

## Assisting student knowledge and critical thinking by E-Learning media: Post-Harvest Fungi poster

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### Abstract

The challenge for a teacher in the learning process is to engage students with the subject and help them comprehend biology using creative and efficient learning media. The research aims to provide information on the postharvest fungi as well as their role as contaminant fungi in Bantenese emping melinjo chips as the contents in the poster as learning media and to determine its effect on assisting student knowledge and critical thinking skills. The Research and Development was conducted using the ADDIE model. The information was gathered through the use of interview guidelines, validation sheets, and students' response questionnaires. The research findings informed that a total of 35 species of post harvest fungi have been successfully isolated from eight different locations in Banten Province. The evaluation results of the poster as learning media showed that it was considered very valid by media and material validators. Student responses showed that the developed poster was categorized as very feasible media. The student knowledge and critical thinking skills achievement facilitated by the poster as e-learning media was significantly higher compared to another class. The produced poster was found to be suitable to be used as e-learning media in the Biology subject.

Keywords: critical thinking, emping melinjo poster, e-learning media, student knowledge, post harvest fungi;

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## 1. Introduction

In the science course, the teacher must involve students with the content and comprehend its ideas. As a subject taught and learned in senior high school, the construction process of science challenges both teachers and students, which involves a conceptual framework and alternative designs to learn the subjects as content and process. Current educational theories indicate, by de Vries, (2014), that learning is a process of reconstructing the learner's knowledge rather than merely transferring skill from an expert to a novice. Another goal of learning is that the students can learn and improve their critical thinking, reasoning analysis and solving problems. Teachers should provide learning experiences that enable students to acquire critical thinking skills.

Critical thinking skills are defined as the capacity to consider all facts from any source, properly formulate and then process it imaginatively and logically, as well as analyze it until it is determined whether it is right and maintainable. Based on the previous research (Persky et al., 2019), students learning analytical thinking skills face several challenges, including their convictions, weak metacognitive capabilities, a predetermined mentality, a non-automated skillset, heuristics, prejudices, as well as the idea that thinking is difficult.

Although difficult, developing student knowledge and critical thinking skill is challenging. For the teacher, explaining the powerful science concept to students is one of the critical skills required (Geelan, 2020). Teachers have to formulate methods and follow instructional methods that fit all students in a class's learning styles. The appropriate practice is for teachers to carefully choose teaching materials and activities that activate all students' creativity and encourage productive learning (Hossain, 2015). According to research and experience, alternative steps in the learning process also provide a thoughtful educational experience, watching or hearing what is applied to executive cognitive operations that students can imitate, and feedback and encouragement of their efforts before they could even work within their own. Learning can take place in situations focused on applications in the real world. Several recent studies suggest that context-based learning and real-life interactions are currently a major concern in science education (Kuhn & Müller, 2014). Students will comprehend abstract concepts in this kind of learning activity and develop their knowledge. However, previous research has suggested that the context might have a significant effect on academic learning. A new approach may be applied to facilitate the condition by adding empirical knowledge based on research as learning material to the class.

Following the integration of scientific fields in learning, article 8 of Regulation No 44 of the Ministry of Science and Technology of 2015 clarifies that the research findings must be referred to in the learning materials. Thus, with instructional materials focused on research findings, research items have significant advantages in the educational aspect. Besides, the education sector was deemed a useful forum to accomplish the goal of fostering local content. To provide students with an awareness of the opportunities in the student's area of residence, the research material was designed by providing local content aspects. Through creating Decrees 22 and 23/2006 of the Ministry of National Education, the Government of Indonesia provides an excellent opportunity for local material to be introduced into different school subjects, either in primary and secondary education curricula.

Research findings based on local content can be presented and visualized by posters as learning media. Up to now, there are still limited data about the information on the implementation of Bantenese local content for learning content in the school. The local content acts as a basis for incorporating comprehension and devolution of learners' geographic characteristics. In addition, the local content position is not a distinct subject; rather, it is an interconnected subject that was formerly a part of the subject (Fisnani et al., 2020). A poster should stimulate the classroom environment and assist successful learning. Rowe and Ilic (2009) stated that review, synthesis, and assessment are examples of active learning strategies that allow the learner to participate in such tasks instructed. However, that still serves the articulated professional demand since Clark and Paivio (1991) mentioned that the dual coding theory, explains the value of both verbal and non-verbal techniques

for crucial components of cognition. Cognitive ability supports the visual representation of knowledge that is advantageous for student learning. Posters, a supporting media, integrate visual learning with reading textbooks, discussion, and typical learning processes. Posters can be classified as a hybrid as it integrates a written article with an oral presentation (Miller, 2007) and should be given the same importance as other modes of scientific communication and not regarded as an afterthought. The significance is because posters are visual media that allow readers to engage with the author (Krausman & Cox, 2018).

Emping, made from melinjo (*Gnetum gnemon* Linn.) seeds is famous as a local culinary commodity from Banten Province and has great potential to be developed. Accordingly, it is being used as a vegetable. It is also used as a raw material for making emping melinjo chips, in several areas in Banten Province, which is becoming a centre for producing emping melinjo chips. Banten Province's statistical data in 2016 mentioned about 13% of Serang Regency farmers planted melinjo, and melinjo is the second largest production for this type of vegetable crop, after bananas, which was further produced as many as 176,123 quintals. Along with the food supply of emping melinjo chips from producer to consumers, the possibility of losses can occur, therefore agricultural commodities' quality, quantity, and market value have all decreased significantly of pathogen infection, handling, storage, transportation, and processing (Zhang et al., 2019). Pathogens infection on seeds can be caused by postharvest fungus perceived as a threat of seed-borne disease transmission (Chang et al., 2020). Postharvest fungi act as saprophytic seed-borne fungi that directly damage the seeds. Moreover, mycotoxin production in stored seeds can be produced and posing a health concern to people (Balendres et al., 2019).

Characteristic, morphology, structure of somatic reproductive stage and the role of post-harvest fungi as food contaminant can be applied as material to learn the biology subject especially in the concept of fungi as the materials are related to the student's life directly. Based on the Ministry of Education and Culture Regulation No 37 of 2018, basic competency needs to be accomplished by the student when studying the principle of fungi and classifying the fungi based on characteristics and how to reproduce, and connecting fungal roles in life. According to the finding of the interview process with biology teachers conducted in several high schools located in Banten province, the student encountered some difficulties in studying the concept of fungi which can lead to a diminished capacity or desire to participate in learning process.

Another important constraint was during the Covid-19 pandemic, students had to learn online. Globally, daily activity has been adjusted to adapt to the condition. Nevertheless, students proceed with their education through online learning and video calls with their teachers as the design is currently the best choice as keeping schools open bearings a safety risk for students. Closures of universities and schools have a lot of psychological consequences for a student, including interrupted studying, which negatively affects students and youth of chances for learning and success. Mostly as result, online digital learning systems with easy access to these systems and rapid internet connectivity will overcome this problem. The most recent efforts proposed by Khachfe et al., (2020) controlling people's unconstrained knowledge of rigorous safety precautions such as maintaining social isolation, following medically recommended quarantine procedures, and encouraging cleanliness and sanitation, makes a COVID-19 pandemic more probable.

The challenges with the situation recently dealing with a teacher's creativity and innovation were driven as a result of the pedagogical change from conventional to modern teaching methods. in providing activities for students while learning online. One of the examples is the utilisation of poster-based science research as learning media. A number of studies have explored poster utilisation as learning media. There is a clear result that educational posters used by Young et al., (2013) may greatly increase the level of knowledge of primary and secondary school teachers in Hong Kong. Such findings are also seen in the recent report of Hasanica et al., (2020) where there was a change in attitude attitudes of school children who received health-educational materials printed on a poster

with their healthy lifestyles. More research is needed to understand how a poster can be used for facilitating student knowledge while learning especially biology subjects.

However, as the importance of a poster can be perceived by the student, it is also possible to introduce research findings related to post-harvest fungi harbour in emping melinjo as a poster for learning media and teaching aid as a successful initiative that will enable the student to study biology effectively. The research thereby aimed to develop poster as e-learning media based on the research of post-harvest fungi in Bantene emping melinjo. This research also aimed to determine its effect on assisting student knowledge and critical thinking skill on biology subject for the concept of fungi.

## 2. Methodology

The post-harvest fungi in Bantene emping melinjo's poster were prepared using the ADDIE model (Figure 1) comprising steps of analysis, designing, developing, implementing, and evaluating (Dick et al., 2004). The key explanation for using this model is that the production steps are more modular, relatively simple, and customised to the type of final product to be developed.

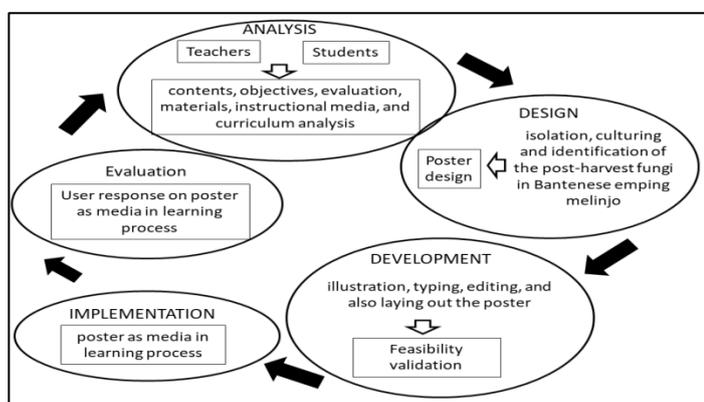


Figure 1. Procedures of ADDIE comprising steps of analysis, designing, developing, implementing, and evaluating

The analysis stage was used to collect data based on the needs analysis, substance, aims, assessment, resources, instructional media, and curriculum evaluation. A questionnaire was used to gather information from a five-state senior high school in Banten Province Indonesia, which represented the district and area, on the problem faced by students while studying biology subject toward the concept of fungi. Although the teacher's questionnaire was similar to the student's, it was based on the teacher's perspective. An assessment of the curriculum was performed in order to get information on basic competencies, indicators, and necessary material and student's requirements.

The designing step was carried out for preparing the poster initially filled with several aspects of consideration: readability, visibility, legibility, and good composition (Pauwels, 2015). At this phase, the design of a poster was an initial design of the media to be developed. The content of the posters included a title, basic competency, a brief introduction of the fungal concept, image, and a description of post-harvest fungi in Bantene emping melinjo. Prior to post-harvest fungi in Bantene emping melinjo, isolation, culturing, and identification of the fungi were carried out on May 2019-April 2020 (Khastini et al., 2020). This design of learning media was still conceptual and had become the foundation of the next development process.

The poster was developed using CoreIDRAW. Creating the illustration, typing, editing and also the lay out of the poster was conducted in this order. Later on, poster feasibility was validated by an expert as a validator assessment (material and media experts). A questionnaire and a validation sheet were used as the instruments to collect the data. Validators were handed validation sheets to consider

the poster as a learning media. Moreover, both the teacher and the student completed the questionnaire for the poster media assessment procedure. Students' response to audio-visual learning medium was determined via questionnaires distributed. About 15 students from each school who had received and studied fungi concept filled the student questionnaire responses. The instrument used for data collection was a set of five-point Likert-type questionnaires (Cooper & Johnson, 2016). Individual responses to the media have been assessed using it by assigning particular perspectives to each question: strongly agree, agree, disagree, and strongly disagree. Based on validator review, Table 1 displays the qualifying conditions.

Table 1. The eligibility requirements based on the validator's evaluation

Eligibility criteria (%)	Level of Eligibility
85-100	Very effective, the media can be used without revision
70-84	Quite effective the media can be used but need minor improvements
50-69	Less effective, the media need major improvements
0-50	Ineffective, the media cannot be used

The next step was the implementation of the poster in the learning process considering the poster effectiveness in a small group with samples of correspondence of 30 students. The practicality and feasibility tests for the poster were obtained through questionnaire sheets. The data collected by questionnaire were analysed based on the eligibility criteria which can be seen in Table 2. The outcomes of the analysis were later used as a basis for revising the poster media.

Table 2. Student response questionnaire eligibility requirements.

Eligibility criteria (%)	Level of Eligibility
85-100	Very feasible, the media can be used without revision
70-84	Quite feasible the media can be used but need minor improvements
50-69	Poor, the media need major improvements
0-50	Inappropriate, the media cannot be used

The last step of the research was the field trial to determine the effectiveness of developed learning media. In this study, McKenney and Reeves, (2014) methods employed by utilisation of a pre-test and post-test control group design with experimental and control classes. The sample of X MIA 1 and X MIA 3 classes as control and experiment classes was selected by cluster random sampling in one of the state Senior High School in Banten Province. The learning process using the post-harvest fungi in Bantenese emping melinjo poster as a learning media were applied in experimental class, while textbooks used in the control class. Both learning process were conducted by online learning.

The test instruments were modified from Facione (2020) critical thinking skills and consisted of 20 multiple choice questions and 10 essay questions, respectively. The validity and reliability of the instruments used were tested by 30 students as respondents. The data were analyzed with ANCOVA at a significance level of 0.05, and SPSS 21 for Windows ran a prerequisite test, such as the Shapiro-Wilk normality test and Levene's homogeneity test.

### 3. Result and Discussion

Fungi were generally regarded to be one of the most difficult subjects in biology to learn and grasp, according to the need analysis based on student and teacher questionnaires. The learning process

seemed to be less effective since students learn based on memorization and in an abstract way without the presence of observed objects. The lack of teaching-learning strategies, methods, approaches, and techniques will also influence the learning of students in biology, often reflected through disinterest and pessimistic attitudes during the learning process. Based on teacher interviewed, even though Banten Province has a diverse range of habitat types, natural potential, and high levels of biodiversity, including fungus, a small set of references was utilized as a student learning resource for the idea of fungi based on local content. Beyond the resource income, local content refers to the value that an extraction operation adds to the local, regional, or national economy., according to the Natural Resources Governance Institute (2015). Local content are incredibly valuable to Indonesian communities, particularly in terms of boosting the local economy, hence it is critical for students to learn about them.

The experiments conducted by the student when they learn on fungi concept were only limited by observing tempeh colonized with *Rhizopus* spp. as an example of fungi and Oyster mushrooms to describe the role of fungi as edible food in student daily lives. *Rhizopus* spp. have long been regarded as an economically significant mold in Indonesia due to their usage as an inoculum source in the production of tempeh, a traditional soybean-based fermented meal (Hartanti et al., 2015). Fungi are diverse, easily found, and are related to students' daily life. Indonesia is a tropical country characterized by weather conditions favorable for fungi suitable to support the abundance and richness of the fungi. Regarding the diversity of fungi, at present, there are approximately 3 million fungi species worldwide found in just about any habitat (Hawksworth & Lücking, 2017).

The post-harvest fungal contamination of melinjo chips can be used as alternative topics to be discussed and to facilitate student knowledge in learning biology. In the form of a poster, materials related to the fungi concept were delivered simply and supported by interesting pictures based on post-harvest fungal morphology. The characteristic trait for a particular fungus colonized and isolated from melinjo chips was displayed through a series of images including somatic and reproductive structure. A total of 35 species of post-harvest fungi were successfully isolated from 8 different locations of producer and distributor of melinjo chips in Banten Province (Table 3).

Table 3. Composition of post-harvest fungi in bantenese emping melinjo

No.	Code of Isolate	Species	Sample Location	GPS Coordinate
1.	ASp.1	<i>Aspergillus</i> sp.1		6°4'33.042 "S
2.	ASp.2	<i>Aspergillus</i> sp.2	Emping Producer in Sukabares	106°5'18.969 " E
3.	BSp.1	<i>Aspergillus</i> sp.1	Waringinkurung	6°3'41.912" S
4.	BSp.2	<i>Aspergillus</i> sp.2	Sukadalem	106°4'50.16" E
5.	Cwt1	<i>Fusarium</i> sp.		6°6'49.826"S
6.	CSp.1	<i>Aspergillus</i> sp.1		106°2'47.034"E
7.	CSp.2	<i>Aspergillus</i> sp.2	Waringinkurung 1	
8.	CSp.3	<i>Aspergillus</i> sp.3		
9.	Cwt2	<i>Basipetospora</i> sp.	Emping Distributor in Waringinkurung	
10.	DSp.1	<i>Aspergillus</i> sp.1		6°4'1.346"S
11.	DSp.2	<i>Aspergillus</i> sp.2	Waringinkurung 2	106°3'51.575"E
12.	Dwt2	<i>Basipetospora</i> sp.		
13.	Dwt1	<i>Fusarium</i> sp.		
14.	ESp.1	<i>Aspergillus</i> sp.1		6°13'29.442"S
15.	ESp.2	<i>Aspergillus</i> sp.2		106°1'44.779"E
16.	ESp.3	<i>Aspergillus</i> sp.3	Emping Producer in Pondok Kahuru	
17.	ESp.4	<i>Aspergillus</i> sp.4	Ciomas	
18.	ESp.5	<i>Aspergillus</i> sp.5		
19.	Ewt1	<i>Fusarium</i> sp.		

No.	Code of Isolate	Species	Sample Location	GPS Coordinate
20.	Ewt2	<i>Basipetospora</i> sp.		
21.	Ewt3	<i>Candida</i> sp.		
22.	Ewt4	<i>Paecilomyces</i> sp.		
23.	Egy	<i>Cladosporium</i> sp.		
24.	EPC	<i>Rhizopus</i> sp.		
25.	FSp.1	<i>Aspergillus</i> sp.1		6°15'31.23"S
26.	FSp.2	<i>Aspergillus</i> sp.2		105°59 '34.217"E
27.	FSp.4	<i>Aspergillus</i> sp.4	Ujung Tebu	
28.	Fwt4	<i>Paecilomyces</i> sp.		
29.	Fgy	<i>Cladosporium</i> sp.		
30.	GSp.1	<i>Aspergillus</i> sp.1		6°13'29.657"S
31.	GSp.4	<i>Aspergillus</i> sp.4		106°2'45.502"E
32.	GSp.5	<i>Aspergillus</i> sp.5	Emping Distributor	
33.	Ggy	<i>Cladosporium</i> sp.	in Ciomas	
34.	HSp.1	<i>Aspergillus</i> sp.1		6°13'48.621"
35.	Hgy	<i>Cladosporium</i> sp.	Ciomas 2	106°1'54.099"

The genera of post-harvest fungi were *Aspergillus*, *Candida*, *Cladosporium*, *Fusarium*, *Paecilomyces*, *Basipetospora*, and *Rhizopus* (Figure 2) collected from emping producers and distributors in Waringinkurung and Ciomas also known as the center of emping production in Kabupaten Serang, Banten Province. According to Arsal (2015), the expertise in processing melinjo into emping chips influenced its consistency and quality which are determined by the ripeness of the melinjo seed when roasting, pressure level during hitting the melinjo, evenness, and cleanliness of the emping chips produced.

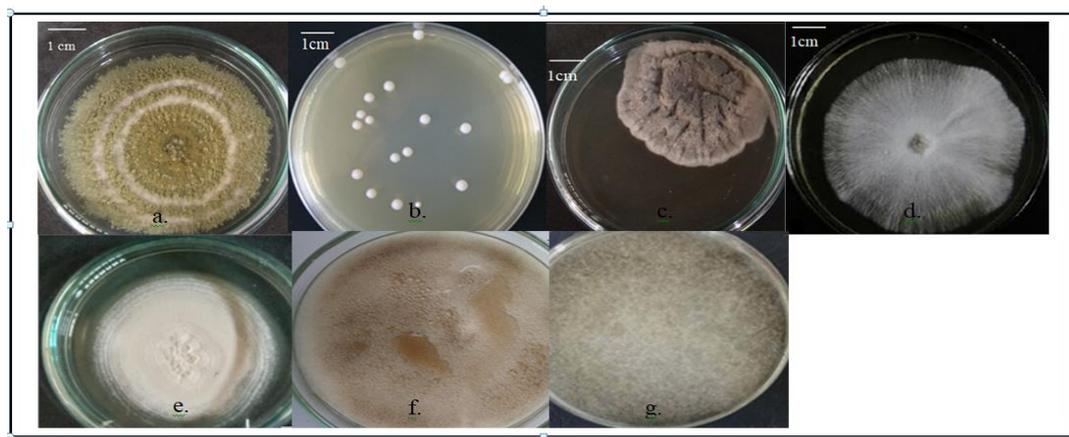


Figure 2. Diversity of post harvest fungi colony morphology in PDA medium to be observed in the poster. a. *Aspergillus*, b. *Candida*, c. *Cladosporium*, d. *Fusarium*, e. *Paecilomyces*, f. *Basipetospora*, and g. *Rhizopus*

It is critical to inform the student that the value-added usage of fungus is based on fundamental research aimed at better understanding fungal biodiversity, growth, nutrition, physiology, genetics, metabolism, and experimental ecology (Lange, 2014). Moreover, cultural contents such as information on how melinjo chips are produced, stored, and distributed to the consumers determined the quality of the chips because, during these stages, post-harvest fungi can grow and contaminate melinjo chips in such a supportive environment. Some parameters such as temperature, water supply, and humidity

are important environmental factors that affect the rate contamination of fungal spoilage (Magan et al., 2003). Student urges to know this information as understanding the influence of environmental conditions on fungal contamination is critical not only for the restore the product but also related to the health reason. Several species of post-harvest fungi e.g *Aspergillus* and *Penicillium* produce mycotoxin. Mycotoxins can induce a variety of problems, including mycotoxicoses and mycoses that can lead to death (Omotayo et al., 2019). As our understanding of human growth and learning has expanded at a rapid rate, so has our ability to construct more effective educational approaches. As stated by Darling-Hammond et al., (2020), to take advantage of these advancements, The learning process, on the other hand, must integrate results from a range of fields—from biology to psychology, sociology, developmental, and learning sciences—to new knowledge of successful teaching approaches in the biology topic.

Table 4 shows that the validation results are in average scores of 89 % and 90%. It can be observed that the learning media created was highly effective, as the average percentage score acquired as high as 89.5 % based on the content and media expert assessment. This also means that the learning media did not need to be revised to be implemented.

Table 4. Validation result of the post-harvest fungi in Bantenes emping melinjo poster by content and media expert

No.	Validator name	Rated aspect	Percentage of eligibility (%)	Eligibility criteria
1	DR	Content eligibility	89	Very valid
2	MS	Media eligibility	90	Very valid
Average			89.5	Very valid

The teacher’s responses showed positive responses as can be seen in Table 5. They considered that the media was very valid with the average of 88.66% and can be used as learning media while student need to accomplish learning objectives on fungi concept. According to Blazar and Kraft (2017), A teacher who succeeds in developing students' topic knowledge but struggles to encourage joy in learning or students' personal self-efficacy, for example, through the use of learning media, will have an impact on their students' learning results. As teacher is a key person, therefore teacher perceptions are critical in evaluating instructional media in line with learning practices. Teachers' abilities in evaluating teaching media may include the ability to recognise the most appropriate media for delivering content, the media role in enacting educational objectives, the principles and advantages of learning media, and the use of learning media.

Table 5 Teacher’s responses on the content of the post-harvest fungi in Bantenes emping melinjo poster

No.	Teacher’s name	Percentage of eligibility (%)	Eligibility criteria
1	SM	87.5	Very valid
2	IDL	89	Very valid
3	RHS	89.5	Very valid
Average		88.66	Very valid

The criteria of the assessed poster based on media and material validators consisted of graphics- originality, content accuracy, and attractiveness. According to Ranse and Aitken (2008), there are several important considerations in poster development. The layout of the poster should be in a reasonable order, concise, and easy to comprehend in the absence of the author. Furthermore, the amount of colour and graphic choices available to improve the look of the poster is infinite.

An important finding of the research was that the post-harvest fungi in Bantenes emping melinjo poster had become an important part of the student learning process. It is integrated as a main information delivery mechanism in online learning especially during the Covid-19 pandemic. According

to Rapanta et al., (2020), online teaching and learning require a certain amount of pedagogical material awareness (PCK) with the assistance of developing tools, which is largely concerned with planning and organizing for improved learning possibilities and establishing different educational environments. Almaiah, (2018) stated that the success of any information system is determined by how people use it. As a result, in the sense of an e-learning scheme, student adoption in e-learning is considered one of the most important factors for the system's effectiveness.

The utilisation of posters as learning media through online learning indicated that the use of technological advancements is subjected to direct, design and emphasis learning content, as well as to facilitate two-way communication between students and teachers (Mukhtar et al., 2020). Understanding the acceptance conditions as well as the key obstacles that exist in e-learning systems is important for efficient e-learning system use. The method of teaching may be accomplished with exploring the data based on the poster content and other information on fungi concept based on literature for more than one time, thus improving the learning of fungi concept. During the learning process, Some discussion was offered on the pedagogical benefits of poster design, including directions in which the representation of ideas encourages learning, mostly through active learning methods such as creative problem-solving, but also through the development of critical thinking skills and broader information sharing competent of interactive skills (Brownlie, 2007).

In brief, students' responses were been generally positive responses to the post-harvest fungi in Bantene emping melinjo poster majority and categorised as very feasible media (95%). The students expressed that implementing posters as media increased their awareness capability, argumentativeness and communication skills in biology subjects. The example of student opinion related to the utilisation of poster as learning media include:

- 'During the discussion, we learned how to scientifically communicate with each other and critically analyze the poster content based on the research result related with the fungi, the characteristic based on macroscopic or microscopic observation.'
- 'During poster observation, we gradually discovered that a diverse of fungi data can be found in our daily lives. We must realize that these fungi play a major role in life, both positively and negatively'.
- 'In addition, we should draw the connection between the evidence and what we assert using empirical arguments, as well as how we react to such critiques. Of course, this approach strengthened our listening skills and inspired us to learn more about biology'.

As a result, the created poster as a medium has a high level of beauty, message delivery, and user friendliness. According to Dharmawan and Wahyuni, (2017), a learning media is legitimate if all elements are rated in the same way by students and the user.

A field trial was carried out through online learning for analysing the effect of learning media in assisting student knowledge and critical thinking. The validity and reliability of the instruments were conducted before the experiment and the results are presented in Table 6. With regard to the value of  $r$  count  $>$   $r$  table, the validity and reliability tests show that the test instruments are both valid and reliable.

Table 6. The validity and reliability result analysis of the instruments used

Question Type	N	N item	Validity (%)	Reliability
Multiple choices	30	20	100	0,962>0.361
Essay	30	10	100	0,621>0.361

Based on field trial results, a learning process facilitated by post-harvest fungi poster developed is suitable to be implemented in learning activities. A preliminary test, which employs the normality and

homogeneity tests from both classrooms, experimental and control, reveals also that sample distribution is normal and homogenous. The average value of students' critical thinking abilities in each element is depicted in Figure 3. The poster's efficacy in enhancing students' critical thinking abilities in the experimental and control groups was 86 and 70, respectively.

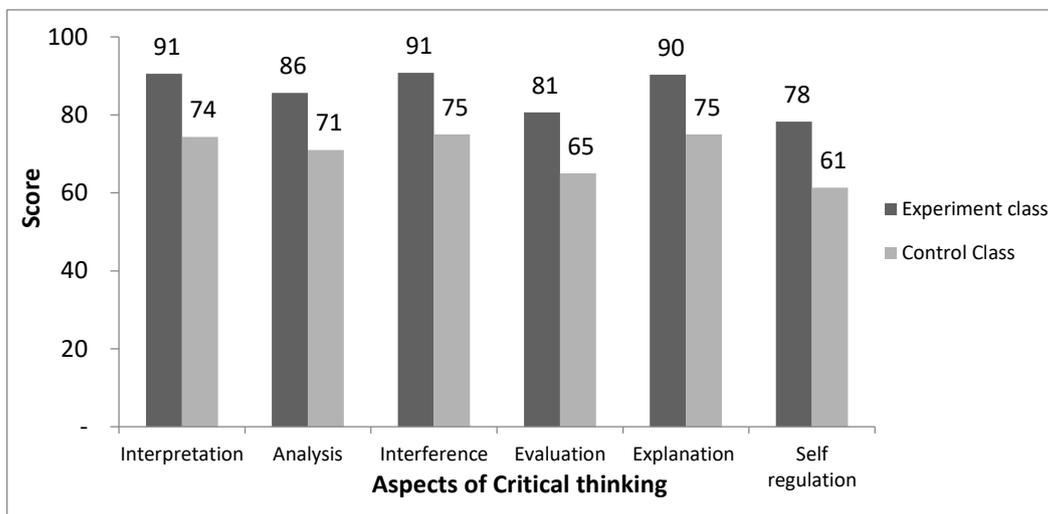


Figure 3. The students' critical thinking skills scores on each of the aspects observed.

The core of critical thinking skills has been classified by Facione (2020), including interpretation, analysis, inference, evaluation, explanation, and self-regulation. If a person can group the received difficulties such that they have meaning and are significant, he can satisfy the feature of interpretation. If someone can link facts and concepts, analysis aspects are completed. If the problem can be solved, the inference aspects are met. When someone can assess assertions or opinions that come from both him and others, evaluation elements are met. If someone can explain why a statement or viewpoint was conveyed as a strong viewpoint, the explanation component is completed. Students' ability to self-regulate their existence in the midst of a difficulty can be used to help them solve it.

Furthermore, ANCOVA was used to analysing students' critical thinking skills and the results show that the *F*-value was 115.21 with a significance level of 0.00 ( $\alpha < 0.05$ ). These results indicate that there are significant differences between the experimental classes using poster as learning media with the control class using textbooks in schools. These results indicate that the use of a poster learning media is effective in assisting students' critical thinking skills. This is consistent with Sherman's (2013) study, who evaluated that the critical thinking skills concerning the use of technology and learning media will affect the way students think and learn.

#### 4. Conclusion

A total of 35 species of post-harvest fungi were successfully isolated from 8 different locations of producers and distributors of melinjo chips in Banten Province. The genera of post-harvest fungi were *Aspergillus*, *Candida*, *Cladosporium*, *Fusarium*, *Paecilomyces*, *Basipetospora*, and *Rhizopus*. The research findings implemented to be the content of the poster as learning media in Fungi concept. The evaluation results of the poster as learning media showed that it was considered very feasible to be used with an average score of 88.66 from media and material validators. Students' responses showed that the developed poster was a very feasible media (95%). The success of the designed learning

media was demonstrated by the findings, which revealed a substantial difference in critical thinking capabilities between students in the experimental and control classes. This difference indicates that the produced poster is more effective in assisting students' knowledge and critical thinking abilities than the textbooks. It can be concluded that a developed poster can assist student knowledge in biology subjects especially in the concept of fungi.

## 5. Recommendations

The research might serve as a starting point for creating a learning method that will help students develop critical thinking abilities. Recommendations in this research are for further investigation that is required to observe other areas in order to complete the student's critical thinking abilities, allowing them to answer the biological issues entirely. In addition, it is better that the school samples used in this research are expanded with represented district and city in Banten Province to gain more comprehensive information.

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