THE EFFECTIVENESS OF INDEX CARD MATCH TO PRACTICE ANALYSIS AND EVALUATION THINKING SKILLS ON VIRUS MATERIAL FOR SENIOR HIGH SCHOOL GRADE 1

Siti Yuktika
Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya
E-mail: sitiyuktika@mhs.unesa.ac.id

Endang Susantini
Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya
E-mail: endangsusantini@unesa.ac.id

Abstract

The analysis and evaluation thinking skills should be trained to learners in entering the 21st century. Skills could be trained through various ways in learning activities, including the application of media in learning. Learning media was used to facilitate learners in understanding learning materials and to solve a problem. Index Card Match was a learning media in the form of cards that contain important concepts of a learning material. The card consisted of a question sheet and an answer sheet. Index Card Match developed on virus material. Virus material included the structure, replication, and role of the virus in life. The development of Index Card Match used ASSURE development methods. Effectiveness data was obtained by using the one group pretest and posttest design. The pretest and posttest results were analyzed using the method of the gain score. This research aimed to describe the effectiveness of media Index Card Match to practice the thinking skills of analysis and evaluation on virus material of X class. The research activities were conducted in the Biology Department, Mathematics and Natural Science Faculty, Universitas Negeri Surabaya. A limited trial was conducted on 15 students at SMAN 3 Tuban. The results of this research showed that the media Index Card Match was very effective based on the acquisition of the increased mastery test results 100% (very effective), as well as the thinking skills of analysis and evaluation were increasingly high with acquisition gain score 0.71. Based on these results the media Index Card Match developed in virus material was effective to practice analysis and evaluation thinking skills.
Keywords: Index Card Match, analysis and evaluation thinking skills, virus material.

INTRODUCTION

In the 21st century, the development of the world increasingly sophisticated so that learners must prepare themselves to face these developments. Analysis and evaluation thinking skills was a skill that must be trained to learners in entering the 21st century. Analysis and evaluation thinking skills could be trained in various ways in the learning activities. One of them was through learning that was able to create a simple and fun learning situation (Crumpler & Paatel, 2014). This was in accordance with Permendikbud 103, 2014 that learning in the classroom should be based on activities that possess the characteristics of fun, challenging, and motivate learners to participate actively.

A game in the learning activities was one of the activities that have characteristics in accordance with Permendikbud 103, 2014. However, the application of the game in learning must be related to the learning materials. Virus material was the material that was taught to students in senior high school. It had many concepts that were closely related to life, although the concept was still abstract to learners.

Research by Umiyati & Susilo (2014) stated that there were some difficulties experienced by learners in learning the virus material. These difficulties included the use of Latin language in virus material, especially on subclassification and the role of the virus in life. The other factors that affected the material of the virus were difficult to understand, among others, the interest of learners to seek fewer references, inadequate school facilities (there was no laboratory equipment that could be used for practicum virus), as well as a less supportive student environment.

Learning activities in schools especially for virus material could not be done by providing information by educators or teachers through memorization because the contextualization of virus material was very broad. Therefore educators should be able to facilitate learners in the form of learning strategies or learning media that could embed the concept and practice thinking skills analysis and evaluation.

According to Motlhabane (2017) thinks C4 analyzes and evaluates C5 were the hallmarks of higher-order thinking. But most educators did not use this level of thinking during learning activities. It is also similar to

Azar's (2005) research that educators rarely used high-level questions such as analysis, synthesis, and evaluation that could help learners to advance in their scientific thinking, most of the questions that educators had given when teaching learners were at the application level.

Based on interviews with a Biology teacher at SMA Negeri 3 Tuban, biology learning on the viral material had not been fully directed to high-level thinking especially analysis and evaluation. In addition rarely given effective learning media innovation in conveying a learning material and also fun for learners, teachers also had never provided learning media in the form of game cards or the like.

An alternative solution that felt appropriate to teach learners to think analysis and evaluation were through learning with Index Card Match. This learning media was a card that contained important concepts of a learning material. The card consisted of a question sheet and an answer sheet. This media also be equipped with instructions for using Index Card Match and answer sheets of learners. Index Card Match developed by researchers had some specific advantages. Among them were training students to learn independently in solving problems, improve students' understanding of the material that has been taught, train students to be active and increase participation in learning, and improve learning outcomes in the cognitive domain (Sarinarulita, et al., 2014).

Indicators used to assess thinking skills C4 analysis was analyzing a problem and exploring the relationship associated with how to classify, compare, differentiate, and check. Furthermore for C5 evaluation was evaluating an information and problem by way of assessing, giving an opinion, selecting, supporting, and evaluating (Anderson, et al., 2001).

Research by Sarinarulita et al. (2014) showed that learning using Index Card Match was able to increase students' learning activity and learning achievement. Improved learning outcomes could be seen in the completeness of cognitive learning outcomes of learners who increased from 7.89% to 92.86%. Another research by Alodia et al. (2016) that the game card would provide enhanced thinking skills through C4 analysis and C5 evaluation of learners with the gain score 0.7 (high increase), and a positive response of 97.75%.

Based on the above description, the researcher conducted media development research that served to facilitate the consolidation of the concept, trained the thinking skills of analysis and evaluation on virus material using Index Card Match. The purpose of this research was to describing the effectiveness of Index Card Match to practice the thinking skills of analysis and evaluation on virus material in X class. In the development of Index Card Match, in addition to the data obtained effectiveness, also obtained the results of validity and practicality. The validity data obtained was used to reinforce the research on the effectiveness. The results showed that Card Index Match obtain the average level of validity 97% (very valid), and expressed practically with the percentage of the positive response of students 100% (very practical).

METHODS

Development of Index Card Match used ASSURE development methods. The development of this media obtained data of validity, practicality, and effectiveness. In Utilize Materials we had obtained the result of validity from media Index Card Match. The validity media obtained from the validation by lecturers of virus material experts and media experts from the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, and biology teacher from SMA Negeri 3 Tuban. Then performed Require Learner Participant, Evaluate, and Revise to saw the practicality and effectiveness of the media. The data of media practicality was determined based on the observation sheet of activity of learners using media Index Card Match and student's response. Furthermore, data effectiveness was determined based on the results of pretest and posttest learners.

This research focused on the effectiveness of Index Card Match. Effectiveness data was obtained by using the one group pretest and posttest design. It aimed to determine the learning outcomes of learners before and after being given treatment in the form of application of Index Card Match. The limited trial was conducted on 15 students of class X SMAN 3 Tuban. This research was conducted in February 2018 until May 2018 in the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya. The research instrument used a test sheet (pretest and posttest) virus material. The pretest and posttest results were analyzed using the method of the gain score (Hake, 1999). The gain score was then analyzed using the gain level criteria to determine the improvement of the pretest and posttest result of the learner. Index Card Match to practice analysis and evaluation thinking skills developed on the material virus was effective if the gain score $\geqslant 0.31$.

RESULTS AND DISCUSSION

Research on media development produced media Index Card Match, that was divided into two sets of cards. The card consisted of 10 question cards and 10 answer cards (Figure 1). Question cards and answer cards were 17 × 12 cm in size. Each question card was given a record of the level of thinking as information to learners that the

questions obtained were high-level questions that analyze and evaluate. Likewise on the answer cards were also given a description of the grid answers to facilitate learners in thinking solving problems. This media also be equipped with instructions for using Index Card Match and answer sheets of learners (Figure 2).

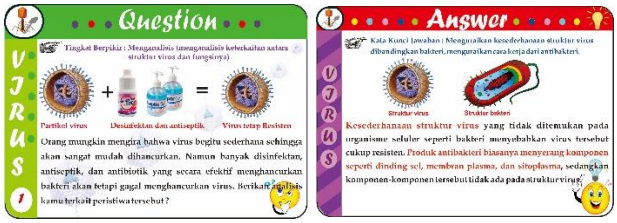

Figure 1. Question and answer cards

Figure 2. Instruction cards and answer sheets

Index Card Match was developed on virus material that includes the structure and function of virus parts, stages that occurred in the process of virus replication, the role of the virus in everyday life, the characteristics possessed by various viruses, and the impact caused by virus infection. Coverage of these materials was a material commonly taught to high school students of class X.

Based on pretest and posttest it could be seen the difference in average score of the test result on each indicator of learning. The result of pretest indicated that the learning indicator was divided into four assessment criteria: very good, good, poor, and bad. After learning using media the Index Card Match, overall indicator on posttest obtained criteria very good. Figure 3 presented the average percentage of test scores on the test results of learners before and after using media Index Card Match.

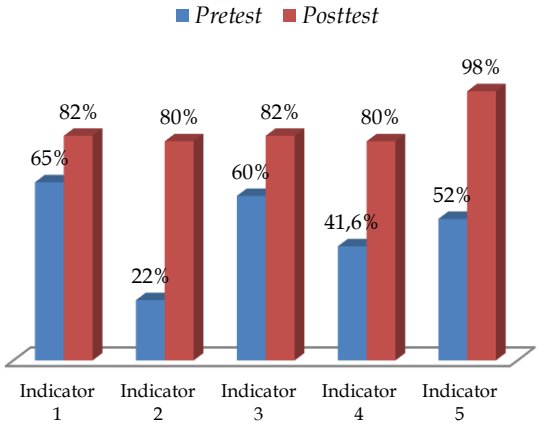

Figure 1. Graph of percentage increase in average test results of learners.

Information :

Indicator 1: Analyze the structure and function of the virus section

Indicator 2: Analyze the steps that occur in the viral replication process

Indicator 3: Analyze the role of the virus in everyday life

Indicator 4: Analyze the characteristics of various viruses

Indicator 5: Evaluate the impact of viral infection.

After the learners used media Index Card Match, the learning indicators 1 to 5 obtained the criteria of posttest results with very good criteria. The highest percentage was in indicator 5 98%, followed by indicators 1 and 3 82%, the next indicator 2 and 4 were 80%. Figure 3 also showed the increasing gained of all learning indicators. Indicators pretest and posttest had a different percentage of average scores test. It appeared that Indicator 5 had the highest increase compared to other indicators.

The effectiveness of the Index Card Match could be seen from the comparison of pretest and posttest result of learners. The pretest result showed that most learners were not able to complete each question on each indicator appropriately. Supported by the acquisition of pretest results that the completeness percentage could not reach 75% (Figure 3). This was caused by the initial knowledge of learners was not extensive enough. Learners did not understand the material of the virus in depth. Because at the time of previous learning learners only presented material from the results of teacher explanation through power point.

The questions presented at the time of pretest include analytical questions comparing between the structure of tobacco mosaic virus (TMV) with influenza viruses, outlining the reason for events occurring in the stages of viral replication, outlining the reasons for microscopic but non-cell characteristic viruses. Also, the evaluation question was to assess the truth related to rabies disease caused by viruses and assess the truth about the impact of TMV infection on tobacco leaf.

Most learners had not yet understood the viral material that used as the subject of pretest questionspretest. Moreover, if the questions did not contain an image, it would make the students difficult to answer. The question that contained the image as in the question indicator 1 was comparing the structure of TMV with the influenza virus was able to obtain the average percentage of 65% pretest result score with good criteria. 65% was the highest percentage earned during pretest.

Learners complete in indicator 1 because the question refers to the indicator was a question with the command compare the image structure of the virus. This showed that if visual images were provided in the question, learners would be more likely to solve a problem. Accordance with the opinion of Youssef & Damad (2016)

that through the visual form of learners would be easier to observe in detail, create relationships and responses based on the analysis made, gain the ability to understand, interpret, and identify any information presented. Also according to Sativa (2012) that images on learning media aimed to strengthen the concept of taught material and of course the existence of images would make learners more easily describe the differences and processes that occur in the picture.

Indicator 2 "analyzes the stages that occur in viral replication" had the lowest average percentage of test scores among the four other indicators, 22%. This indicated that all learners did not complete the questions related to the stages that occurred in the process of viral replication. Learners had not been fully able to describe the reasons related to events that occurred at the stages of viral replication.

The data completion of test results were presented in Table 1. Media Index Card Match was said to be effective if the percentage of result completeness posttest $\geqslant$ 75%. Table 1 also showed the improvement of analysis and evaluation thinking skills. Learners were said to be able to improve analysis and evaluation thinking skills if had the gain score $\geqslant$ 0.31.

Based on the data in Table 1 the percentage of result completeness posttest learners reached 100% and the average gain score 0.71 with high criteria. This indicated that Index Card Match could effectively improve analysis and evaluation thinking skills. The average pretest score of the learners was 48, the average indicated that all learners did not complete the pretest because of the standard completeness criteria minimal learners that were 75, while the average acquisition of the posttest score were 85. It showed that all learners complete the posttest.

The problems that were faced by the learners so as to make them unable to obtain score $\geqslant$75, because the learners were not accustomed to analyzing and evaluating a question, while questions given during pretest were high-level questions including analysis and evaluation. Often the tasks in the learning activities in the classroom just asked the students to complete the tasks contained in the textbook. Unfortunately, textbooks did not provide questions or tasks that asked learners to analyze and evaluate a problem. According to Zareian et al. (2015) most of the questions in textbooks as a handbook for educators were low-level questions that are aligned with remembering, understanding and applying.

Based on the case, it was important for educators to try to overcome it. Every classroom learning needed to be taught high thinking skills especially in analysis and evaluation. Skills could be trained by the educator when explaining the subject matter in the classroom. For example, providing a picture or a life phenomenon then asked the learner to express his or her opinion regarding the phenomenon. From there the learner would try to use his thought process and try to connect his initial knowledge with the new information obtained.

Furthermore, when all learners were given the posttest, they were successfully capable to solve the question on each indicator of learning. Supported by the average percentage of posttest scores posttest on all learning indicators exceeding 75% , also the percentage of posttest result completeness posttest reached 100% and the resulting score of posttest all learners reaching $\geqslant$75.

Table 1. Data Completion of Test Results and Improvement of Analysis and Evaluation Thinking Skills of Student

Learners for-	Score Pretest	CC	CP (%)	Score Posttest	CC	CP (%)	Gain Score
1	45	I	0	85	C	100	0.73
2	35	I	0	85	C	100	0.77
3	50	I	0	80	C	100	0.6
4	50	I	0	90	C	100	0.8
5	50	I	0	85	C	100	0.7
6	50	I	0	85	C	100	0.7
7	60	I	0	90	C	100	0.75
8	50	I	0	85	C	100	0.7
9	50	I	0	80	C	100	0.6
10	40	I	0	85	C	100	0.75
11	45	I	0	80	C	100	0.64
12	45	I	0	85	C	100	0.73
13	45	I	0	85	C	100	0.73
14	50	I	0	85	C	100	0.7
15	50	I	0	85	C	100	0.7
Average	**48**	**I**	**0**	**85**	**C**	**100**	**0.71**
		Gain Score Criteria					**High**

Information :

CC : Completeness Criteria C : Complete
CP : Completeness Percentage I : Incomplete

The highest average percentage of posttest scores 98% was found in indicator 5 "evaluate the impact of virus infection". Learners were asked to evaluate the effects of viral infections on tulips. And the result, all learners were able to describe the answer well in accordance with the condition of the picture of the tulip flowers that the learners observe on the question.

The lowest average percentage of the posttest scores 80% was found in indicators 2 and 4. From the results pretest and posttest Indicator 2 "analyze the stages that occurred in the viral replication process", obtaining the lowest average percentage of test results. From this, it could be concluded that the subject contained in indicator 2 was a subject that had not been understood easily by learners. Based on the exposure of the replication cycle by Jacquelyn & Laura (2015) there were five stages in viral replication including adsorption, penetration, synthesis, maturation, and release. Each stage of the virus replication undergoes a different process. The likelihood that learners had difficulties in understanding this subject and were confused to describe each stage. Moreover, there were two kinds of cycles in the process of viral replication including the lysogenic cycle and lytic cycle.

The right solution to solve the problem was as an educator should give a strong enough emphasis in explaining viral replication materials. Through the explanation given, learners were asked to try to re-explain the material that had been submitted by the educator. It aimed to make the students' memory and understanding of viral replication material could be embedded and sticking longer.

Indicator 4 also earned the percentage 80%. Learners were asked to describe the answers about the characteristics of biological viruses and computer viruses. In this case, learners had not understood the characteristics of computer viruses, students thought that computer viruses and biological viruses were same because they both infect and were parasitic. But if studied further there were differences from biological viruses and computer viruses were related with the media to spread the virus. Computer viruses spread through intermediate media such as flash disk, bluetooth, and internet. Meanwhile, according to Bauman (2009), the media to spread out biological viruses could be air inhaled every day by living things.

The reason of the students succeeded in obtaining the percentage of result completeness posttest reached 100%, also get the average percentage of score posttest above the minimum standard that was determined before doing posttest learners did learning material virus using media Index Card Match.

Virus material learning process using media Index Card Match asked the learners to read questions on question cards, write temporary answers while digging literature related questions obtained, searching and matching answers cards containing answers to questions obtained, then write back answers contained in an answer card, and the final stage was presenting their work to judges and other players. These activities could make learners rich in information and able to remember the concept of learning materials without having to memorize. As revealed by Boot et al. (2008) that learning activities through exciting games would encourage learners to tend and to have a greater memory of what they had learned.

Media Index Card Match developed on virus material was also effective for practice analysis and evaluation thinking skills. This was supported by the acquisition of data gain score 0.71 with high criteria. The media could provide improved thinking skills through C4 analysis and C5 evaluation of learners with the gain score 0.7. Also research by Sarinarulita et al. (2014), which states that learning using Index Card Match could improve the activity and learning outcomes of learners.

Although in the use of media Index Card Match inserted in a challenging game situation, but after done pretest and posttest was able to improve test results of learners. A large percentage increase indicates that through the use of media Index Card Match in learning viral material learners had succeeded in increasing understanding of the taught viral material, as well as improving their thinking process especially in high-level thinking which includes analyzing and evaluating a problem or event.

This is supported by Mustolikh's (2010) research that media Index Card Match could improve students' understanding of the material being taught. Also research Klonari & Gousiou (2014) that game-based learning such as cards will improve critical thinking skills and solve problems.

CONCLUSION

Based on data acquisition and description of the discussion in this research, it could be concluded that the media Index Card Match developed on the viral material was declared very effective to practice analysis and evaluation thinking skills based on the completeness of pretest and posttest result of learners as well as improvement of analysis and evaluation thinking skills of

learners. The completed result of posttest learners reached 100% with very effective criteria, analysis and evaluation thinking skills of learners increased height with gain score 0,71.

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