

## DEVELOPMENT OF INTERACTIVE VIDEO BASED ON LOOMIE LIVE APPLICATION ASSISTED BY NEARPOD AS LEARNING MEDIA ON THE SUBJECT OF CHEMICAL BONDS

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### Abstract

The abstract nature of chemical bonding concepts often results in low student engagement and suboptimal learning outcomes, particularly when instruction relies on teacher-centered approaches. This study aimed to develop and evaluate an interactive video learning medium based on the Loomie Live application integrated with Nearpod and structured using the Problem-Based Learning (PBL) model. Employing a Research and Development (R&D) design, the study involved expert validation, small-group trials (n = 9), and field implementation with 30 tenth-grade students. Data were collected using validation sheets, practicality questionnaires, observation sheets, and pretest–posttest instruments, and analyzed using percentage criteria and N-gain scores. The results indicated that the developed media achieved high validity (media aspect = 80.55%; material aspect = 78.27%), very high practicality (teacher response = 92.43%; student response = 95.83%), and strong effectiveness (N-gain = 0.8, high category). Student learning activity reached 84.28%, indicating very active engagement. The novelty of this study lies in the integration of real-time animated video production (Loomie Live) with interactive assessment features (Nearpod) within a PBL framework, enabling synchronous conceptual visualization and formative feedback in chemistry learning. The findings imply that technology-enhanced, problem-based interactive video can significantly improve conceptual understanding and learner engagement in abstract science topics. This model offers a scalable digital learning innovation adaptable to secondary chemistry education contexts.

**Keywords:** Chemical Bonding, Chemistry Education, Interactive Video Learning, Loomie Live, Nearpod, Problem-Based Learning.



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## INTRODUCTION

Chemistry lessons in high school contain many concepts that are considered quite difficult to understand by students because they involve chemical reactions, calculations, and contain many abstract

concepts (Tanti et al., 2020). The scope of chemical bonding material is quite broad, so it requires students to understand the concept as well as critical thinking, creativity, and student involvement in learning (Yovanie, 2024; Musfiroh et al., 2025). The characteristics of the material that require conceptual understanding cause many students to not understand the material being taught (Li & Xu, 2021). The outcomes of (Widarti et al., 2024) showed that learning obstacles faced by students can arise from multiple sources, one of the most common being conceptual misunderstanding (Isra & Mufit, 2023). Hence, the learning process needs to constantly transform students' conceptual understanding; learning is not only centered on the teacher but also involves students actively in the learning process (Wahyuni et al., 2023) (Martin-Alguacil et al., 2024). So, that students can understand the various concepts conveyed by the teacher through a deep and high-level thinking process (O'Reilly et al., 2022; Nafi'ah & Faruq, 2025; Tanti et al., 2025). This deep thinking process can be honed by critical thinking in order to construct knowledge so that it is even better (Cahyaningsih & Maemonah, 2024; de los Santos et al., 2025).

The results of initial observations and interviews with chemistry teachers at MA Al-Muhajirin Pondidaha showed that the school had used an independent curriculum. The learning outcomes of chemical bonding material are known to be 62% of students getting a score of 65-70, below the minimum completion criteria, which is 75. This is due to the lack of interest of students in chemistry lessons because the media and methods used are lecture methods with PowerPoint media, in learning the teacher does not use a variety of media so, learning becomes ineffective and boring, in the chemistry learning process using lecture methods that are only centered on the teacher, when the teaching and learning process takes place and sometimes uses PowerPoint video media or what is often called moving PowerPoint because of its monotonous one-way nature is only able to display images and writing without animation that explains the material in detail and provides a less clear depiction causing students to be less than optimal and also the learning media is only one way or there is no reciprocal relationship between students and the media provided.

According to previous research, when the learning process is only through reading activities without other media, the stage of student memorization of the subject matter is only 10% (Latifah et al., 2020; Prasetyo et al., 2023). Furthermore, when learning, students listen to explanations from the teacher, and the stage of student memorization of the subject matter is 20% (Tanti et al., 2021; Amin & Harahap, 2023). However, when the learning process uses audio-visual learning media, the stage of student recall of the subject matter increases to 30% (Fauzi, 2017) (Fendy et al., 2024). However, in the process of application or implementation, the use of learning media has not been used optimally as a means of learning in schools.

Any medium used to transmit messages from a source in an organized manner, to foster a productive learning atmosphere, and facilitate an efficient learning process, is considered learning media (Marpanaji et al., 2018). One of the learning media that can be used is interactive video. Based on the results of observations, many previous studies have used and developed interactive videos as learning media; among the applications used are Powtoon (Kurniawan et al., 2022), Canva (Ikhlas et al., 2023), PowerPoint, Sparkol (Wahyudi & Amir MZ, 2022), and Sparkol Videoscribe (Humanity et al., 2022). According to the outcomes of interviews, opinions and input from students and teachers, interactive videos that have been there tend to be less effective because students can only watch interactive videos and have difficulty filling in questions directly in the video, so according to some teachers this interactive video is not yet practical to use, besides that learning is expected to stimulate the development of psychomotor, affective, and cognitive domains of students, so one of the alternatives that can be used is the Loomie Live application assisted by Nearpod. Interactive learning videos based on the Loomie Live application, assisted by Nearpod, are teaching materials using the Nearpod website to support internet-based teaching and learning. Interactive learning videos based on the Loomie Live application, assisted by Nearpod, will force students to be responsible and independent in their learning.

The Loomie Live application itself is a video editing application that allows users to create and edit videos in real-time with various visual effects, filters, and interactive pictures (Zulfiqar et al., 2023; Richards et al., 2024). Meanwhile, Nearpod is a web-based platform for offline and online learning that allows teachers and students to interact directly or indirectly (Sari et al., 2023). The advantages of interactive learning videos, according to the Loomie Live application assisted by Nearpod, can take advantage of technological advances by adding or inserting video, image, and audio components, as well as question and answer columns, which can provide an experience that can help students more easily understand something that is not clear to be more real. Interactive learning video media based on the Loomie Live application, assisted by Nearpod, creates classes that achieve learning goals, one of which

is to foster a focused attitude towards learning, presenting a variety of active learning in the classroom by encouraging students in the learning process to receive feedback that gives the impression of student satisfaction in learning.

Interactive learning videos, based on the Loomie Live application and assisted by Nearpod, are packaged in a way that allows students to study the teaching material independently. This is supported by Nurhayati (2014), who states that the use of learning media can attract students' attention, have a positive effect on student learning outcomes, and increase interest in learning the material by providing images and videos. In addition to being assisted by Nearpod. Interactive learning videos also use the Program-Based Learning (PBL) learning model (Nurjanah et al., 2025). According to Cindi (2022), the use of learning media will not provide satisfactory results without being accompanied by a learning model in the learning media (Febrina & Setiawan, 2024). Meanwhile, the characteristics of chemistry learning expected in the independent curriculum include using a discovery model, one of which is the Program-Based Learning (PBL) learning model (Simangunsong, 2023). Program-Based Learning (PBL) is a learning model that trains students' abilities in solving a problem (Asyhari & Sifa'i, 2021). According to Arends, problem-based learning is a learning approach in which students work on authentic problems with the intention of constructing their own knowledge and high-level thinking skills, developing independence and self-confidence (Anisaroh et al., 2018; Nadeak & Naibaho, 2020).

Previous research showed that student learning outcomes were able to improve due to the application of video as a learning medium in teaching and learning activities (Putra & Witari, 2024). The results of another study showed that there was an enhancement in student learning outcomes by 45.3% which had a high potential impact on attracting student interest in learning. The practicality of using learning media is also shown in a study of 92.90% simplifying the learning process for students with the use of interactive videos.

Recent advancements in digital learning technologies have introduced interactive multimedia tools that support visualization and student participation. Interactive video platforms and web-based formative assessment systems have demonstrated potential in increasing engagement and improving learning outcomes. However, existing implementations often function in isolation: video media are frequently limited to passive viewing, while digital assessment platforms are used separately without deep integration into structured pedagogical models. Consequently, many technology-enhanced interventions fail to simultaneously optimize conceptual visualization, formative feedback, and higher-order problem-solving processes.

Moreover, although Problem-Based Learning (PBL) has been widely recognized as effective for fostering critical thinking and conceptual understanding, limited studies have integrated PBL syntax systematically within an interactive video ecosystem that allows real-time engagement and embedded assessment. This indicates a practical and theoretical gap: the absence of an integrated instructional model that combines dynamic visualization, synchronous feedback mechanisms, and structured inquiry-based learning within a single digital environment. Addressing this gap is urgent in the context of curriculum reforms emphasizing student-centered and technology-supported learning. Without integrated digital learning designs, the pedagogical potential of educational technology remains underutilized, particularly for abstract science topics such as chemical bonding. To respond to this need, the present study develops an interactive video learning medium using Loomie Live for dynamic visual production and Nearpod for embedded interactive assessment, structured explicitly according to the Problem-Based Learning model. This integration aims to create a coherent instructional ecosystem in which visualization, inquiry, and immediate feedback function synergistically.

Accordingly, the objectives of this study are: (1) to determine the validity of the developed interactive video learning media in terms of content and media quality; (2) to evaluate its practicality in classroom implementation from both teacher and student perspectives; (3) to examine its effectiveness in improving students' conceptual understanding and learning engagement in chemical bonding material. By addressing these objectives, this study seeks to contribute an empirically tested, technology-integrated problem-based instructional model suitable for secondary chemistry education.

## RESEARCH METHOD

The research employed a Research and Development (R&D) design. This investigation was conducted in the even semester of class X, the academic year 2024/2025, from April at MA Al-Muhajirin Pondidaha, Pondidaha District, Konawe Regency. The subjects in this study were Class X students of MA Al-Muhajirin Pondidaha who were registered in the 2024/2025 academic year, chemistry learning

media experts, and high school chemistry teachers. This type of development is in the form of quantitative and qualitative data. Quantitative data is in the form of numeric data obtained from the assessment scores of media experts, material experts, and students (Handayani & Djukri, 2024; Bennett et al., 2025). Qualitative data were obtained from comments, criticisms, and suggestions through questionnaires (Bletzer, 2015). The objects in this study are interactive learning videos on the main material of chemical bonds, and the Loomie Live and Nearpod Applications.

The population in this study was 30 class X students of MA Al-Muhajirin Pondidaha. The sample used in the limited trial in this study was 9 students of class X, MA Al-Muhajirin Pondidaha. Meanwhile, the sample for the effectiveness test was all students of class X, MA Al-Muhajirin Pondidaha. To determine whether the sample size was adequate, an a priori power estimation was conducted using conventional parameters for paired-sample comparisons: effect size (expected): large ( $d = 0.80$ ), based on similar interactive media studies, Alpha level ( $\alpha$ ): 0.05 Statistical test: paired-sample t-test, and sample size:  $n = 30$ . With these parameters, the estimated statistical power exceeds 0.85, which is above the recommended minimum threshold of 0.80 for behavioral and educational research. Therefore, the sample size of 30 students is considered sufficient to detect a large educational intervention effect.

The validation data collection technique is a validation sheet questionnaire given to the validator as an expert validation test conducted by 2 experts, consisting of 2 lecturers of Chemistry Education, at Halu Oleo University (Yennita et al., 2022). The practicality data of the media using a questionnaire sheet was conducted on 1 chemistry teacher at MA Al-Muhajirin Pondidaha and students on a small scale of 9 students (Khoirunnisa & Suryelita, 2023). At the implementation stage, it was conducted on 30 students in class X, MA Al-Muhajirin Pondidaha. Learning outcome data were obtained from the results of the pretest and posttest. Consisting of 20 multiple-choice questions (Bustami & Florentina Rahayu Esti Wahyuni, 2022). Data were collected using multiple instruments to evaluate validity, practicality, effectiveness, and student activity. Validation Instruments used to assess media feasibility by two expert validators (material and media experts). The instrument used a 5-point Likert scale (1 = very poor to 5 = very good).

Practicality Questionnaires, administered to one chemistry teacher and students (small-group and field trials). The instrument measured ease of use, clarity, engagement, and alignment with PBL principles. Learning Outcomes Test via a 20-item multiple-choice test was administered as pretest and posttest to measure conceptual understanding of chemical bonding. Student Activity Observation Sheet used to measure engagement during learning implementation based on PBL syntax.

Table 1. Instrument Grid for Data Collection

Variable	Indicator	Instrument Type	Number of Items	Scale
Media Validity	Content suitability, curriculum alignment	Validation sheet	10	Likert (1–5)
Media Validity	Presentation quality	Validation sheet	8	Likert (1–5)
Media Validity	Language clarity	Validation sheet	7	Likert (1–5)
Media Practicality	Ease of access and use	Questionnaire	6	Likert (1–5)
Media Practicality	PBL integration	Questionnaire	5	Likert (1–5)
Media Practicality	Engagement and attractiveness	Questionnaire	7	Likert (1–5)
Learning Outcomes	Concept mastery (ionic, covalent, metallic bonds)	MC test	20	Dichotomous
Student Activity	Problem identification	Observation sheet	2	Rating scale
Student Activity	Investigation and discussion	Observation sheet	3	Rating scale
Student Activity	Presentation and reflection	Observation sheet	3	Rating scale

Data Analysis of Interactive Learning Video Product Validity. The analysis of interactive learning video validity is divided into two parts, namely material validity and media validity (Ananda & Zulfadewina, 2023). Analysis of the results of the interactive video media validation sheet based on the Loomie Live application, assisted by Nearpod, is carried out employing the formula outlined below:

$$\text{Percentage value} = \frac{\text{Total score obtained}}{\text{Maximum Score}} \times 100\% \quad \dots (1)$$

Percentage value to assess the quality of the Interactive Video product (Yulia Anggraeni et al., 2025).

Table 2. Validation of interactive videos based on the Loomie Live application, assisted by Nearpod

Percentage	Category
81-100	Very good
61- 80	Good
41- 60	Pretty good
21- 40	Less good
0- 20	Not good

The analysis of the outcomes of the practicality questionnaire is divided into two, namely the analysis of the practicality questionnaire by teachers and the analysis of the practicality questionnaire by students (Astutik & Prahani, 2018). Carried out employing the formula outlined below:

$$\text{Percentage value} = \frac{\text{Total score obtained}}{\text{Maximum Score}} \times 100 \quad \dots (2)$$

Category of determining the design of interactive video-based learning media based on the Loomie Live application, assisted by Nearpod (Daniel et al., 2023).

Table 3. The practicality of interactive video, based on the Loomie Live application, assisted by Nearpod

Percentage	Category
0- 20	Not Practical
21- 40	Less Practical
41- 60	Quite Practical
61- 80	Practical
81-100	Very Practical

Analysis of student learning outcome data to determine the effectiveness of using interactive video learning media. The effectiveness of interactive video learning results is carried out using the following formula: (Purwanto, 2010) (Asrifah & Henucahyani, 2025).

$$\text{N-Gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Maximum Score} - \text{Pretest Score}} \quad \dots (3)$$

The improvement in student learning outcomes can be seen from the N-Gain value interpreted according to Table 4.

Table 4. Effectiveness of Interactive Learning Videos

G Value	Category
-1.00 < g < 0.00	Bad
G = 0.00	Very bad
0.00 < g < 0.30	Fair
0.30 < g < 0.70	Medium
0.70 < g < 1.00	High

All quantitative data were analyzed using descriptive and inferential statistics. Descriptive statistics included mean, standard deviation, percentage, and normalized gain (N-gain). Prior to inferential

testing, data normality was assessed using the Shapiro–Wilk test. Because the data met normality assumptions, a paired-sample t-test was conducted to determine whether there was a statistically significant difference between pretest and posttest scores at a significance level of  $\alpha = 0.05$ . Effect size (Cohen's  $d$ ) was calculated to determine the magnitude of the intervention effect. Statistical analyses were conducted using SPSS version 25.

## RESULTS AND DISCUSSION

### Definition

Activities carried out at the definition stage aim to find out the basic problems experienced by teachers and students, which are obtained by conducting interviews with teachers and students regarding the material, teaching materials, and strategies used, and then determining the creativity to overcome existing problems. The initial analysis carried out in this study was based on the results of interviews conducted with teachers and students. The results showed that the analysis obtained by students in learning that students had never carried out interactive learning, both in terms of media and methods. It can be concluded that the problems faced at MA Al-Muhajirin Pondidaha, especially in class X, can be solved by developing learning media that utilize electronic media, in this case, developing interactive video-based learning media based on the Loomie Live application, assisted by Nearpod with the PBL model on chemical bonding material.

### Design

Product design starts with making interactive videos. Designing interactive video displays using the Loomie Live application. Done according to the following steps: 1) Determine the boundaries, 2) Determine and collect sources, 3) Prepare the cover or opening video for the interactive video, 4) Edit the video using the Loomie Live application, 5) Select the appropriate image on the site that provides free images, in addition the image is also selected from the images provided by the Loomie Live application, 6) Provide subtitles for the interactive video, 7) Record sound (add voice-over), 8) The results of the interactive video design are downloaded from Loomie Live in MP4 format, 9) Videos that have been successfully integrated into Nearpod (Pagán et al., 2020).

The development of interactive videos using Nearpod is carried out according to the following steps: 1) Registering a Nearpod account is done by logging in to the page (Nearpod.com), 2) The log. in the menu is selected using a Google account and the Create a lesson menu is clicked, 3) The Untitled Lesson menu, select Add New, then in the Content section, select Video, then Upload A Video, 4) The Choose File menu is selected to upload interactive video files in MP4 format stored in PC or Laptop storage data (File size no more than 40 MB) and click the Save button, 5) After the file is uploaded, the Nearpod editing page can be accessed to add several features to the video product, 6) Adding an answer box is done by clicking the plus sign (+) or Add Activity At to the desired location. The quiz box consists of 2 types, namely essay and multiple choice. The answer has no character limit, so filling it in can be done freely (Popham, 2017). 7) Essays and multiple-choice questions have the same way of entering questions. For multiple choice questions, there are answer key settings for multiple choice, and there are time settings for answering each question. Click + Add Question in Lesson Details, please fill in the subject and grades. 8) The video that has been set is uploaded to Nearpod, and then click Save. If you want to share it with students as an assignment, please click Student-Paced. A code and link will appear that can be shared with students to access the video that has been synchronized into Nearpod. 9) The document that has been successfully saved already has a link that can be shared directly. If you still need other settings, select open worksheets and click the custom link.

These settings are in the form of duration of work, link validity schedule, default action, automatic answer checking, and others that are adjusted to your needs. These settings produce a new link that can be shared (Dwivedi et al., 2021). Students can access interactive videos based on the Loomie Live application, assisted by Nearpod, according to the following steps: 1) the Nearpod website is opened via the Browser page, 2) on the Nearpod page, log in as a Student, enter the Nearpod code that has been shared by the teacher, the code is: NHQFJ, and Link: <https://app.nearpod.com/pin=NHQFJ>, fill in the identity column, click next, and students can watch learning videos while answering questions contained in the video.

### Development

#### *Product Development*

The development stage is to combine the Loomie Live design and then integrate it into Nearpod. Tegeh and Kirna (2013) show the development stage as the stage of compiling a product, such as collecting all the materials used and then combining them. The results show that four materials have been made into one video, in general, interactive videos consist of covers, learning objectives, and achievements, materials summarized as videos, and core activities guided by the structure of the Problem-Based Learning (PBL) model including the following stages: (1) Introducing students to the problem, (2) Facilitating students' organization of learning activities, (3) Supporting both individual and group investigations, (4) Encouraging the development and presentation of findings, and (5) Reviewing and assessing the problem-solving process. In addition, the development stage is also carried out to measure the feasibility of the product and the instruments used in the research by the validator before being tested on students. According to Dewi, (2022), the development stage includes research on aspects of product and instrument feasibility before proceeding to the implementation stage.

**Product Validation**

This study divides the validation process into three aspects, namely validation of material aspects and media aspects. 1) Product Validation, The initial product design of the interactive video, based on the Loomie Live application assisted by Nearpod, was improved based on suggestions and input. The validation sheet serves as a tool to assess the validity or feasibility of the interactive video developed using the Loomie Live application supported by Nearpod, before its testing(Hasniar et al., 2025). Experts have provided several suggestions and inputs concerning the interactive video, namely, 1) the researcher's identity does not need to be included in the video, and 2) paying attention to the use of punctuation and capital letters (Mufidah et al., 2020). 2) Product Revision, Revisions are made to improve interactive videos based on the Loomie Live application, assisted by Nearpod, based on input and suggestions from validators before the product is tested(Rohimah et al., 2025). The interactive video, based on the Loomie Live application, assisted by Nearpod, which has been improved, is then reconsulted for further discussion and will stop when the validator states that the interactive video product based on the Loomie Live application, assisted by Nearpod, has been declared worthy of being tested (Yulia Anggraeni et al., 2025). 3) Product Validation Results from the Material Aspect, The validity of the material in the product is carried out based on the aspects of presentation material and language. The results of the product validation analysis from the media aspect are shown in Table 5.

Table 5. Product Validation Results from the Material Aspect

No.	Assessment Aspect	Average Percentage	Category
1.	Material	83.33%	Very good
2.	Presentation	74.0%	Good
3.	Language	77.5%	Good
	Average	78.27%	Good

The outcomes of product validation on the material aspect obtained an average percentage of all aspects of 78.27% with a good category. Riduwan (2010) stated that a product is said to be good if the average percentage is greater than 61%. Therefore, product validation from the material aspect has been good for utilization in the chemical bonding study process. In the material aspect, there are several things that are assessed, namely, the suitability of the material with the independent curriculum, CP, and TP. In the presentation aspect, there are several things that are assessed, namely questions presented by the material, size, and format of letters, learning activities that are structured, including sources, clarity, and relevance of images and videos presented. In the language aspect, what is assessed is the use of sentences adjusted to Indonesian language rules and easy to understand. This aspect refers to the aspects of material assessment, presentation, and language (BSNP, 2014). 4) Product Validation Results from Media Aspect, Assessment of media validation used in the product based on media, presentation, and language. The outcomes of the product validation analysis from the media aspect are shown in Table 6.

Table 6. Product Validation Results from Media Aspect

No	Assessment Aspect	Average Percentage	Category
1.	Media Quality	75.0%	Good
2.	Language	81.66%	Very Good
3.	Media Layout	85.0%	Very Good
	Average	80.55%	Good

The validation results on the media aspect obtained an average percentage of all aspects of 80.55% with a good category for use in the chemical bond learning process, but revisions still need to be made based on suggestions from experts. The language aspect received the lowest score among the three aspects assessed. This is based on comments from experts (validators). There are things that need to be revised again related to the spelling of the writing text in the interactive video, and also in the quiz column for the selection options. This needs to be considered to produce better media (Tanti et al., 2021)

### Small Group Trial

After the revision process was carried out, the product was tested on students. This activity was carried out to measure the criteria of practicality and to see whether the product was suitable for use in the field trial. The trial conducted was a limited trial, with a sample size of 9 students taken from 30% of the total number of students, consisting of 3 high-ability students, 3 medium-ability students, and 3 low-ability students. The limited trial was conducted for 2 meetings. The agenda of the first meeting was to provide a pretest, which was then continued with the provision of a chemistry learning video that was shared via a code that had been integrated into Nearpod. Initially, students followed the directions of the researcher for 15 minutes, after which they continued to watch the shared video. There was 1 video shared with 4 topics of material discussed, namely atomic stability, ionic bonds, covalent bonds, and metal bonds. In each topic of the material discussed, there were several questions, and students were controlled by the teacher to answer the questions given through the video within a predetermined time. Next, a protest was given, and at the end of the activity, students were given a response questionnaire, which is for consideration of product improvement before being developed in a field trial. The following are the results of the student response sheets for interactive videos based on the Loomie Live application, assisted by Nearpod on the chemical bonding material, exhibited in Table 7.

Table 7. Results of limited trials of interactive video products based on the Loomie Live application, assisted by Nearpod

No.	Assessment Aspect	Average	Category
1.	Top-performing students	92.30%	Very practical
2.	Students in the intermediate group	90.76%	Very practical
3.	Students categorized as low achievers	81.53%	Very practical
	Average	88.19%	Very practical

The results of the data analysis obtained from the results of the student response questionnaire to the interactive video in Table 7 obtained an average value of 88.19% which is in the very practical category. This value shows that students gave a positive response to the media developed. If more than 50% of students provide favorable responses on the questionnaire, it is considered a positive outcome of the statements get a strong response so that the media is said to be practical, and a positive response also shows that students are interested in understanding the material being taught and have a high interest in the lesson (Saifullah et al., 2022). The learning media that has been developed has proven to be very easy to use and can be easily accessed on smartphones/PCs. The game features available in this media are also easy to operate. In terms of benefits, it shows that the media that has been created can help students increase their understanding of the material.

### Implementation Results

After the revision process was carried out, the investigation Instrument product was tested on one teacher and class X students. This activity was carried out to measure the practicality criteria of the product being developed. This research was conducted on one chemistry teacher and class X students of

MA Al-Muhajirin Pondidaha. The number of samples was 30 people, consisting of students with top-performance, intermediate, and low-achiever levels. The application to class X students was carried out for 2 meetings. The agenda of the first meeting was to provide a Pretest, after which an interactive video based on the Loomie Live application, assisted by Nearpod, was provided. In the initial activity, all students followed the directions of the researcher for 15 minutes. After that, students were directed to watch a video that contained a quiz that needed to be answered by each group according to the syntax of the Problem-Based Learning (PBL) learning model. At the second meeting, students were directed to fill out the posttest and questionnaire.

**Practicality analysis by educators**

The analysis of the results of practicality obtained based on the use of interactive video-based learning media was carried out to measure the practicality of the product by chemistry teachers at MA Al-Muhajirin Pondidaha. The aspects assessed include aspects of content quality, presentation quality, language, and appearance. The results of the practicality assessment by teachers are shown in Table 8.

Table 8. Practicality based on educator responses to interactive videos based on the Loomie Live application, assisted by Nearpod

No.	Assessment Aspect	Average	Category
1.	Content Quality	96.6%	Very practical
2.	Model Problem-Based Learning	98.0%	Very practical
3.	Presentation Quality	87.5%	Very practical
4.	Language	90.0%	Very practical
5.	View	90.0%	Very practical
Average		92.43%	Very practical

The outcomes of data analysis obtained from the results of the practicality of interactive video products based on the Loomie Live application assisted by Nearpod with the PBL model on chemical bonding material by chemistry teachers at MA Al-Muhajirin Pondidaha in Table 7 obtained an average value per aspect as a whole of 92.432% which is in the very practical category. Judging from Table 7, it tends to be seen that the results of the practicality by teachers at MA Al-Muhajirin Pondidaha state that the Nearpod interactive learning media is very practical to use in daily learning activities. The results of the practicality also show that this media is very easy to apply in the process of learning chemical bonds with an attractive video display, easy-to-understand language structure, and quality of material that covers learning objectives.

**Practicality analysis by students**

Analysis of student response questionnaires on the use of interactive videos based on the Loomie Live application, assisted by Nearpod with the PBL model on chemical bonding material, was carried out to measure the practicality of the product. After students used the product, the student response questionnaires were then distributed and filled out by each student. The outcomes of the product's practicality analysis can be seen in Table 9.

Table 9. Results of Student Response Questionnaires on Interactive Videos Based on the Loomie Live Application Assisted by Nearpod

Ability Level of Students	Aspect	Percentage of Assessment All Aspects (%)	Category
Low	Content Quality	100.0%	Very practical
	Appearance	86.66%	Very practical
	Language	100.0%	Very practical
	Benefits of Problem-Based Learning	90.0%	Very practical
Medium	Content Quality	100.0%	Very practical
	Appearance	93.33%	Very practical

Ability Level of Students	Aspect	Percentage of Assessment All Aspects (%)	Category
High	Language	100.0%	Very practical
	Benefits of Problem-Based Learning	85.0%	Very practical
	Content Quality	100.0%	Very practical
	Appearance	100.0%	Very practical
	Language	100.0%	Very practical
	Benefits of Problem-Based Learning	95.0%	Very practical
	Average	95.83%	Very practical

Based on Table 9, the average student response assessment is 95.83%, which is in the very practical category. These results indicate that student responses are positive towards interactive videos based on Problem-based Learning on chemical bonding material that has been developed. The data in the table above proves that the media that has been developed is interesting in terms of appearance, video, presentation quality, material, and language for use in learning activities. Learning by utilizing interesting media creates varied learning activities that make students more active (Padang & Sitepu, 2023). In addition to attracting student interest, the learning process that applies interactive videos based on the Loomie Live application, assisted by Nearpod, helps students to successfully master learning materials faster. According to Sihotang, R. et al., (2021), the media's attention function states that the media can attract attention and focus students on the core material.

The learning media that has been developed has proven to be very easy to use and can be easily accessed on smartphones/PCs. The game features available in this media are also easy to operate. In terms of benefits, it shows that the media that has been created can help students increase their understanding, make it easier for students to understand chemical bonding material, and conclude the material with interactive videos and quizzes that provide direct feedback to students. It may be concluded that interactive learning tools utilizing Nearpod are very helpful in teaching chemical bonding material

### Media Effectiveness Analysis

The effectiveness of interactive video based on the Live application, assisted by Nearpod with the Problem-Based Learning learning model on the chemical bonding material that has been developed, can be seen by looking at the learning outcomes of students after using interactive video based on the Loomie Live application assisted by Nearpod in the study process. Student study outcome data is shown in Table 10.

Table 10. Learning Outcomes of Class X Students

Statistics Parameter	Pretest	Post-test	N-Gain	Criteria
Max	65	100		
Min	20	75		
Mean	38	89		
Modus	35	90	0.8	High
Median	35	90		
Standard deviation	13.36	7.32		
Student amount (n)	30	30		

Based on Table 10, there is a difference between students' chemistry learning outcomes before and after being given treatment in the form of implementing interactive videos according to the Loomie Live application, assisted by Nearpod with the PBL model on chemical bonding material. This is because, at the time of the pretest, students had not been taught the main material of chemical bonds, so students' initial conceptual abilities regarding the main material of chemical bonds were still very lacking, and they were not able to answer the questions given properly and correctly. After students were given an interactive video treatment based on the Loomie Live application assisted by Nearpod with the PBL model on the chemical bonding material and carried out the posttest, students were able to answer the questions

well, so from the data above, it can be concluded that all students have met the KKM value set by the school. The minimum completion criteria is 75 with an average posttest score on the interactive video of 89 (high category) and an average pretest score of 38.

Interactive videos based on the Loomie Live application, assisted by Nearpod with the Problem-Based Learning (PBL) model, require students to identify the problems that have been provided, using interactive videos based on the Loomie Live application, assisted by Nearpod with the Problem-Based Learning (PBL) learning model, where students are directed to find answers and conduct experiments. Therefore, students are more active in the study process in gaining new knowledge. Table 10 shows an average N-Gain of 0.8 in the high category. This shows that the use of interactive videos based on the Loomie Live application, assisted by Nearpod with the Problem-Based Learning (PBL) learning model on chemical bonding material for class X students of MA Al-Muhajirin Pondidaha is very effective. The high effectiveness of the media indicates that students can more quickly and accurately accept concepts. The existence of discussion activity features on interactive videos based on the Loomie Live application, assisted by Nearpod, helps participants be more active in learning because they discuss and exchange information, knowledge, and opinions to find lesson concepts, so that learning is realized more interactively. The high enthusiasm and activeness of students when involving sophisticated media as a learning experience are significant benchmarks for achieving more optimal learning outcomes. The results of observations of student activities for class X, MA Al-Muhajirin Pondidaha, in implementing learning on the main material of chemical bonds can be seen in Table 11.

Table 11. Results of student activities for class X, MA Al-Muhajirin Pondidaha in implementing learning on the main material of chemical bonds

Material	Question	Group							Criteria
		1	2	3	4	5	6	7	
Chemical equilibrium	Question 1	10	0	10	0	10	10	10	84,28 % (very active)
	Question 2	10	10	10	10	10	10	10	
	Question 3	10	0	10	0	10	10	10	
Ionic bond	Question 4	5	10	10	10	10	10	10	
	Question 5	15	0	15	15	15	10	15	
Covalent bond	Question 6	20	20	20	20	20	20	20	
	Question 7	0	10	10	0	10	10	10	
Metal bond	Question 8	15	15	15	0	5	15	15	
	Average Amount	85	65	100	55	90	95	100	

The average percentage of student learning activities from 4 materials is 84.28% in the active category. This shows that student activity in chemistry learning with interactive videos based on the Loomie Live application, assisted by Nearpod, is effective in guiding student learning activities during the learning process, so that it can encourage students to be more active in learning activities. According to (Arsyad et al., 2024), the PBL model can enhance students' chemistry learning activity. Based on the data obtained, all students, both students with high, medium, and low ability levels, can work on questions in interactive videos well because each learning activity is guided by the PBL syntax, and students can follow the learning. Students look enthusiastic and active because they get new learning guides that are different from before.

Utilizing interactive videos as instructional materials can enhance students' academic performance because students are required to be active in developing their thinking skills in solving problems, so that learning is of better quality. With the use of this teaching material, it is hoped that students can understand the material so that it affects their learning outcomes. The results of (Jundana, 2025) research show that the use of interactive videos using the Loomie Live application in conjunction with Nearpod as instructional material has a beneficial impact on student achievement. It also promotes a more active, efficient, and engaging learning environment, thereby enhancing the overall quality of education. Improving the quality of teaching and learning is not only from the media, but in this case, the use of methods also affects the teaching and learning process for students. According to [27], the effectiveness of the PBL model can improve student learning outcomes, because when learning, students

focus on solving and are problem-oriented, asking questions, and arguing. Easy-to-understand learning stages are very necessary for implementing learning so that students are not burdened with complicated steps. The results obtained from the relationship between student responses during the trial and observations of interactive video answers based on the Loomie Live application assisted by Nearpod are interrelated, where student responses say that the interactive video developed has a positive impact, as well as the results of the answers obtained that this interactive video is very effective for use by students.

The competence of students in participating in learning tasks also improves based on the guidance packaged in interactive videos, based on the Loomie Live application, assisted by Nearpod. Interactive videos using the Problem-Based Learning method make it easier for students to find and investigate new knowledge themselves, so that the knowledge lasts a long time in their memory and is not easily forgotten. Another study also revealed that interactive videos can create student independence and activate students during learning activities. However, there are several shortcomings of the Nearpod application as a container for learning media, when applied in schools, interactive videos tend to have unclear video display quality, or images tend to be blurry. This is because the Nearpod application, which is also used as a container for media, can only load videos with a size of no more than 40 Mb, so the videos made tend not to have good image quality in this case HD format (Muzakki et al., 2025), the quality of the video which tends to be blurry can affect the quality, practicality, and validity of the interactive video itself during the process of applying teaching and learning to students (Abdullah & Isa, 2019). The interactive video developed using the Loomie Live application and supported by Nearpod has undergone several revisions based on the suggestions and input of the expert team. The effectiveness or otherwise of the interactive video, based on the Loomie Live application assisted by Nearpod, can be measured from the increase in understanding of the concept (Nurmailia et al., 2024).

This study aimed to answer three research questions: (1) Is the developed interactive video valid? (2) Is it practical for classroom use? (3) Is it effective in improving students' conceptual understanding of chemical bonding? The first research question concerned the validity of the interactive video based on Loomie Live integrated with Nearpod within a Problem-Based Learning (PBL) framework. Content validity analysis, calculated using percentage agreement from expert judgment instruments, showed an average score of 78.27% for material aspects and 80.55% for media aspects. According to the predetermined feasibility criteria, these results fall within the "good" to "very good" category, indicating that the product is theoretically and technically appropriate for instructional use.

These findings confirm that the integration of curriculum alignment, structured PBL syntax, and interactive video elements meets pedagogical standards. The relatively balanced scores between material and media aspects suggest that both instructional substance and technological design were adequately developed. This aligns with multimedia learning theory, which emphasizes the coherence between content quality and visual presentation in promoting meaningful learning. The second research question examined the practicality of the developed media. Practicality was measured using Likert-scale questionnaires administered to teachers and students, analyzed through percentage conversion. The teacher response yielded an average score of 92.43%, while student responses reached 88.19% in small-group trials and 95.83% in full implementation. These results indicate that the media falls within the "very practical" category. From a methodological standpoint, practicality analysis demonstrated consistent positive responses across different ability levels (low, medium, high). This suggests that the media is accessible and usable regardless of students' prior academic performance. The structured embedding of quizzes and immediate feedback within Nearpod likely contributed to this usability.

The findings support the assumption that interactive video integrated with formative assessment tools enhances usability and instructional clarity. Importantly, the practicality outcomes validate the development phase of the R&D model, confirming that revisions based on expert feedback successfully improved the product before field testing. The third research question addressed the effectiveness of the developed media in improving students' understanding of chemical bonding concepts. Effectiveness was evaluated using a one-group pretest–posttest design. Data analysis included descriptive statistics, normalized gain (N-gain), and inferential testing. The mean pretest score was 38, while the mean posttest score increased to 89. The calculated N-gain was 0.8, categorized as "high." This indicates substantial conceptual improvement following the intervention. Furthermore, based on effect size estimation (Cohen's *d*), the magnitude of improvement can be classified as large, demonstrating strong practical significance. The increase in learning outcomes directly answers the effectiveness research question and confirms that the integration of Loomie Live-based visualization and Nearpod-assisted interactive assessment within a PBL structure significantly enhances students' conceptual mastery. Additionally,

student activity observation showed an average engagement level of 84.28%, categorized as “very active.” This behavioral evidence supports the quantitative improvement found in test scores. The PBL structure required students to identify problems, investigate, discuss, and present solutions, thereby promoting higher-order thinking and sustained engagement. Taken together, the findings demonstrate that the developed media satisfies three essential educational quality dimensions: (1) Theoretical feasibility (validity), (2) practical applicability (practicality), (3) empirical instructional impact (effectiveness). The high N-gain value suggests that conceptual visualization combined with interactive problem-solving significantly reduces misconceptions in abstract topics such as ionic, covalent, and metallic bonding.

The results are consistent with constructivist learning principles, which posit that students construct knowledge more effectively when actively engaged in problem-based and technology-enhanced environments. The Nearpod platform’s embedded questioning and feedback features likely strengthened cognitive processing by providing immediate formative reinforcement. Importantly, this study demonstrates that the synergy between real-time animated video production (Loomie Live) and interactive digital assessment (Nearpod) within a structured PBL model produces measurable learning gains rather than merely increasing student enjoyment. Methodologically, this study extends prior interactive media research by: (1) Integrating real-time video animation and synchronous interactive assessment, (2) Evaluating effectiveness using normalized gain and effect size, (3) Providing empirical evidence of engagement and conceptual improvement simultaneously. Thus, the findings not only answer the research questions but also provide empirical support for technology-enhanced, problem-based chemistry instruction at the secondary level.

## CONCLUSION

This study aimed to develop and evaluate the validity, practicality, and effectiveness of an interactive video learning medium based on Loomie Live integrated with Nearpod and structured within a Problem-Based Learning (PBL) framework for chemical bonding instruction. The findings confirm that the developed media meets pedagogical feasibility standards, is highly practical for classroom implementation, and effectively enhances students’ conceptual understanding and engagement. Beyond fulfilling its development objectives, this study demonstrates that the integration of real-time animated visualization, embedded formative assessment, and structured problem-based inquiry creates a synergistic instructional model capable of addressing abstract chemistry concepts more effectively than conventional media. The empirical improvement in conceptual mastery and learning activity indicates that interactive, feedback-oriented digital environments can strengthen both cognitive processing and active participation simultaneously. Conceptually, this study proposes a Technology-Integrated Problem-Based Interactive Model (TIPBI Model) for chemistry instruction, in which (1) dynamic visualization supports conceptual representation, (2) synchronous digital assessment promotes immediate cognitive reinforcement, and (3) structured problem-solving scaffolds higher-order thinking. This integrated structure may serve as a transferable framework for other abstract science topics beyond chemical bonding. From a practical perspective, the findings imply that secondary chemistry educators can leverage interactive video platforms not merely as supplementary tools but as central instructional media within inquiry-based learning designs. At the policy level, the results support the strategic incorporation of interactive digital ecosystems into curriculum implementation under student-centered learning paradigms. Future research may expand this model using experimental control-group designs, larger multi-school samples, and longitudinal measurements to examine retention and higher-order transfer effects.

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## AUTHOR CONTRIBUTIONS

Conceptualization: AH, EK, M. Data curation: AH, EK, M, D. Formal analysis: EK, M, MA. Research: AH, EK, M. Methodology: AH, EK, MA. Supervision: AH, EK, M. Validation: AH, D, E, MA. Drafting - original draft: AH, EK. Writing - proofreading and editing: M, D, E, MA.

## CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

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## USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

### REFERENCES

- Abdullah, A., Yahaya, M. F., & Mat Isa, N. (2020, July). The impact of nearpod interactive learning platform in quality accounting education for sustainable development. In *Charting a Sustainable Future of ASEAN in Business and Social Sciences: Proceedings of the 3<sup>rd</sup> International Conference on the Future of ASEAN (ICoFA) 2019—Volume 1* (pp. 203-213). Singapore: Springer Singapore. <https://doi.org/10.1007/978-981-15-3859-9>.
- Amin, M. T., & Harahap, R. D. (2023). Analysis of students learning interest in biology subject matter of viruses in grade X senior high school. *BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan*, 5(2), 179. <https://doi.org/10.20527/bino.v5i2.15549>.
- Ananda, S. R., & Zulfadewina, Z. (2023). Analysis of the Effect of Powtoon Application Interactive Learning Media on Mathematics Learning Ability of Elementary School Students. *Jurnal Paedagogy*, 10(1), 268. <https://doi.org/10.33394/jp.v10i1.5688>.
- Anisaroh, A., Roesminingsih, M. V., & Suyanto, T. (2018). Implementation of Problem Based Learning to Improve the Critical and Creative Thinking Skills. *2nd International Conference on Education Innovation*, 212, 29–32. <https://doi.org/10.2991/icei-18.2018.7>.
- Arsyad, M., Guna, S., & Barus, S. (2024). Enhancing Chemistry Education through Problem-Based Learning: Analyzing Enhancing Chemistry Education through Problem-Based Learning: Analyzing Student Engagement, Motivation, and Critical Thinking. *International Journal of Curriculum Development, Teaching and Learning Innovation*, July. <https://doi.org/10.35335/curriculum.v2i3.178>.
- Asrifah, M. N., & Henucahyani, B. H. C. K. B. (2025). Analysis of the Use of Interactive Learning Media on Student Learning Motivation. *Jurnal Pendidikan Anak*, 8(2), 271–279. <https://doi.org/10.58344/jmi.v4i5.2515>.
- Astutik, S., & Prahani, B. K. (2018). The practicality and effectiveness of Collaborative Creativity Learning (CCL) model by using PhET simulation to increase students' scientific creativity. *International Journal of Instruction*, 11(4), 409–424. <https://doi.org/10.12973/iji.2018.11426a>.
- Asyhari, A., & Sifa'i, M. (2021). Problem-Based Learning to Improve Problem-Solving Skill: Is it Effective Enough? *Indonesian Journal of Science and Mathematics Education*, 4(1), 78–88. <https://doi.org/10.24042/ij sme.v4i1.8674>.
- Bennett, J., Hajilo, M., Paula, A., Rosa, D., Arthur, R., James, W., & Matthews, K. (2025). *Democratizing Quantitative Data Analysis and Evaluation in Community-Based Research Through a New Automated Tool*. *Gupta 2024*, 1–13. <https://doi.org/10.3390/socsci14060346>.
- Bletzer, K. V. (2015). Visualizing the qualitative: making sense of written comments from an evaluative satisfaction survey. *Journal of Educational Evaluation for Health Professions*, 12(April), 12. <https://doi.org/10.3352/jeehp.2015.12.12>.
- Bustami, Y., & Florentina Rahayu Esti Wahyuni. (2022). Jurnal Pendidikan MIPA. *Jurnal Pendidikan MIPA*, 24(3), 690–698. <https://doi.org/10.23960/jpmipa/v24i3.pp690-698>.
- Cahyaningsih, E., & Maemonah. (2024). Implementing a constructivist approach to enhance critical thinking skills in integrated science learning among elementary islamic school students. *Jurnal Ilmiah Mahasiswa Raushan Fikr*, 13(1), 102–113. <https://doi.org/10.24090/jimrf.v13i1.11560>.
- Daniel, Y., Banjarnahor, M., & Tarigan, D. (2023). Nearpod-Based Interactive Learning Media in Improving Learning Outcomes of Class V Elementary School Students. *Indonesian Journal of Advanced Research (IJAR)*, 2(6), 767–778. <https://doi.org/10.55927/ijar.v2i6.4554>.
- de los Santos, O., Hernández-Padilla, E., Vázquez-Alonso, Á., López-Aymes, G., Aguilar-Tamayo, M. F., & Arce, E. (2025). Scientific Thinking Promotes the Development of Critical Thinking in Primary Education. *Education Sciences*, 15(9), 1–13. <https://doi.org/10.3390/educsci15091174>.
- Dewi, N. K. A. K. (2022). Discovery Learning in E-Book with Natural Science Lesson at Elementary School. *Indonesian Journal Of Educational Research and Review*, 5(1), 111–122. <https://doi.org/10.23887/ijerr.v5i1.44733>.
-

- Dwivedi, Y. K., Ismagilova, E., Hughes, D. L., Carlson, J., Filieri, R., Jacobson, J., Jain, V., Karjaluto, H., Kefi, H., Krishen, A. S., Kumar, V., Rahman, M. M., Raman, R., Rauschnabel, P. A., Rowley, J., Salo, J., Tran, G. A., & Wang, Y. (2021). Setting the future of digital and social media marketing research: Perspectives and research propositions. *International Journal of Information Management*, 59(June 2020), 102168. <https://doi.org/10.1016/j.ijinfomgt.2020.102168>.
- Fauzi, H., A. (2017). Utilization of Audio Visual Media to Improve Student Learning Result in IPS Learning. *International Journal Pedagogy of Social Studies*, 2(1), 88. <https://doi.org/10.17509/ijposs.v2i1.8666>.
- Febrina, V., & Setiawan, D. (2024). Analysis of the Use of Learning Media on the Learning Interest of Learning Science Students and Environmental Themes. *Jurnal Penelitian Pendidikan IPA*, 10(8), 5702–5709. <https://doi.org/10.29303/jppipa.v10i8.7497>.
- Fendy, I. M., Gunawan, A., & Jayanta, I. N. L. (2024). *Innovative Learning Media Development : Improving Elementary Students ' Speaking Skills with Storytelling -Based Audiovisual Tools*. 12(2), 355–363. <https://doi.org/10.23887/jeu.v12i2.74625..>
- Haetami, A., Zulvita, N., Dahlan, Maysara, Marhadi, M. A., & Santoso, T. (2023). Investigation of Problem-Based Learning (PBL) on Physics Education Technology (PhET) Simulation in Improving Student Learning Outcomes in Acid-Base Material. *Jurnal Penelitian Pendidikan IPA*, 9(11), 9738–9748. <https://doi.org/10.29303/jppipa.v9i11.4820>.
- Handayani, N. D., & Djukri. (2024). Development of Electronic Student Worksheet Based on Problem-Based Learning for Material on Environmental Change Geoheritage Gumuk Pasir. *Jurnal Penelitian Pendidikan IPA*, 10(5), 2438–2445. <https://doi.org/10.29303/jppipa.v10i5.7283>.
- Hasniar, H., La Djangka, L. D., Haerani, R. P. R., & Buhari, M. R. (2025). Development of Nearpod-Based Interactive Media on Science Learning Style Material Theme 7 Subtheme 1 Class IV SDN 008 Sungai Kunjang. *Journal of Education and Learning Research*, 2(2), 118–125. <https://doi.org/10.62208/jelr.2.2.p.118-125>.
- Humanity, E. F. O. R., Islam, U., Walisongo, N., & Sciences, F. O. F. (2022). Proceeding of International Conference of Education , Sciences , Technology , Engineering , & Mathematics. *Sains Dan Teknologi*. <https://drive.google.com/file/d/1ik45Yg1qj1fbzvPm3dbopCXEH4jSd6l7/view..>
- Ikhlas, R. Z., Japakiya, R., & Muzayanah, T. (2023). Utilization of Canva Application as a Learning Media Video Creation. *Journal of Social Science Utilizing Technology*, 1(3), 158–169. <https://doi.org/10.70177/jssut.v1i3.558>.
- Isra, R. A., & Mufit, F. (2023). Students' conceptual understanding and causes of misconceptions on Newton's Law. *International Journal of Evaluation and Research in Education*, 12(4), 1914–1924. <https://doi.org/10.11591/ijere.v12i4.25568>.
- Jundana, F. H. (2025). The Use of Nearpod Interactive Learning Media on Student Learning Motivation in Reading Skills at Mts Al-Rifa'ie 2 School. *Abjadia : International Journal of Education*, 10(4), 1101–1109. <https://doi.org/10.18860/abj.v10i4.33732>.
- Khoirunnisa, A., & Suryelita, S. (2023). Pengembangan media pembelajaran menggunakan instagram pada materi kesetimbangan kimia sebagai sumber belajar mandiri siswa kelas xi sma [Development of learning media using Instagram on chemical equilibrium material as a source of independent learning for class XI high school students]. *Edukimia*, 5(1), 017–022. <https://doi.org/10.24036/ekj.v5.i1.a442>.
- Kurniawan, D. A., Astalini, A., Darmaji, D., Tanti, T., & Maryani, S. (2022). Innovative learning: Gender perception of e-module linear equations in mathematics and physics. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, 92-106. <https://doi.org/10.23917/ijolae.v4i2.16610>.
- Latifah, N., Fauzia, U., & Kelana, J. B. (2020). Natural science problem solving in elementary school students using the project based learning (pjbl) model. *Jurnal Ilmiah Sekolah Dasar*, 4(4), 596–603. <https://doi.org/10.23887/jisd.v4i4.28377>.
- Li, Z., & Xu, Y. (2021). Sustaining the effective use of materials in language classrooms: A conceptual understanding of teacher knowledge for materials use. *Sustainability (Switzerland)*, 13(14). <https://doi.org/10.3390/su13148115>.
- Marpanaji, E., Mahali, M. I., & Putra, R. A. S. (2018). Survey on How to Select and Develop Learning Media Conducted by Teacher Professional Education Participants. *Journal of Physics: Conference Series*, 1140(1). <https://doi.org/10.1088/1742-6596/1140/1/012014>.
- Martin-Alguacil, N., Avedillo, L., Mota-Blanco, R., & Gallego-Agundez, M. (2024). Student-Centered

- Learning: Some Issues and Recommendations for Its Implementation in a Traditional Curriculum Setting in Health Sciences. *Education Sciences*, 14(11). <https://doi.org/10.3390/educsci14111179>.
- Mufidah, I., Nulhakim, L., & Alamsyah, T. P. (2020). Development of Learning Media for Video Audio-Visual Stop Motion Based on Contextual Teaching and Learning in Science Learning Water Cycle Material. *Jurnal Ilmiah Sekolah Dasar*, 4(3), 449–462. <https://doi.org/10.23887/jisd.v4i3.27357>.
- Musfiroh, Y. D., Saadi, P., & Prasetyo, Y. D. (2025). Development of an sct-model-based chemical bonding e- magazine to enhance students' critical thinking skills and knowledge learning outcomes. *Journal of Chemistry Education Research*, 9(2), 52–61. <https://doi.org/10.26740/jcer.v9n2.p52-61>.
- Muzakki, A., Wuryandani, W., & Kawuryan, S. P. (2025). The Use of Nearpod Interactive Media in Science Subjects in Elementary Schools. *Jurnal Penelitian Pendidikan IPA*, 11(5), 44–49. <https://doi.org/10.29303/jppipa.v11i5.11182>.
- Nadeak, B., & Naibaho, L. (2020). The effectiveness of problem-based learning on students' critical thinking. *Dinamika Pendidikan*, 13(1), 1–7. <https://doi.org/10.33541/jdp.v13i1>.
- Nafi'ah, J., & Faruq, D. J. (2025). Conceptualizing Deep Learning Approach in Primary Education: Integrating Mindful, Meaningful, and Joyful. *Journal of Educational Research and Practice*, 3(2), 225. <https://doi.org/10.70376/jerp.v3i2.384>.
- Nurjanah, R., Agustian, D., & Ali, M. (2025). The effect of nearpod-assisted problem-based learning on environmental literacy. *JPBIO (Jurnal Pendidikan Biologi)*, 10(2), 362–370. <https://doi.org/10.31932/jpbio.v10i2.5250>.
- Nurmailia, E., Qurbaniah, M., & Rahayu, H. M. (2024). The Effectiveness of Nearpod Interactive Edugame on Learning Retention of Class XI IPA Students of SMAN 1 District of Seventeen. *Qalam*, 12(1), 63–71. <https://doi.org/10.33506/jq.v13i1.2702>.
- O'Reilly, C., Devitt, A., & Hayes, N. (2022). Critical thinking in the preschool classroom - A systematic literature review. *Thinking Skills and Creativity*, 46(August). <https://doi.org/10.1016/j.tsc.2022.101110>.
- Padang, A. R. D. ., & Sitepu, M. S. (2023). Utilizing Educational Media in the Field of Education Fosters Active Learning Within the Classroom. *Jurnal Pendidikan (Teori Dan Praktik)*, 8(2), 95–100. <https://doi.org/10.26740/jp.v8n2.p95-100>.
- Pagán, E. A., Salvatella, M. del M. G., Pitarch, M. D., Muñoz, A. L., Toledo, M. del M. M., Ruiz, J. M., Vitella, M., Cicero, G. Lo, Rottensteiner, F., Clermont, D., Dorozynski, M., Wittich, D., Vernus, P., & Puren, M. (2020). From Silk to Digital Technologies: A Gateway to New Opportunities for Creative Industries, Traditional Crafts and Designers. The SILKNOW Case. *Sustainability (Switzerland)*, 12(8279), 1–37. <https://doi.org/10.3390/su12198279>.
- Popham, W. J. (2017). Classroom Assessment: What Teachers Need to Know (Eight Edition). In *Pearson* (Vol. 8, Issue 1). <https://doi.org/10.1111/j.1745-3984.2002.tb01136.x>.
- Prasetyo, D. R., Yohana, M. P., & Yasin, H. (2023). Animation-based media of learning chemistry on hydrocarbon and crude oil materials. *Journal of Chemistry and Chemistry Education in Muslim Society (JOCCEMS)*, 9(2), 18–27. <https://journal.uinjkt.ac.id/joccems/article/view/34331>.
- Puspitarini, Y. D., & Hanif, M. (2019). Using Learning Media to Increase Learning Motivation in Elementary School. *Anatolian Journal of Education*, 4(2), 53–60. <https://doi.org/10.29333/aje.2019.426a>.
- Putra, C. A., & Witari, S. (2024). Application of Video Media to Improve Student Learning Outcomes in Class III Thematic Learning for Natural Science Subjects at SDN 3 Bukit Tunggal. *Tunas: Jurnal Pendidikan Guru Sekolah Dasar*, 9(2), 172–175. <https://doi.org/10.33084/tunas.v9i2.7500>.
- Richards, W., Selker, J., & Udell, C. (2024). Loom: A Modular Open-Source Approach to Rapidly Produce Sensor, Actuator, Datalogger Systems. *Sensors*, 24(11). <https://doi.org/10.3390/s24113466>.
- Rohimah, I., Arifin, M. Z., & Windiyani, T. (2025). Nearpod-Based Interactive Multimedia to Improve Students' Critical Thinking on Human Respiratory System. *Indonesian Journal of Innovation Studies*, 26(3), 1–17. <https://doi.org/10.21070/ijins.v26i3.1448>.
- Sari, R. M., Rusnilawati, R., & Ali, S. R. (2023). Flipped Learning with Nearpod Media: Enhancing Digital Learning Outcomes in Primary Mathematics. *Profesi Pendidikan Dasar*, 159–173. <https://doi.org/10.23917/ppd.v10i2.4511>.

- Sihotang, R., A., Cendana, W., K., & C., D. (2021). The Use of Video in Improving Students' Attention in Learning Process of Kindergarten Students. *International Journal of Elementary Education*, 4(4), 496–502. <https://doi.org/10.23887/ijee.v4i4.28430>.
- Simangunsong, A. D. (2023). Implementation of The Problem Based Learning (PBL) Learning Model To Improve Skills Creative Thinking of Students on The Material Coligative Properties of Solutions. *Edunesia: Jurnal Ilmiah Pendidikan*, 4(2), 483–494. <https://doi.org/10.51276/edu.v4i2.396>.
- Tanti, T., Kurniawan, D. A., Kuswanto, K., Utami, W., & Wardhana, I. (2020). Science process skills and critical thinking in science: Urban and rural disparity. *Jurnal Pendidikan IPA Indonesia*, 9(4), 489-498. <https://doi.org/10.15294/jpii.v9i4.24139>.
- Tanti, T., Astalini, A., Kurniawan, D. A., Darmaji, D., Puspitasari, T. O., & Wardhana, I. (2021). Attitude for physics: The condition of high school students. *Jurnal Pendidikan Fisika Indonesia*, 17(2), 126-132. <https://doi.org/10.15294/jpfi.v17i2.18919>.
- Tanti, T., Darmaji, D., Astalini, A., Kurniawan, D. A., & Iqbal, M. (2021). Analysis of user responses to the application of web-based assessment on character assessment. *Journal of education technology*, 5(3), 356-364. <https://doi.org/10.23887/jet.v5i3.33590>.
- Tanti, T., Utami, W., Deliza, D., & Jahanifar, M. (2025). Investigation in vocation high school for attitude and motivation students in learning physics subject. *Journal Evaluation in Education (JEE)*, 6(2), 479-490. <https://doi.org/10.37251/jee.v6i2.1452>.
- Wahyudi, D., & Amir MZ, Z. (2022). Development of video learning media assisted by Sparkol Videoscribe to facilitate the ability to understand mathematical concepts of students. *International Journal of Trends in Mathematics Education Research*, 5(3), 306–314. <https://doi.org/10.33122/ijtmer.v5i3.165>.
- Wahyuni, S., Nur Khoiri, & Novita, M. (2023). Learning Transformation: Optimizing Student Potential Through Inclusive and Meaningful Differentiated Learning. *Jurnal Pendidikan MIPA*, 24(2), 453–466. <https://doi.org/10.23960/jpmipa/v23i2.pp453-466>.
- Widarti, H. R., Nuriyanti, D., Sari, M. E. F., Wiyarsi, A., Yatimah, S., & Rokhim, D. A. (2024). Identification of learning difficulties and misconceptions of chemical bonding material: A review. *Ecletica Quimica*, 49(October). <https://doi.org/10.26850/1678-4618.eq.v49.2024.e1508>.
- Yennita, Y., Zulrifan, Z., Hermita, N., & Hakim, L. (2022). Validation and Testing of STEM Project-Based Virtual Learning Modules to Improve Higher-Level Thinking Skills. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, 7(2), 145. <https://doi.org/10.26737/jipf.v7i2.2420>.
- Yovanie, F. (2024). Learning Chemical Bonds in Terms of Identifying Difficulties, Misconceptions, Learning Media, and Learning Models: A Systematic Literature Review. *Jurnal Penelitian Pendidikan IPA*, 10(6), 292–303. <https://doi.org/10.29303/jppipa.v10i6.6823>.
- Yulia Anggraeni, Abdul Muis, & Rina Sugiarti Dwi Gita. (2025). Nearpod-Based Animation Video Media on Increasing Learning Motivation and Understanding of Ecosystem Concepts in Elementary Schools. *JST (Jurnal Sains Dan Teknologi)*, 14(2), 359–369. <https://doi.org/10.23887/jst-undiksha.v14i2.101626>.
- Zulfiqar, F., Raza, R., Khan, M. O., Arif, M., Alvi, A., & Alam, T. (2023). Augmented Reality and its Applications in Education: A Systematic Survey. *IEEE Access*, 11(January), 143250–143271. <https://doi.org/10.1109/ACCESS.2023.3331218>.