006). The impact of technology on the 21st century. *Teaching Science in the 21st Century*, *March 1981*, 3–19. https://cmapsconverted.ihmc.us/rid=1JVHR9TKT-1VMCFZP-SHW/21st century.pdf.

Islam, M. K., Sarker, M. F. H., & Islam, M. S. (2022). Promoting student-centred blended learning in higher education: A model. *E-Learning and Digital Media*, *19*(1), 36–54. https://doi.org/10.1177/20427530211027721.

Istri Aryani, I. G. A., & Rahayuni, N. K. S. (2016). Innovation of Teaching and Learning English Applied to Animal Sciences' Student with the Combination of Computer Media and Audio Visual. *International Journal of Linguistics, Literature and Culture*, *2*(1). https://doi.org/10.21744/ijllc.v2i1.5.

Khalid, M. S. (2011). ICT in Education: Secondary Technical Vocational Education and Training Institute Centered Diffusion of Innovation in Rural Bangladesh. In *International Technology, Education and Development Conference* (pp. 1126–1134). International Association of Technology, Education and Development (IATED). https://vbn.aau.dk/en/publications/ict-in-education-secondary-technical-vocational-education-and-tra.

Narut, Y. F., & Supradi, K. (2019). Literasi sains peserta didik dalam pembelajaran ipa di indonesia. *Jurnal Inovasi Pendidikan Dasar*, *3*(1), 61–69. http://jurnal.unikastpaulus.ac.id/index.php/jipd/article/view/214.

Ormancı, Ü., & Çepni, S. (2020). Views on interactive e-book use in science education of teachers and students who perform e-book applications. *Turkish Online Journal of Qualitative Inquiry*, *11*(2), 247–279. https://doi.org/10.17569/tojqi.569211.

Purwoko, R. Y., Nugraheni, P., & Nadhilah, S. (2020). Analisis Kebutuhan Pengembangan E -Modul Berbasis Etnomatematika Produk Budaya Jawa Tengah. *Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *5*(1). https://doi.org/10.26486/jm.v4i2.1165

Putra, E. F., & Suharjana, S. (2018). Model senam lansia untuk kebugaran jasmani dan fungsi otak. *Jurnal Keolahragaan*, *6*(2), 120–129. https://doi.org/10.21831/jk.v0i0.20626.

Rizki, M., & Listiara, A. (2015). Penyesuaian Diri dan School Well-Being pada Mahasiswa.

Seminar Psikologi & Kemanusiaan, 978–979. https://mpsi.umm.ac.id/files/file/524-528 Maulidina.pdf.

Robandi, B., Kurniati, E., & Puspita Sari, R. (2019). *Pedagogy In The Era Of Industrial Revolution 4.0*. *239*, 38–46. https://doi.org/10.2991/upiupsi-18.2019.7.

Rokhim, D. A., Widarti, H. R., & Fajaroh, F. (2020). Pengembangan Bahan Belajar Flipbook pada Materi Redoks dan Elektrokimia Berbasis Pendekatan STEM-PjBL Berbantuan Video Pembelajaran. *Kwangsan: Jurnal Teknologi Pendidikan*, *8*(2), 234–250. https://doi.org/http://doi.org/10.31800/jtp.kw.v8n2.p234--250 PENGEMBANGAN

Sailer, M., Stadler, M., Schultz-Pernice, F., Franke, U., Schöffmann, C., Paniotova, V., Husagic, L., & Fischer, F. (2021). Technology-Related Teaching Skills and Attitudes: Validation of a Scenario-Based Self-Assessment Instrument for Teachers. *Computers in Human Behavior*, *115*(1), 1–12. https://doi.org/10.1016/j.chb.2020.106625.

Sari, N. F. (2017). Perbandingan Hasil Belajar Siswa yang Diajar Menggunakan Model Pembelajaran Quantum Teaching dengan Model Pembelajaran Langsung (Direct Instruction) Pada Sub Bab Materi Pokok Sistem Respirasi Pada Manusia di Kelas XI SMA Swasta Medan Putri Tahun Pembelaja. *Edu Science*, *4*(2), 18–24. https://doi.org/10.36987/jes.v4i2.935.

Setyaningrum, W., & Waryanto, N. H. (2017). Media Edutainment Segi Empat Berbasis Android: Apakah Membuat Belajar Matematika Lebih Menarik? *Jurnal Mercumatika : Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *2*(2), 40–56. https://doi.org/10.26486/jm.v2i2.369.

Smaldino, S. E., & Lowther, D. L. (2017). *Instructional Technology and Media for Learning*. 1–22.

Suryaningtyas, A., Kimianti, F., & Prasetyo, Z. K. (2020). *Developing Science Electronic Module Based on Problem-Based Learning and Guided Discovery Learning to Increase Critical Thinking and Problem-Solving Skills*. *401*(Iceri 2019), 65–70. https://doi.org/10.2991/assehr.k.200204.013.

Suwartono, T., & Aniuranti, A. (2019). Digital Teaching Tools in 21st Century EFL Classroom: Are Our Teachers Ready? *ELLITE: Journal of English Language, Literature, and Teaching*, *3*(2), 57. https://doi.org/10.32528/ellite.v3i2.1916.

Tinja, Y., Towaf, S. M., & Hariyono. (2017). Pengembangan Bahan Ajar Tematik Berbasis Kearifan Lokal Sebagai Upaya Melestarikan Nilai Budaya Pada Siswa Sekolah Dasar. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *2*(9), 1257–1261. https://doi.org/10.17977/jptpp.v2i9.9990.

Uygarer, R., & Uzunboylu, H. (2017). An investigation of the digital teaching book compared to traditional books in distance education of teacher education programs. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(8), 5365–5377. https://doi.org/10.12973/eurasia.2017.00830a.

Wen, J. M., Do, H. D., Liu, E. Z. F., Lin, C. H., & Huang. (2020). SK Educational board game and flashcard: Which is better for learners at beginner level of Chinese language? *International Journal of Serious Games*, *7*(4), 89–104, https://doi.org/10.17083/ijsg.v7i4.347.

Winayarti, E., Handarsari, E., & Fathurohman, A. (2012). Analysis pengembangan model pembelajaran "Wisata Lokal" pada pembelajaran sains. *Seminar Nasional Hasil Penelitian*, 332–341. https://doi.org/https://jurnal.unimus.ac.id/index.php/psn12012010/article/download/527/576.

Yildirim, S. (2017). Approaches of Designers in the Developed Educational Purposes of Infographics ' Design Processes. *European Journal of Education Studies*, *3*(1), 248–284. https://doi.org/10.5281/zenodo.231283.