

DEVELOPMENT OF NEARPOD LEARNING MEDIA FOR THE CONCEPT OF REACTION RATES COMPREHENSION

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Abstract

The integration of Android technology and the internet into education in Indonesia has introduced innovative approaches to the learning process, enhanced by digital media. One notable example is the Nearpod application. This study aims to develop and evaluate the feasibility of Nearpod as a learning medium for reaction rate topics and to assess student responses to the application. The research follows the Research and Development (R&D) methodology, employing the ADDIE model, which includes five stages: Analyze, Design, Develop, Implement, and Evaluate. The study was conducted in the Chemistry Education Department, Syiah Kuala University, and involved 60 students from the 2022 cohort who had completed the Basic Chemistry 2 course. Research instruments included a needs analysis questionnaire, a media feasibility assessment validated by experts, student response sheets, and System Usability Scale (SUS) questionnaires. The findings indicated that the Nearpod learning media achieved a validity score of 0.91, categorized as highly valid. The reliability assessment showed a reliability rate of 91%, indicating that the media is trustworthy. Student responses to Nearpod were overwhelmingly positive, with a satisfaction rate of 90%. The System Usability Scale (SUS) evaluation yielded a score of 71, placing the application in the "good" usability category. Based on these results, it can be concluded that the Nearpod application is a viable and effective learning medium for teaching reaction rate concept.

Keywords: Learning media; nearpod; reaction rates; R&D; web-based platform

doi: <https://doi.org/10.24815/jcd.v13i1.43967>

Received: April 7, 2025; **Revised:** May 7, 2025; **Accepted:** May 12, 2025; **Published:** 5 June 2025.

Citation IEEE style: Sarmita, R.F.I. Rahmayani, and Syahrial, "Development of nearpod learning media for the concept of reaction rates comprehension," *Chimica Didactica Acta*, vol. 13, no. 1, pp. 31-38, 2025, doi: 10.24815/jcd.v13i1.43967

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INTRODUCTION

The development of Information and Communication Technology (ICT) in Indonesia is progressing rapidly, permeating various sectors of life, including education [1]. Many educational institutions are leveraging ICT to enhance the learning process, particularly in the selection and use of ICT-based learning media. The role of ICT in education is substantial, offering numerous benefits and advantages, such as facilitating broader access to education and improving the effectiveness and quality of learning, especially in fostering interaction between lecturers and students. [2]. With changes in the educational paradigm, lecturers are required to be more creative and innovative in designing methods, selecting materials, and delivering presentations to make the learning process more engaging and enjoyable. One strategy employed by lecturers to enhance teaching efficiency and effectiveness is the integration of ICT-based learning media. [3].

The use of ICT-based learning media is expected to simplify and enhance students' understanding of the material being taught. [4]. In addition, ICT can promote student independence in learning. The integration of internet technology, supported by digital media, has led to

innovative approaches in education, such as the Nearpod application, which offers students an interactive and engaging learning experience. Nearpod is a web-based, multiplatform e-learning application designed to engage students and lecturers alike, regardless of the size or type of learning environment [5]. With its array of engaging features, the Nearpod application supports interactive learning and is freely accessible to students and lecturers worldwide. Nearpod offers a wide range of tools that make learning more enjoyable and interactive. These features include uploading slides, creating slideshows, collaborative boards, polls, open-ended questions, multiple-choice quizzes, interactive quizzes, "Time to Climb" activities, fill-in-the-blank exercises, web content integration, video playback, and much more. [6]

Based on the data collected, most students find reaction rate material challenging to understand because it requires both conceptual comprehension and mathematical calculations. Another contributing factor is the limited use of interactive learning media by lecturers, which could otherwise support learning enthusiasm and address these difficulties. Therefore, there is a need for

learning media that can assist both lecturers and students in enhancing learning outcomes [7].

Research on the Nearpod application has been previously conducted in various educational fields. In chemistry, [8] explored the design and testing of Nearpod-based interactive learning media, while [9] investigated its effectiveness in increasing student interest in thermodynamics courses. However, prior studies have primarily focused on the application and effectiveness of Nearpod, leaving a gap in the development of Nearpod-based learning media for specific chemistry topics. This research addresses this gap by focusing on developing Nearpod as a learning tool for reaction rate material, leveraging features such as slide uploads, multiple-choice questions, and web content integration to simplify complex concepts for students. Additionally, the researcher's review indicates that Nearpod has been underutilized in the field of chemistry education.

The choice of reaction rate material was informed by interviews and polls conducted via WhatsApp with Chemistry Education students from the class of 2022 at FKIP USK. According to [10], reaction rate material is considered abstract, requiring students to grasp concepts, memorize, calculate, analyze data, and engage in active practice. Consequently, a learning medium that can visualize complex material is crucial. Interactive multimedia based on Nearpod provides an effective solution, as it is user-friendly, offers numerous engaging features, and supports student learning. This application is expected to aid students in comprehending the material and overcoming learning challenges. As noted by [11], Nearpod-based interactive multimedia can be an effective tool for improving student understanding of reaction rate material.

The reaction rate is defined as the speed at which the concentration of reactants decreases or the concentration of products increases per unit of time [12]. Reaction order refers to the power of the concentration terms in the rate law equation, indicating how the reaction rate depends on reactant concentrations. There are three primary reaction orders: zero-order, first-order, and second-order reactions. A zero-order reaction has a rate independent of reactant concentration, expressed as $V=k[A]_0$. A first-order reaction has a rate proportional to the reactant concentration, while a second-order reaction depends on either the square of one reactant's concentration or the product of the concentrations of two different reactants [13][14].

The effect of reactant concentration and temperature on reaction rate can be explained through the collision model, which states that molecules must collide to initiate a reaction [15]. For a collision to be effective, it must meet two criteria: proper particle orientation and sufficient energy [16]. Factors influencing the reaction rate include concentration, temperature, surface area, and the presence of a catalyst. Additionally, the reaction rate is inversely

proportional to the activation energy, which is the minimum energy required for a reaction to occur [14].

This study aims to develop and evaluate the feasibility of Nearpod-based learning media for reaction rate material and to assess student responses to its application. The novelty of this research lies in the specific adaptation of Nearpod for reaction rate topics, a domain that has been sparsely explored. By utilizing unique features tailored to a single topic, this study makes a significant contribution to the advancement of digital learning media in chemistry education.

METHOD

This research employs the Research and Development (R&D) method using the ADDIE model, which comprises five stages: Analyze, Design, Development, Implementation, and Evaluation. However, the Implementation and Evaluation stages were not carried out due to the study's limited scope and short timeframe. Consequently, the conclusions drawn are preliminary and pertain only to the development phase and initial user responses. Further research is necessary to conduct full implementation and evaluation to verify the product's effectiveness and success. As noted by [17], R&D research aims to develop products and test their effectiveness. The ADDIE model was chosen for its flexibility and suitability for development research [18].

Stages of Research Activities

Analyze: This stage involved identifying the research site and its associated problems, establishing research objectives, selecting appropriate teaching materials and devices for learning media development, and determining the features to be utilized.

Design: During this stage, the initial product for reaction rate material was designed. Activities included creating the initial media design, formulating learning objectives, preparing learning materials using PowerPoint, and designing questions related to reaction rates.

Development: This stage involved product validation by subject matter experts and media experts before testing with students. Revisions were made based on feedback from the validators. Following validation, trials were conducted with students to assess the feasibility and effectiveness of the developed learning media.

Research Location and Population

This study was conducted at the Faculty of Teacher Training and Education, Syiah Kuala University, located at Jln. Tgk. Hasan Kruneng Kalee, Kopelma Darussalam, Kec. Syiah Kuala, Banda Aceh City, on September 3, 2024. The population included all 2022 Chemistry Education students, as this cohort had recently completed the Basic Chemistry

II course. A full-sample technique was employed, involving all members of the population [19].

Data Collection and Instruments

Data were collected through interviews, WhatsApp polls, and questionnaires. The study utilized several types of questionnaires, including needs analysis questionnaire, feasibility assessments by expert validators, student response questionnaire, System Usability Scale (SUS) questionnaires. The questionnaires employed a combination of Guttman and Likert scales, with five response options. Data analysis for media feasibility was conducted using Aiken's V formula and the percentage of agreement.

Validity Measurement

The validity of the instrument was evaluated using Aiken's formula, which is based on multiple validators' assessments of each item and aligned with the Aiken's V index [20]. The formula for calculating Aiken's V is as follows:

$$V = \frac{r - lo}{[n(c - 1)]}$$

Where,

- r = Score given by a validator
- lo = The lowest score
- n = Number of validators
- c = The highest score

Table 1. Aiken's V index categories

No	Index range	Category
1	0.81 < V ≤ 1.00	Highly Valid
2	0.41 < V ≤ 0.80	Valid
3	V ≤ 0.40	Invalid

Source : [21]

Meanwhile, to measure the level of reliability by four expert validators on the media feasibility questionnaire sheet, the following formula is used:

$$\text{Percentage of Agreement} = \left[1 - \frac{A - B}{A + B} \right] \times 100\%$$

Where, A = the highest score given, B = the lowest score given, the media can be considered to be reliable if the agreement of ≥ 0.75 or ≥ 75% [22].

The needs analysis was measured using a Guttman scale. While the analysis of student responses is measured using a Likert scale and calculated using the percentage formula and the level of practicality is calculated using the SUS formula.

$$\text{Score} = \frac{\sum \text{obtained score}}{\sum \text{the highest possible score}} \times 100\%$$

The percentage score results obtained are interpreted in the assessment criteria as depicted in Table 2.

Table 2. Needs analysis questionnaire assessment score

No.	Score range	Criteria
1	51 -100	Need
2	0 – 50	No need

Source : [23]

While the score of student responses obtained were analyzed with the criteria as given in Table 3.

Table 3. Criteria for the percentage score of student response questionnaires

No.	Interval (%)	Criteria
1	78 – 100	Excellent
2	56 – 75	Good
3	45 – 55	Fairly Good
4	0 – 39	Poor

Source : [24]

The results calculated using the System Usability Scale (SUS) method are converted into specific values to assess the feasibility of the product [25]. The SUS method provides an adjective rating to evaluate the system's usability, helping determine whether the product is acceptable to users. SUS score analysis was conducted using Microsoft Excel, which was employed to calculate the average scores obtained from respondents. These scores were then interpreted based on the standard SUS scale. Additionally, student responses were analyzed using Excel to generate meaningful and relevant insights.

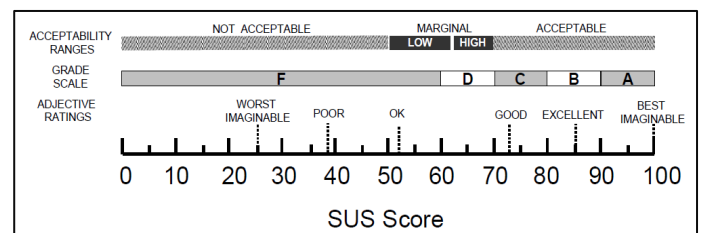


Figure 1. SUS grading criteria

RESULTS AND DISCUSSION

Analysis Stage

This study aims to develop and test the feasibility and determine student responses to the products developed. The product developed is Nearpod learning media on reaction rate material. This research uses the ADDIE development model which is limited to the third stage. At the needs analysis stage, the results are obtained from interviews, polls via WhatsApp and needs analysis questionnaires by students. At the analysis stage, respondents were asked to answer 19 questions regarding their perceptions assessing whether they need the learning

media to comprehend the chemical reaction rates concepts. Two questions assessed their prior involvement with learning media and the preferred concepts that the Nearpod should be developed in. When asked about the experience regarding media in their prior attended lecturers, most of students report PowerPoint as the most common media employed in the classroom besides other tools like virtual practicum, simulation, and video as depicted in Figure 2.

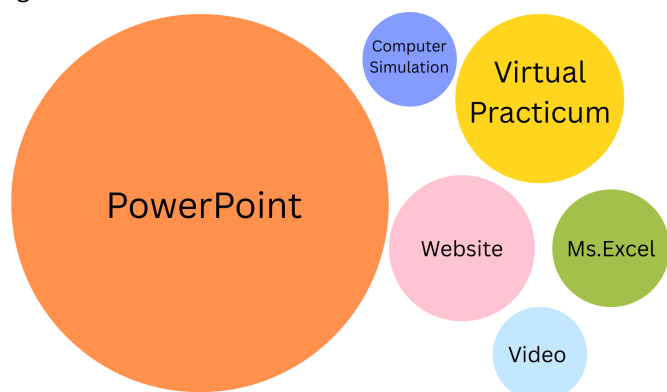


Figure 2. The learning media frequently employed by lecturers during the class of general chemistry course

When asked about the difficult concepts in chemistry, where then become the targeted concept of Nearpod development, the results show that the most concepts chosen by more than 54% of students was the reaction rate as can be seen in Figure 3.

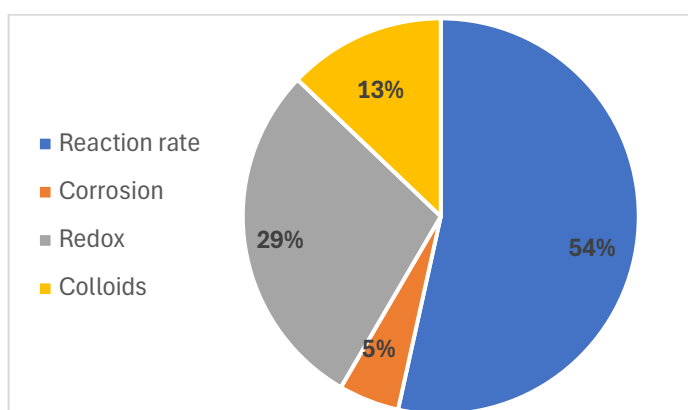


Figure 3. The concepts in Chemistry that were considered difficult according to students' perceptions

Figure 3 illustrates students' perceptions of challenging chemistry topics, with "Reaction Rate" being identified as the most difficult concept, accounting for 54% of the responses. This significant proportion indicates that a majority of students struggle to grasp the principles underlying reaction kinetics, including factors influencing reaction rates, mathematical modeling, and theoretical applications. Other concepts like "Redox Reactions" (29%), "Colloids" (13%), and "Corrosion" (5%) were also mentioned, but their smaller percentages highlight that reaction rates pose the most significant learning barrier.

This finding underscores the necessity of tailored interventions to address students' difficulties in understanding this topic.

Given this context, integrating interactive learning media, such as the Nearpod platform, could significantly enhance the teaching and learning experience. Nearpod offers tools for delivering dynamic and engaging content, including interactive simulations, quizzes, and collaborative activities, which are particularly effective for explaining abstract or complex ideas like reaction rates. By utilizing these features, educators can visualize reaction mechanisms, allow students to experiment virtually with parameters affecting rates, and provide immediate feedback to solidify their understanding. Such an approach not only caters to diverse learning styles but also promotes active participation, ultimately fostering a deeper comprehension of reaction kinetics.

In addition, other items of the questionnaires reflected that most students (up to 78.5%) need the learning tool to increase their learning motivation and learning outcomes. Therefore, researchers developed learning media in the form of Nearpod applications *with slide upload features, web content, and multiple choice* as an alternative tool to be used in a learning process of chemical reaction rates. These features were chosen because they already contain learning materials, multiple choice questions and animated/learning videos.

Design Stage

In the design stage, the initial design of the media was carried out, formulating learning objectives, compiling learning materials, and designing reaction rate questions. Some of the tools used in designing Nearpod learning media content, namely *Powerpoint*, are used to compile learning materials. Then *Google drive* to store images of multiple choice questions, because the multiple choice feature cannot load images clearly. Furthermore, *Google form* to load statements or questions from the student response questionnaire and SUS questionnaire.

The components of Nearpod learning media design consist of title, course learning outcomes, table of contents, learning materials, sample questions, multiple choice questions and student response questionnaires and SUS questionnaires. An overview of the Nearpod learning media design format can be seen in Table 4 below and can be accessed through the Nearpod web/platform (<https://nearpod.com/>) with the shared link or code. The appearance of some Nearpod slides can be seen in Figure 3.

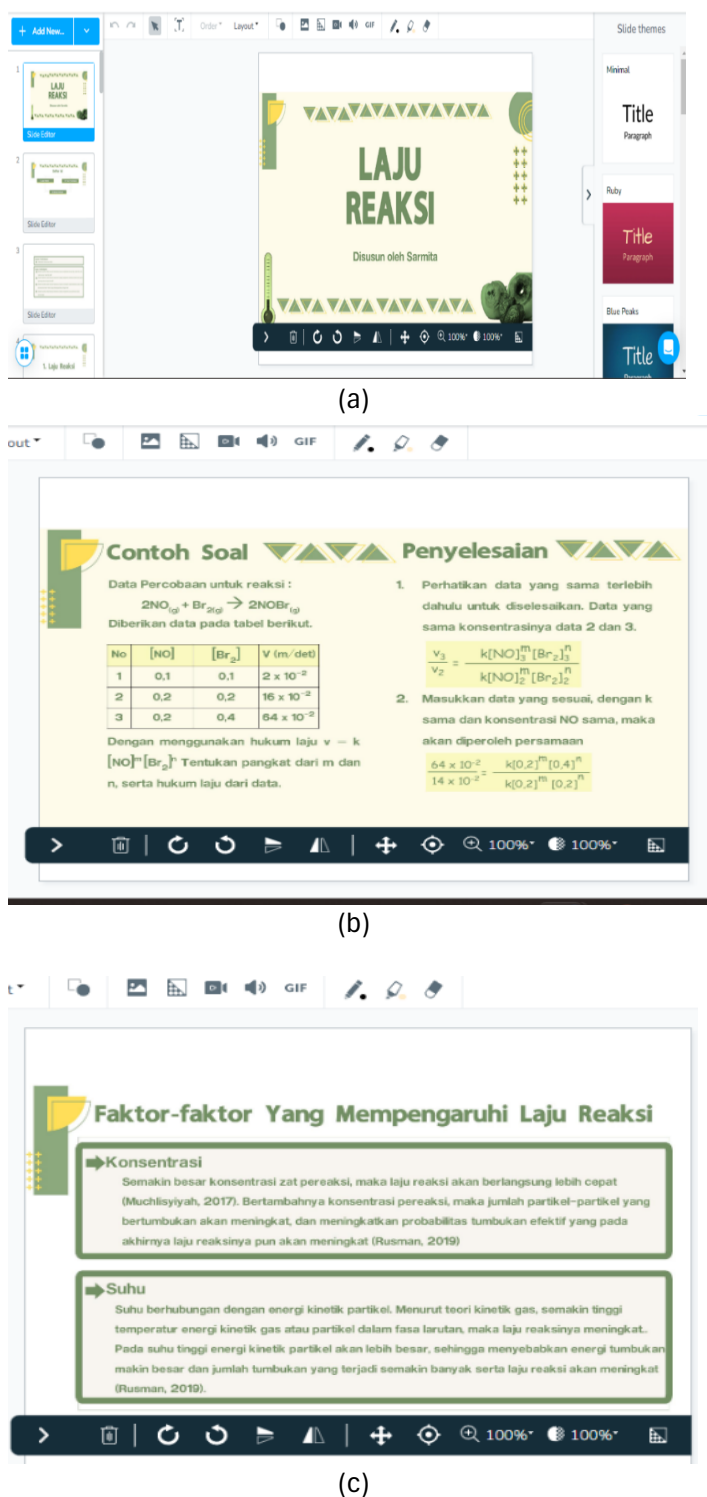


Figure 3. Some selected Slides in the Nearpod Application (a) Slide 1 Title Section, (b) Slide 10 Responsible Problem Example Section, (c) Slide 21 Factors Affecting the Reaction Rate

Development Stage

The last stage, namely development, was carried out by providing the results of products that have been developed to expert validators and product feasibility questionnaire instruments, then revised based on suggestions / input from validators. The purpose of the media feasibility test is carried out to determine whether or not the media that has been developed is feasible before being tested on students [27]. Suggestions or input from the

four validators, namely: improving the writing of chemical phases, changing the layout of sample problems with solutions, adding animated videos and video examples of explanations of contextual learning materials.

The results of the validity calculation by the validator based on the assessment aspects, obtained an overall average value of 0.90 which categorized as valid as depicted in Figure 4.

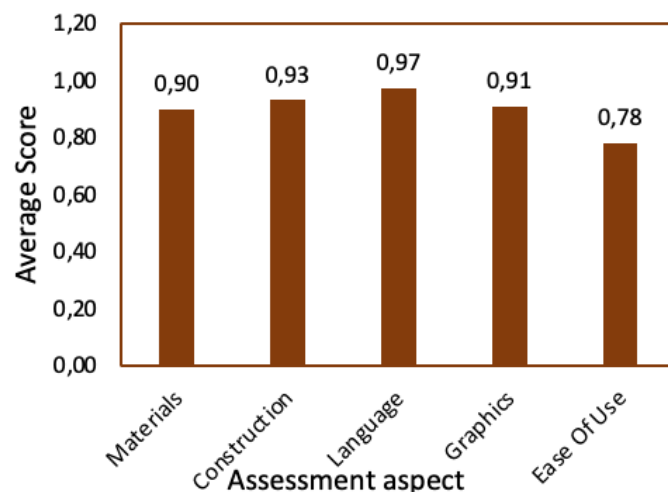


Figure 4. Validity Score of the Nearpod Media

Furthermore, the reliability test was carried out, the results of data analysis obtained at 91% which shows that Nearpod learning media is reliable or trustworthy. Based on the results of the validity and reliability tests, Nearpod learning media on reaction rate material is declared suitable for use as learning media.

The student testing phase was carried out by distributing Nearpod links that already contained student response questionnaires and SUS questionnaires to 60 students. This questionnaire is used to obtain information and see student responses after trying Nearpod learning media on reaction rate material. Based on the results of the trial of Nearpod learning media, it was found that there were 51 students who scored above the pass mark, while 9 others scored below the pass mark. The passing limit in the Chemistry Education department of FKIP USK is 51.

Based on the results of the student response questionnaire, it can be concluded that the Nearpod learning media on reaction rate material is very effective to use as a learning media, with a score of 90%. However, students who scored below the pass mark gave high ratings in the response questionnaire with points 5 or 4. This shows that there is a difference between the results of the reaction rate test and the response to the use of Nearpod learning media, which is caused by several factors. One of the factors is lack of accuracy in reading the questions, based on a statement from one of the respondents with the initials AAZ and lack of understanding of the questions according to SNU's statement. In accordance with the statement [28]

that lack of accuracy in understanding questions often causes errors in answering questions.

The results of the next data analysis are the results obtained from student responses through the SUS questionnaire, with an average score of 71. The adjective rating is in the “good” category which indicates that the system is good, acceptability ranges in the high acceptable category that users / students are interested in using the system and the grade scale is in the “C” category, which means that developed system falls into the average or moderately satisfactory category. According to [29] the acceptability of a product is determined by the score value: values above 70 are considered “acceptable”, values between 50-70 are “marginally acceptable” and values below 50 are “unacceptable”. The result of student response to the SUS questionnaire can be seen in Figure 5.



Figure 5. SUS Score given by all respondents (N=60)

Figure 5 depicts the SUS score of the Nearpod media evaluated by 60 users. The average score was found to be 70% which categorized as acceptable according to the scales suggested by many researchers as mentioned in Figure 1. The SUS evaluation of Nearpod Media, as depicted in Figure 5, yielded an average score of 70, indicating an "acceptable" level of usability. This score surpasses the widely recognized average SUS benchmark of 68, which represents the 50th percentile of usability scores across various systems. According to Bangor et al. (2009) [26], a SUS score above 70 falls within the "acceptable" range, suggesting that users generally find the system usable, though there may still be areas for improvement.

When comparing Nearpod's SUS score to similar educational technologies, it aligns closely with the average scores reported for internet platforms (mean SUS score of 66.25) and multimedia applications (mean SUS score of 76.43). This positioning indicates that Nearpod's usability is competitive within its domain. However, it's noteworthy that some mobile applications have achieved higher SUS scores, such as the AR-SPU app [31], which scored an average of 84.8, reflecting a "good to excellent" usability rating. Therefore, while Nearpod's usability is acceptable, there

remains potential for enhancements to elevate user satisfaction further.

CONCLUSION

Nearpod learning media on reaction rate material is declared feasible for use in learning based on the results of validity, reliability, student responses and practicality. The level of validity of Nearpod learning media on reaction rate material by expert validators was found to be very valid or suitable for use by students and the reliability results obtained were reliable or trustworthy. Student responses to Nearpod learning media on reaction rate material received positive responses with very good criteria. The level of practicality of Nearpod learning media tested through the System Usability Scale (SUS) method by students resulted in a good category.

Future research is expected to provide instructions to respondents to complete all tasks or activities to completion, the Nearpod link is distributed according to each class, so that it cannot be accessed by other classes and the research results show that only 21.7% (13) students have used Nearpod. Therefore, it is necessary to investigate the causes of Chemistry Education students' lack of interest in exploring media development. In addition, future research is recommended to use the ADDIE model by involving all stages to obtain more comprehensive results. This Nearpod learning media can be developed better according to learning needs.

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