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H5P Based Learning Media to Reinforce Pre-Service Science Teachers' Critical Thinking Skills: Development and Validation

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Abstract: Student's critical thinking skills in higher education level should be enhanced using diverse methods, one of which by developing learning media as assistance in conceiving the skills. This study was undertaken to determine the validity of the H5P learning media using ALLR (Activity Based-Lesson Learn-Reflection) model that could be embedded in a Moodle-based learning management system for Basic Science course to reinforce the pre-service science teachers' critical thinking skills. This study used research and development (R&D) design using 4D development model. The developed learning media was an interactive learning media for Basic Science course that contained the ALLR learning model developed using the H5P platform embedded in Moodle-based SIDIA UNESA learning management system. The media was given to three experts whose expertise were science learning and learning media development. The validation was based on assessment criteria which included content, presentation, and language aspects. The results showd that all the assessment criteria for the learning media developed were declared very valid, except for interactivity sub-criteria which was valid. It can be concluded that H5P-based interactive media in LM with ALLR Learning Model is suitable for improving the critical thinking skills of pre-service science teachers in the Basic Science Course.

Keywords: Basic Science; Critical Thinking Skills; H5P Learning

Introduction

Critical thinking skills are mental processes that help people find solutions to problems they encounter (Costa & Kallick, 2013; Thayer-Bacon, 1998). They involve a variety of cognitive skills and strategies (Halpern, 2013), as well as interpretation and analysis activities (Facione, 2011). A person with strong critical thinking skills is able to consider all options and think optimally (Al-Mahrooqi & Denman, 2020). Critical thinking skills are greatly enhanced by higher education (Bassham et al., 2013; Costa & Kallick, 2013). This is done to help students think more critically and better prepare them for college and the future workplace (Costa & Kallick, 2013). Therefore, it should come as no surprise that this skill is one of the most crucial for obtaining success in life during the Fourth Industrial Revolution (Radulović & Stančić, 2017) and that it also contributes significantly to the student's profile with Pancasila characteristics (Satria et al., 2022).

The Pancasila student profile is introduced to help students grow into a generation that upholds Pancasila's ideals while also being smart, moral, and prepared to compete worldwide (Elementary School Directorate of the Republic of Indonesia, 2020). As Ministerial Decree Number 1177/M/2020, which states that the aim of the curriculum is to strengthen skills and personality accordance with Pancasila student profile. Considering that the Pancasila student profile policy is something new and research related to the project to strengthen the Pancasila student profile is still limited (Dasmo et al., 2023), research on this topic must continue to be developed (Kurniawaty et al., 2022).

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A learning model called ALLR (Activity Based-Lesson Learn-Reflection) has been developed by (Widodo et al., 2018). This model can be utilized as an alternate option to teach science concepts through student-centered activities and integrate character education by using local wisdom to interpret the moral messages implicit in the science curriculum. The results of the study show that the ALLR learning model can be applied to learning science courses (Sari et al., 2019; Widodo et al., 2018), strengthening student character (Sari et al., 2019; Widodo et al., 2018, 2019), and developing mathematical modeling skills for science teacher candidates(Widodo et al., 2020).

The development of critical thinking skills in Higher Education can be facilitated through online flipped classroom learning that is supported by Google Classroom or Learning Management System (LMS) (Widodo, 2022). LMS is software used to create web-based online learning materials with complete and complex menus (Henderson et al., 2017), which lecturers can use to manage learning in the digital era (Nguyen, 2021; Thepwongsa et al., 2021), deliver teaching materials, monitor student activities in learning and evaluate online learning (Lochner et al., 2015). The use of LMS also provides flexibility for students to control themselves over existing learning resources and learning activities without being limited by space and time (Lochner et al., 2015).

H5P (HTML 5 Package) is one of the information and communication technology-based interactive learning media platforms that may be integrated with LMS. According to (Kiryakova, 2022), H5P is an interactive e-learning content creation platform that can be used to create a variety of engaging learning materials and be integrated with a number of other platforms and websites, including WordPress, Canvas, Moodle, and others, that can be accessed from a variety of devices. According to (Mutawa et al., 2023), H5P has interactive features including gamification and interactive multimedia that can be created collectively and distributed across networks. H5P works to simplify the creation, sharing, and reuse of interactive HTML 5 content by users (Sofiyullah, 2015).

According to (Pinoa, 2021), the creation and use of H5P content in LMS-based e-learning was able to improve the outcomes of video interactive task content, which were more important than the outcomes of interactive book content tasks. Similarly, the study conducted by (Utari et al., 2022) found that learning activities including H5P-based learning media were successful and efficient. In order to improve students' critical thinking skills in inquiry materials as well as their deductive, inductive, and abductive thinking skills in the context of science, further studies are required. H5P learning materials should be created with a focus on giving feedback and answering queries from interactions in order to achieve this.

The novelty of this research is (1) the development of H5P learning media focused on improving students' critical thingking skills in inquiry material, and also decutive, inductive and aductive thinking skills in the scope of science, and (2) media development H5P learning is focused on interaction in answering questions and providing feedback.

Learning activities in the Basic Science course can be incorporated to help pre-service science teachers develop their critical thinking skills. Those who complete this course will be able to (1) use science and technology as a tool for science development, (2) master the nature and scope of science, (3) be skilled at carrying out scientific inquiry activities with the content and context of the high school curriculum, and (4) develop attitudes that are responsible, open to criticism, cooperative, and critical in thinking. This course is an effective tool for educating and enhancing pre-service science teachers' critical thinking skills.

Therefore, this study aims to determine the validity of H5P-based interactive media in the LMS with the ALLR learning model to improve pre-service science teachers' critical thinking skills in the Basic Science course.

Method

This study used a research and development (R&D) design with the 4D development model consisting of four stages namely define, design, develop, and disseminate (Thiagarajan, 1974). However, the study was only limited to the results of validating H5P-based interactive media in the LMS with the ALLR learning model to improve pre-service science teachers' critical thinking skills in Basic Science course. There are four stages carried out in this research.

The first stage was to *identify learning objectives*. At this stage, an analysis of the learning outcomes of the course was carried out which was then developed into teaching objectives. The aim of the teaching and learning process was that students were able to think critically in the area of inquiry and have deductive, inductive, and abductive thinking skills in the scope of science. This study was conducted in Basic Science course with the steps of inquiry and thinking skills in inquiry as the focused materials. An improvement in pre-service science teachers' critical thinking skills was the anticipated long-term comprehension after the learning process.

The second stage *determined information related to pre-service science teachers' background knowledge and*

expertise before determining the type of knowledge and skills taught. Such information can be obtained through quizzes, tests, projects, etc. The assessment compiled must be aligned with the desired learning outcomes. In this study, the increase in students' critical thinking skills was assessed from the increase in students' pre-test and post-test scores. The test given was to measure pre-service science teachers' critical thinking skills with the adaptation of Facione critical-thinking test.

The third stage was *the planning of learning and teaching experiences*. By being focused on the assessment conducted in Stage 2, these activities should help to define the instructional objectives. An H5P-based interactive media was created in the LMS with the ALLR Learning Model to enhance the critical thinking skills of pre-service science teachers in the Basic Science course in order to meet the teaching objectives.

The developed learning media was an interactive learning media using the H5P platform that was embedded in Moodle-based SIDIA UNESA LMS and contained the ALLR learning model on Basic Science course. The features contained in the H5P interactive media were the video presentations and animations on inquiry material as well as material on deductive, inductive and abductive thinking skills in science that were equipped with multiple choice questions. These questions could be directly worked on the H5P page by clicking on the available answer choices. When the user had clicked on the selected answer option, the user would automatically get feedback.

The fourth stage after the learning media was developed, the next step was to *validate the learning media to three experts who had expertise in science learning and learning media development*. There were three aspects assessed namely content, presentation, and language aspects. Content aspect covered appropriateness of content for activity-based learning and reflection, accuracy of content to enhance critical thinking, correctness of concepts, and adequacy of content in accordance with the scope of material and activities according to the lesson plan. Presentation aspect included presentation flow according to ALLR (activity based, lesson learned, and reflection), H5P media interactivity in terms of user control over impressions/displays, and H5P media interactive in terms of presenting questions, alternative answers, scores, and feedback. Language aspect encompassed understandable content and use appropriate language (including contexts that did not contain tribe, religion, race, and intergroup sensitive issues). The validation results became materials for revising the developed learning media. Table 1 shows the assessment scale along with each categorization.

Tabel 1. H5P Learning Media Validity Assessment Scale

Score	Category
4	Very valid
3	Valid
2	Less valid
1	Not valid

Furthermore, the data validation results were analyzed using descriptive analysis with quantitative approach. The final score was obtained from the mode of score given by the validators. The mode of score was then interpreted according to the assessment category as presented in Table 1.

Result and Discusion

H5P Learning Media

The developed learning media was an interactive learning media using the H5P platform that was embedded in Moodle-based SIDIA/ UNESA LMS and contained the ALLR learning model on Basic Science course. Figure 1 shows the appearance and content of the H5P learning media.

The contents contained in the developed H5P learning media included "The Nature of Natural Sciences" that contained materials related to the nature and characteristics of Natural Sciences; "Web meeting" for meeting supports that enabled point-to-point or multipoint communication between lecturers and students and the use of this web meeting was also very practical because it was able to display and improve text, voice, and video-based messages simultaneously via laptops, tablets, or smartphones; "Materials About Nature and Scope of Science" in which this content involved learning materials as well as multiple choice questions that students must work on, and "Making Interpretations" that contained pictures and questions related to the interpretation of certain pictures based on the nature and scope of science material, which students must fill in according to their interpretation.

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Figure 1. SIDIA (Unesa LMS) contains of modul and H5P platform about the nature characteristics and scope of Natural Sciences, Web Meeting feature, and making interpretation activity

Figure 2. Student Worksheet and Lesson Learn activity on SIDIA

Figure 3. Screenshot of H5P platform contains the nature characteristics and scope of Natural Sciences topic

The use of pictures in learning had many benefits, namely understanding, clarifying, and enlarging important small parts so they could be observed to generate interest and enhance a description-making (Utami, 2018). In addition, pictures also helped students understand the interrelationships between subject matter and assist them to remember the material better (Agnesiana et al., 2023).

Figure 4. Screenshot of H5P platform contains the nature characteristics and scope of Natural Sciences topic

Figure 5. Screenshot of H5P platform contains designing experiment subtopic

Figure 6. Screenshot of H5P platform contains data analyzing and conclusion making

In addition, the developed H5P learning media also contained student worksheet inquiry content in natural sciences that had been adapted to the ALLR learning model. The worksheet was equipped with an interactive video that could be played, paused, and replayed according to student needs. These interactive videos can involve students in active learning (Barman & Jena, 2023) and help students to focused on the video content actively (Mauliana et al., 2022; Richtberg & Girwidz, 2019). (Singleton & Charlton, 2019) explained that interactive videos on H5P can be integrated with specific questions or quizzes, which can be placed at the beginning or at the end of the video. Evaluation activities with the help of H5P provided a more

interesting and accurate method (Llerena-Izquierdo & Zamora-Galindo, 2020).

Using videos in learning process has many benefits. It can make students more interested in learning (Agustini & Ngarti, 2020), improve students' understanding and retention which has an impact on increasing student learning outcomes (Biard et al., 2018) both cognitively and emotionally (Gedera & Zalipour, 2021), present concrete demonstrations (Cohen et al., 2018), conveys information evenly and understandable, is able to explain a process in detail, overcomes space and time limitations, gives a deep impression that influence students' attitudes (Rusman, 2011). In addition, it also influenced the development of critical thinking skills (Slemmons et al., 2018) and enhanced the learning experience and helped students achieve high subject scores (Unsworth & Posner, 2022).

H5P Learning Media Validation Results

The product developed in this study was an interactive learning media using the H5P platform that was embedded in Moodle-based LMS SIDIA and contained the ALLR learning model in Basic Science course. The developed learning media was given to three experts who had expertise in science and learning media. Validation was based on assessment criteria that included aspects of content, presentation, and language. The assessment was carried out by giving a score with a scale range of four (score 4 = very valid, score 3 = valid, score 2 = less valid, and score 1 = not valid). Furthermore, the data validation results were analyzed using quantitative descriptive analysis. The final score was obtained from the mode given by the validators. The score is then interpreted according to the assessment criteria. Table 2 shows the validity of H5P learning media based on expert validation.

Table 2 conveys the information regarding the validity of H5P learning media based on experts. There were three aspects assessed namely content, presentation, and language. Four sub-aspects of the content were evaluated: the relevance of the content for activity-based learning and reflection, the accuracy of the content to foster critical thinking, the correctness of the concepts, principles, theories, and examples, and the appropriateness of the content in light of the materials and activities specified in the lesson plan. The mode of score for the content aspect as a whole was 4, with a highly valid category. (Weay & Masood, 2015) stated that multimedia could play a role in constructing the development of students' critical thinking, by providing an interactive way of presenting information and presenting abstract concepts through a reasoning process.

In the presentation aspect, there were three sub-aspects assessed namely presentation flow according to ALLR (activity based, lesson learned, and reflection), H5P media interactivity in terms of user control over dislay, and H5P media interactivity in terms of presenting questions, alternative answers, scores, and feedback. The validator score mode in the first 2 aspects falls into the very valid category, while the third aspect falls into the valid category. The ability for people to interact with the media made interaction the key component of digital media (Hamimi & Sari, 2018). According to Hamzah et al. (2015), this feature was one of the crucial features for boosting student motivation. Therefore, based on the validator's suggestions, improvements are made to the media according to the validator's suggestions or comments. The suggestions or comments are first, "In the questions related to Data Analysis & Making Conclusions", there are two questions that show examples of data about experiments on the influence of sunlight on the growth of sprouts. The data display is messy and needs to be presented in an appropriate table form so that it is easy to read. And when a student answers one question incorrectly, the student must return to the initial question which has been answered correctly on one slide. So, it is necessary to consider that students only answer the parts where the answer is wrong.

In the language aspect, understandable content and suitable language use (including contexts that did not contain tribe, religion, race, and intergroup sensitive issues) were the sub-aspects evaluated. These two sub-aspects received a mode of score of 4 that falls on a very valid category to the language aspect as a whole. The language used in H5P learning materials was already adequate. The success of information transfer in learning was significantly influenced by the linguistic component. It would be simpler for pupils to comprehend the subject if the language was good and correct, in accordance with the rules, consistent, and communicative (Indasah & Sulistiana, 2021).

The general conclusion from the experts' validation was that the developed H5P learning media could be used with minor revisions. The suggestions given by the validators included animated videos should be enriched with real objects and questions for developing abductive thinking skills needed to be increased because this supported the train of critical thinking skills. In accordance with Table 2, it could be stated that the developed H5P learning media was valid and reliable for use in learning activities. Good learning media must be well designed and authentic to help students acquire new knowledge (Yaumi, 2018).

Tabel 2. Validation Results of H5P Learning Media Based on Experts

Aspect	Component	Score A	Score B	Score C	Mode of Score	Inter-preta-tion
Con-tent vali-dity	Appropriateness of content for activity-based learning and reflection.	4	4	4	4	Very valid
	Accuracy of content to enhance critical thinking.	4	4	4	4	Very valid
	Correctness of concepts/principles /theories/examples.	4	4	4	4	Very valid
	Adequacy of content in accordance with the scope of material and activities according to the lesson plan.	4	4	4	4	Very valid
Presentatio n Validity	Presentation flow according to ALLR (activity based, lesson learned, and reflection).	3	4	4	4	Very valid
	H5P media interactivity in terms of user control over impressions/display.	3	4	4	4	Very valid
	H5P media interactivity in terms of presenting questions, alternative answers, scores, and feedback.	3	4	3	3	Valid
Language	Understandable content.	4	4	3	4	Very valid
	Using appropriate language (including contexts that did not contain tribe, religion, race, and intergroup sensitive issues).	4	4	4		Very valid

Description:
A: Validator 1 B: Validator 2 C: Validator 3

Utilization of information and communication technology made learning activities more interesting and easier to understand (Ghavifekr & Rosdy, 2015), supported the development of students' cognitive, affective, and social skills (Hidayat et al., 2017), and improved learning outcomes and critical thinking skills (Carr, 2021). On the other hand, the use of interactive media was also beneficial in overcoming the limitations of traditional learning by exploring natural phenomena from various perspectives as a complex process (Kalogiannakis & Papadakis, 2020). In line with this, the results of previous researchers found that interactive multimedia effectively improved students' thinking skills (Ariani & Festiyed, 2019; Rahmawati et al., 2020). Likewise, learning with H5P media could increase student involvement in learning (Garcia et al., 2022). In addition, it improved the quality, interactivity, and interest of learning activities while also assisting students in remembering the information (Homanová & Havlásková, 2019).

Conclusion

The research results showed that all the assessment criteria for the learning media developed were declared very valid by experts, except for the interactivity sub-criteria which was declared valid. Thus, it can be concluded that H5P-based interactive media in LMS with the ALLR Learning Model is suitable for improving the critical thinking skills of prospective science teachers in the Basic Science Course.

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Conflicts of Interest
The authors declare no conflict of interest. The funder had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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