Development of E-LKPD Based on Project Based Learning (PJBL) on Computer Network Material

Muhammad Abim Afdhal[1] , Novrianti[2] , Meldi Ade Kurnia Yusri [3],Alkadri Masnur[4]
(Teknologi Pendidikan, Fakultas Ilmu Pendidikan, Universitas Negeri Padang)
Email : Bimyb35@gmail.com

Abstract

This research is triggered by one of the common problems encountered in Information and Communication Technology (ICT) learning, which is the low interest of students, resulting in difficulties in mastering the subject matter according to their individual learning styles. The teaching materials used have not helped students think critically, creatively, and learn independently in accordance with the demands of the Merdeka Curriculum. This study aims to produce a valid and practical e-LKPD based on Project-Based Learning for computer network material, so it can be used as teaching material for ICT. This type of research is development research (R&D) using the 4- D development model. The stages used in this development model are: Definition Stage, Design Stage, Development Stage, and Dissemination Stage. The subjects of this study are 10th-grade students from SMA Negeri X Guguak. The instruments used in the research are validity and practicality questionnaires, which are used to assess the practicality of the e-LKPD for students. The validity result of the Project-Based Learning-based e-LKPD is 90.3%, categorized as very valid. There is no final practicality score for the ICT teacher e-LKPD because there is only one ICT teacher, who serves as the material validator. The final practicality score for the student e- LKPD is 84.2%, categorized as very practical. Based on the research results, it canbe concluded that the Project-Based Learning-based e-LKPD on computer network material for 10th-grade students at SMA Negeri X Guguak is valid and practical

Keywords:e-LKPD *Project Based Learning* Jaringan Komputer

INTRODUCTION

Education is seen as a means to produce people who are intelligent, creative, skilled, responsible, productive and have noble character. Education can be done anywhere and at any time, both by families, citizens and the government.

A learning model is a concept used to teach material with a specific purpose, including strategies, approaches, methods and techniques. Therefore, to achieve learning goals more actively, it is important to use one of the learning models.

One model that can encourage student activity is *project-based learning*. By applying this model, students can be more active in solving problems and choosing important things during learning projects, as well as learning skill concepts. According to Wina (2009) states that *project-based learning* is a learning activity that gives students the opportunity to do project work, which means students are given the task of creating a project according to what they have learned. Model I has been widely implemented in the current curriculum. By implementing this model, it is hoped that the quality that has been designed in the curriculum can be achieved.

Educational media is one component that cannot be ignored in developing a successful teaching system. Teaching materials that are manipulated in the form of teaching media can make students more motivated and think critically in following the learning process. By using media in learning, it will be more fun for students and of course the teaching will be truly useful and easier to remember and will indirectly improve students' abilities. Learning activities that do not involve physical and mental processes make students passive and result in learning difficulties and they are not able to solve problems independently (Samala et al, 2019).

Electronic student worksheet (e-LKPD) is a student activity sheet that contains practice questions that can be done anywhere and anytime using electronic media such as a computer. nor cell phone that has an internet connection. e-LKPD is not only in printed form, but with a digital display that contains learning outcomes, materials, learning videos, evaluation questions, attendance, assessments and learning resources. With this LKPD you can think such as analyzing data from investigations by improving skills think creative students.

Developing LKPD is an activity plan and

direct complete and clear activities for each component contained in a LKPD (Noperman, 2022). The purpose of developing this LKPD was developed by formulating learning objectives in a complete, clear and operational manner with material components in the form of concept explanations, providing examples, as well as pictures.

This e-LKPD is a learning product or tool used for the learning process. Apart from that, e-LKPD is a means to help improve student learning achievement. With this, students are able to learn more actively and have responsibility regarding carrying out lessons. The independent learning curriculum is a curriculum that was developed to create a different and comfortable learning atmosphere for teachers and students. Student worksheets (LKPD) are one of the teaching materials that can be used in the independent curriculum. LKPD is printed teaching material that contains material, summaries and instructions for implementing learning tasks so that it can adapt to existing educational developments (Hasim, 2020). The curriculum is not only to improve students' cognitive abilities, but also to develop students' personalities to become more independent, social, brave and polite (Rachmawati et al, 2022). One of the main characteristics of an independent curriculum is that schools are given the freedom to provide learning projects that are relevant and in accordance with local wisdom. Local wisdom is the foundation of a nation's identity.

Information and Communication Technology is one of the subjects that applies science and technology in learning. Students are provided with Information and Communication Technology subjects aimed at encouraging creativity and innovation in using technology to solve problems and create new solutions. Information and Communication Technology Learning is a process where students gain knowledge, skills and understanding of technology. Information and Communication Technology learning can be done through various approaches. Factors that influence students to carry out learning activities are a conducive, enjoyable environment, adequate learning resource facilities, and so on. Given this, in learning Information and Communication Technology in schools, teachers should be able to choose and use strategies, approaches, methods and media that involve students in learning, both mentally, physically and socially so that active and creative learning can be created. and independent (Huda 2020).

The results of observations carried out at SMA Negeri X Guguak from 15 July to 8 December 2023 found that the school had used an independent curriculum for class In the independent curriculum, students are required to be actively involved in the learning process. However, in reality, in the ongoing learning process, students appear to be less active and pay less attention to the teacher's lessons, there are also those who are busy with their own activities, lack confidence in their abilities and only a few students are willing to ask questions when participating in learning activities. During the learning process, students are less independent in learning and more dependent on the teacher's explanations, so that students have difficulty understanding the lesson.

Based on observations done at SMA Negeri The results of interviews conducted with class X ICT teachers at SMA Negeri The teacher provides solutions by reviewing the learning material. According to students, the questions in the textbook used during the learning process are difficult to understand, so students don't understand how to answer the questions. Sometimes teachers also try to find LKPD in other sources such as browsing the internet. As for the media that have been tried in the learning process, such as presentation media, students are quite interested and like the media used, but at school the facilities and the infrastructure such as the lack of LCD projector facilities in schools, so that some teachers cannot use the media during learning. Therefore, the use of technology in the learning process is a solution needed to overcome students' obstacles in understanding practice questions with the need to develop technology-based media and teaching materials such as e-LKPD to make learning more interesting.

The results of interviews conducted on April 24 2024 at SMA Negeri X Guguak with students, especially in class Apart from that, students lack motivation to learn because students think books are just writings and are

boring to read so that the learning carried out is less effective. Regarding the practice questions in the textbook used, students stated that the language was difficult to understand, then they were also confused about solving the problems in the book.

The learning process in educational units at every level always requires teaching materials. One of the teaching materials commonly used in the learning process is Student Worksheets (LKPD), namely teaching materials that have been packaged in such a way that students are expected to be able to study the teaching materials independently. In the LKPD, students will receive material, summaries and assignments related to the material. Apart from that, students can also find structured directions to understand the material provided. Therefore, real efforts are made by teachers to overcome this so that students can easily master the concepts being studied, so that they are more interested and able to understand learning. In the learning process, teaching materials are needed. One of the teaching materials that can be used in the learning process is LKPD. Student Worksheets (LKPD) are a means to help and facilitate learning activities so that effective interaction will be formed between students and can increase students' learning abilities. In the LKPD, students will receive material, summaries and assignments related to the material. Apart from that, students can also find structured directions to understand the material that has been given (Taufiqurrohman et al, 2017).

Efforts that can be made to overcome this problem are by developing teaching materials in the form of e-LKPD as a substitute for doing student exercises. The designed e-LKPD should be equipped with a learning model in the form of material to make it easier for students to learn. One learning model that is oriented towards developing a project, both individually nor as a group to produce a product so that students can think critically and skillfully, namely Project Based Learning (PjBL).

LKPD is one of the teaching materials that contains a summary of the learning carried out and contains work steps assigned to students. This LKPD also refers to learning competencies so that learning objectives can be achieved (Astawan and Agustiana, 2020). LKPD contains a series of basic activities for students to carry out in optimizing understanding and efforts to construct basic abilities in accordance with the learning indicators that must be implemented.

e-LKPD are technology-based sheets that contain information about guide students' learning and assignments are in accordance with the material studied. The function of e-LKPD is to assist teachers in implementing teaching to students. This e-LKPD can be given to students at the group activity step in the learning process. Work on e-LKPD can be done by taking advantage of current developments in educational technology. Educational technology is able to be an intermediary in helping the learning process run effectively and efficiently. One learning method that can be developed by teachers is the Project Based Learning (PjBL) learning method, which can support the creation and execution of e-LKPD, namely the application live worksheet.

Project Based Learning (PjBL) is a learning activity that focuses on students solving a problem and increasing opportunities for individual students to produce realistic student work (Al-Tabany, 2017). Project Based Learning (PjBL) is a learning process that directly involves students to form a project. The Project Based Learning (PjBL) learning model is an excellent tool for helping students solve problems in the form of stories, matching pictures, or practice, through individual series based on project problems or real data on the results that have been obtained. In essence, this learning model further develops students' solving skills in working on a project that can produce something. Learning using projects as a learning method. Students work concretely, as if they were in the real world and can form products realistically (Sari & Angreni, 2018). e-LKPD based on project-based learning (PjBL) on computer network material is thought to be suitable as teaching material that can be accessed at any time.

Live Worksheet is platform interactive which can be used for free and is web-based and includes a menu for delivering material designed by teaching staff (Iriani et al, 2023).

Development of e-LKPD using assistance live worksheet provide many facilities.

Learning using live worksheet accompanied by problems can increase Information and Communication Technology learning activities, students can work on worksheets in the form of exercises online and send answers to the teacher concerned online as well (Lestari, 2022).

RESEARCH METHOD

This type of research is development research (research and development/R&D). According to Sugiyono (2017), research and development (R&D) is a process to improve or improve existing products or methods. Research focuses on the search for new theories or knowledge, while development aims to apply the research results in the form of products or systems that can be used practically.

The development model that researchers use is the 4-D model, which consists of four main stages: Define, Design, Development, & Disseminate. This model is used to develop various types of learning media and is general in nature. According to Thiagarajan et al (1974), the 4-D (Four D) model is an approach used in developing products or learning media that focuses on four stages: 1) definition: this stage aims to analyze existing needs and problems. Here, the researcher identifies the goals, learning objectives, and analysis of the existing situation, 2) design: at this stage, the researcher designs a product prototype or learning media based on the analysis that has been carried out in the first stage, 3) development: at the development stage, the prototype the design has been tested and improvements made based on the test results and feedback received, and 4) dissemination: the final stage is the dissemination of research results or products that have been developed to a wider audience. At this stage, the product or innovation that has been tested can be used by more users or can be implemented on a larger scale. It can be seen in Figure 1 the stages of the 4-D development model.

Figure 1. Stages of 4-D Model Development

This research aims to develop e-LKPD based *Project Based Learning* (PjBL) on valid and practical Computer Network material. The following is a description of the 4-D stages:

1. Definition (*Define*)

   The Define stage in this research includes identifying the needs and objectives of developing e-LKPD, the analysis stage is carried out for the process of collecting information needed to develop learning media. Researchers carried out several stages of analysis which could be possible causal factors of an ICT learning problem at SMA Negeri X Guguak. At this stage, what is done is to collect information in the form of problems or obstacles that occur during the learning process. This information collection consists of:

   a. Curriculum Analysis

      Curriculum analysis is carried out to get an overview of the material coverage, learning objectives and learning outcomes as a reference for developing the expected product. In the curriculum analysis, there are CP and ATP in accordance with the independent

curriculum, and the material presented is well ordered.

b. Needs Analysis
At the needs analysis stage, it is carried out to find out and classify existing problems in schools related to the teaching materials used in schools. Needs analysis is carried out by interviews, interview guidelines for analysis students' needs. In the needs analysis, there are teachers who use conventional methods in learning that do not use technology as learning media so that students lack active and motivated learning styles in learning.

c. Analysis of Student Characteristics
Characteristic analysis aims to look at the learning capacity, knowledge, skills, attitudes that students have and other related aspects. Therefore, the aim of analyzing student characteristics is to ensure that the development of e-LKPD learning media can meet students' active learning needs, increase their involvement in learning in order to increase learning style motivation.

d. Print Book Analysis
Analysis of printed books aims to see the suitability of the contents of the book with the flow of learning objectives used. Books that are suitable will be used as a reference for concept preparation, independent practice on the product to be developed. Analysis of printed books aims to see the suitability of the contents of the book with the required core competency standards and basic competencies reached by students. Books that are suitable are used as a reference for drafting concepts, independent practice on the media being developed.

2. Design (*Design*)
design stage, planning What is done starts from preparing reference, create, compile, and design a conceptual framework based on existing theories, in the form of learning tools consisting of electronic student worksheets (e-LKPD), learning tool validation sheets, and student response sheets. The results of the planning stage will be continued into the next development stage.

3. Development (*Development*)
Next, the third stage is the stage of developing the design into a product. The learning activity steps in e-LKPD refer to a contextual approach. A contextual approach is learning that applies learning concepts that can help teachers connect the ICT material they have with its application in everyday life. The learning media that has been developed is then validated with two experts, namely media experts and material experts. Validity test and practicality test. Product design validation is a process carried out to assess product design. The products developed will be validated by people who are competent in their fields. Developed media tested by 2 media experts and 1 material expert, namely a Lecturer in Educational Technology, Faculty of Education, Padang State University and an ICT Teacher at SMA Negeri
Validation activities take the form of discussions and asking for experts' willingness to carry out assessments by filling in validation sheets on e-LKPD based *Project Based Learning* (PjBL) using the application *live worksheet* until the e-LKPD is said to be valid. The validity of the e-LKPD assessed can be seen

4. Spread (*Disseminate*)
After e-LKPD is based on *Project Based Learning* (PjBL) spread widely developed, the dissemination stage is carried out online via the link (*link*) or *QR Code*, to introduce media to students in small groups by involving subject teacher responses and student responses to the learning media that

have been developed.

RESEARCH RESULTS AND DISCUSSION

The data presented is data collected during the development process of e-LKPD based learning media *Project Based Learning* (PjBL). This e-LKPD was created by researchers with the aim of being able to be used by teachers as an interesting electronic form of LKPD learning media and also as a source for students to do exercises.

The development of e-LKPD uses a 4-D model, namely there are 4 stages consisting of Definition (*Define*), Design (Design), Development (*Development*), and Spread (*Disseminate*). Here are the stages study which is done as follows:

1. Definition (*Define*)

   At this stage the researcher identified the development of e-LKPD, namely analyzing needs, analyzing student characteristics, and analyzing printed books and analyzing the Learning Objective Flow (ATP).

   a. Needs Analysis

      The results of the analysis of students' needs show that the facilities and infrastructure are inadequate to support the use of learning media, so that teaching materials are limited to printed books, which reduces students' learning activities and motivation.

   b. Analysis of Student Character

      The results of the analysis of student characteristics show that phase E students want more interesting informatics learning, such as the use of technology or LKPD, to facilitate understanding and increase learning motivation. Students find it easier to understand narrated and illustrated LKPD, prefer e-LKPD compared to regular LKPD, and prefer to discuss in groups. They also prefer blue LKPD, and learning using technology can increase their interest in learning.

   c. Learning Objective Flow Analysis (ATP)

      The results of the Learning Objective Flow (ATP) analysis show that the ATP implemented in schools is appropriate. Learning Objectives (TP) are aligned with Learning Outcomes (CP), the material is arranged sequentially, and the time allocation is in accordance with students' needs to master the material.

   d. Print Book Analysis

      The results of the analysis of printed books show that the textbooks used are in accordance with the Learning Objectives (TP) and Learning Outcomes (CP) in the Merdeka Curriculum phase E. The language used is good, but students have difficulty understanding the reading content because the language is too standard. Apart from that, the material in printed books is less detailed and there are too many questions that are difficult for students to solve, thereby reducing learning activity and motivation. Material will be more effective if it is accompanied by images that are relevant to everyday life.

2. Design

   At the manufacturing design stage *storyboard*, *storyboard* made as a sketch or design of the appearance of the E-LKPD that will be created. *This* serves as an initial guide in creating E-LKPD. *Storyboard* E-LKPD consists of a cover, instructions for use, CP and TP, learning style model, PjBL syntax, and evaluation.

3. Development (*Development)*

   At this development stage, the stage is to create and validate e-LKPD. The development stage carried out was to develop e-LKPD based on a storyboard which has been created previously. Description of existing e-LKPD designed are as follows:

a. Cover

The e-LKPD cover can be seen in Figure 2.

Figure 2. Cover section

In picture 2 you can see the cover is designed to be as attractive as possible.

b. Directions for Use

c. The instructions for use can be seen in Figure 3.

Figure 3. Directions for Use

In Figure 3 you can see the user instructions display which consists of instructions for using e-LKPD.

d. Learning Outcomes, Learning Objectives, and Learning Style Models

The learning outcomes, learning objectives and learning style models can be seen in Figure 4.

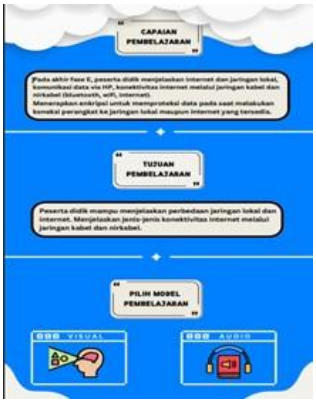

Figure 4. CP, TP, and Learning Style Models

In Figure 4 you can see the learning outcomes, learning objectives and parts of the learning style model that will be selected.

e. Learning Activities

The learning activity section can be seen in Figure 5.

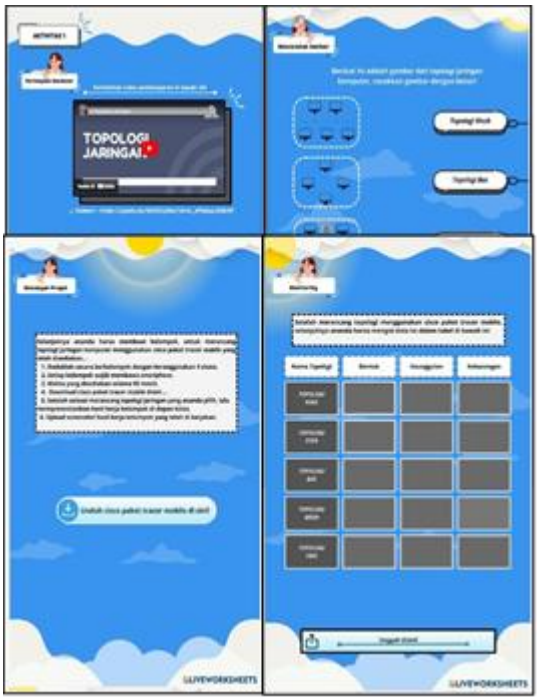

Figure 5. Learning Activities Section

In Figure 5 you can see the display of learning activities which consist of the PjBL syntax structure, namely basic questions, designing project plans, preparing project schedules, monitoring, testing results and evaluating so that they can help students learn the material.

f. Evaluation

The evaluation section can be seen from Figure 6.

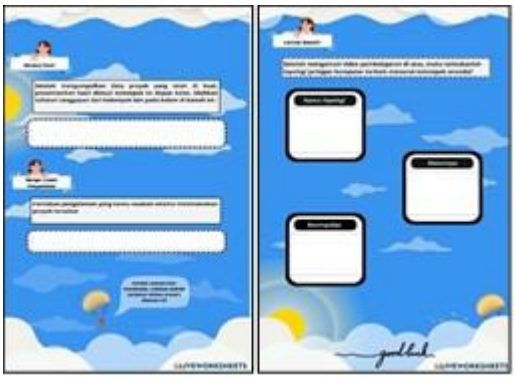

Figure 6. Evaluation

In Figure 6 you can see the evaluation for carrying out independent training for students after carrying out the project.

After e-LKPD is created based on a storyboard that has been designed, the next step is to validate it by a validator. The validity of the PjBL-based e-LKPD was assessed

through a material and media validation questionnaire. The material validation questionnaire covers aspects of appearance, ease of use, and language appropriateness. Meanwhile, the media validation questionnaire assesses the appropriateness aspects of content, presentation, language and graphics. At the validation stage, the validator provides suggestions for improving the e-LKPD that has been designed.

The validator assessment data is described and analyzed quantitatively and qualitatively based on e-LKPD validity data *Project Based Learning* (PjBL) on computer network material. The validity of e-LKPD was tested using a validity sheet given to material experts and media experts. After the validation process by material experts and media experts, both were asked to fill out a material validation questionnaire and a media validation questionnaire. The validation results can be seen in Table 1 below:

Table 1. Validation Results from Material Experts and Media Experts

Assessment Aspects	**Validator (%)**			**Final score (%)**	**Category**
	1	**2**	**3**		
Content Eligibility	100	-	-	100	Very Valid
Presentation Feasibility	100	-	-	100	Very Valid
Language Feasibility	87.5	75	100	87.5	Very Valid
Graphic Feasibility	85.7	-	-	85.7	Very Valid
Display	-	75	87,5	81.3	Very Valid
Ease of Use	-	75	100	87.5	Very Valid
Final Validation Value				**90.3**	**Very Valid**

Based on Table 1, it can be seen that the validation value in the content feasibility aspect obtained a final validation value of 100% in the very valid category. The validation results show that the content of the e-LKPD presented is in accordance with the competencies achieved. In the presentation feasibility aspect, the final validation score was 100%, indicating a very valid category. The validation results show that the presentation of the material on the e-LKPD has been prepared systematically. In the language feasibility aspect, the final validation score was 87.5%, indicating a very valid category. The validation results show that the language used in the media is in accordance with Indonesian language rules. In the aspect of graphic feasibility, the final validation score was 85.7% with a very valid category. The validation results show that the colors, images and writing used are appropriate. In the feasibility aspect, the display obtained a final validation score of 81.3% with a very valid category. The validation results show that the display on the e-LKPD is attractive. In the aspect of ease of use, the final validation score was 87.5% in the very valid category. The validation results show that the e-LKPD developed is easy to use. The overall validation value of the differentiated e-LKPD aspects is based *Project based Learning* in the computer network material, the final score was 90.3% with a very valid category. This shows that e-LKPD is valid and worth testing.

4. Spread (*Disseminate)*

At the deployment stage, e-LKPD trials are based *Project Based Learning* on computer network material that has been validated was carried out on 1 ICT teacher and 12 students with different learning styles to test the practicality and development of e-LKPD.

During the implementation, ICT teachers were asked to try e-LKPD and fill out a practicality questionnaire, but practicality could not be carried out because there was only one ICT teacher and had acted as a material validator. Furthermore, implementation was carried out on 12 students with different learning styles to test the practicality of using e-LKPD based on *Project Based Learning* on computer networking material. Students study e-LKPD individually, work on activities, and are accompanied during the learning process. After completing the activity, students take part in the discussion and fill out the questionnaire provided. Students' learning styles are determined based on a questionnaire filled out by the guidance and counseling teacher.

The results of small group practicality trials can be seen in Table 2 below: Table 2. Student Practicality Results

Assessment Aspects	Final score (%)	Category
Ease of use	85.9	Very practical
Efficient learning time	83,3	Very practical
Benefits gained	83.3	Very practical
Final Value of Practicality	**84.2**	**Very Practical**

Table 2 shows that the practicality results of e-LKPD for students obtained a final practicality score of 84.2% in the very practical category. This shows that e-LKPD based on PjBL on computer network material is practically used for learning information and communication technology at Guguak State High School.

After students fill out the e-LKPD-based practicality questionnaire *Project Based Learning* on computer network material, interviews were conducted to find out their opinions. The interview results show that e-LKPD is easy to understand and use in learning. The arrangement of activities presented is systematic in accordance with learning outcomes and objectives. e-LKPD is also easy to access while working, and helps students learn independently thanks to its usage guide. This allows students to study anywhere without depending on the teacher and increases the motivation of their learning style. Apart from that, this media encourages students to think critically, be active and learn independently. However, e-LKPD requires a better internet network to make access easier.

After conducting interviews on the implementation of teachers and students, it can be concluded that e-LKPD is based on *Project Based Learning* on practical computer network material used as teaching material at SMA Negeri X Guguak.

ACKNOWLEDGEMENT

The author would like to express his deepest gratitude to all parties who have provided support and assistance in writing this journal.

BLIOGRAPHY

Astawan, I, G, & Agustiana, I, G, A, T. (2020), *Pendidikan IPA Sekolah Dasar*. Bali: NIIA Cakra Borg, W.R. dan Gall, M.D. 2003. *Educational Research*: *An Introduction*. New York: Longman

Huda, I. A. (2020). Perkembangan teknologi informasi dan komunikasi (TIK) terhadap kualitas pembelajaran di sekolah dasar. Jurnal Pendidikan Dan Konseling (JPDK), 2(1), 121-125.

Iriani, R., Leny, L., Misbah, M., Rinaya, M. J., Nana, N., Sopranti, N., ... & Norhasanah, H. (2023). Penyusunan Lembar Kerja Peserta Didik (LKPD) Kimia Menggunakan Liveworksheet untuk Meningkatkan Kualitas Pembelajaran pada Kurikulum Merdeka. Bubungan Tinggi: Jurnal Pengabdian Masyarakat, 5(4), 1679-1686.

Maydiantoro, A. (2021). Model-Model Penelitian Pengembangan (Research and Development).Chemistry Education Review (CER), 3(2), 185.

Noperman, F. (2022). INOVASI PEMBELAJARAN: Dari ide kreatif di kepala sampai praktik inovatif di kelas. Laksbang Pustaka

Rachmawati, N., Marini, A., Nafiah, M., % Nurasiah, I. (2022). Projek Penguatan Profil Pelajar Pancasiladalam Implementasi Kurikulum Prototipe di Sekolah Penggerak Jenjang Sekolah Dasar. Jurnal Basicdu, 6(3), 3613-3625.https://doi.org/10.31004/basicedu.v6i3.2714.

Samala, Agariadne Dwinggo, Bayu Ramadhani Fajri, and Fadhli Ranuharja. "Desain dan implementasi media pembelajaran berbasis mobile learning menggunakan moodle mobile app." Jurnal Teknologi Informasi Dan Pendidikan 12.2 (2019): 13-19.

Sari, R. T., & Angreni, S. (2018). Penerapan Model Pembelajaran Project Based Learning (PjBL) Upaya Peningkatan Kreativitas Mahasiswa. Jurnal VARIDIKA, 30(1), 79–83. https://doi.org/10.23917/varidika.v30i1.6548

Taufiqurrohman, Suryani, N., & Suharno.

(2017). Pemanfaatan LKS Digital Untuk Meningkatkan Hasil Belajar KKPI di SMK Negeri 1 Gesi Kabupaten Sragen.pdf (pp. 189–195).

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). Instructional Development for Training Teachers of Exceptional Children: A Sourcebook.