CONFERENCE PROCEEDINGS

INTERNATIONAL CONFERENCE ON MATHEMATICS AND SCIENCE EDUCATION (ICoMSE) 2019

Malang, 27-28 August 2019

ISBN: 978-602-73915-7-4

Strengthening Mathematics and Science Education Research for The Challenge of Global Society

Editors:
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Habiddin, Ph.D
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Faculty of Mathematics and Natural Sciences
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Proceedings

International Conference on Mathematics And Science Education (ICoMSE) 2019

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Welcoming Speech

Assalamu'alaikum warahmatullahi wabarakaatuh

Dear distinguished keynote speakers, invited speakers, the excellent participants, members of the committee, ladies and gentlemen.

On behalf of the organizing committee, I thank you for your participation in the Third International Conference on Mathematics and Science Education (ICoMSE) held on August 27th–28th, 2019 in Malang. This conference is also presented to commemorate the 65th anniversary and the 13th lustrum of Universitas Negeri Malang.

Please allow me to take this opportunity to give my sincere appreciation and gratitude to the excellencies keynote speakers including Dr. Kim Chwee Daniel Tan from Nanyang Technological University, Singapore; Dr. Saeed Almuntasheri from Albaha University, The Kingdom of Saudi Arabia; Prof. Peter Grootenboer from Griffith University, Australia; Prof. Lilia Halim from Universiti Kebangsaan Malaysia; Prof. Dr. Hadi Suwono, M.Si from Universitas Negeri Malang and Dr. Noor Azean and Marlina Ali From University Teknologi Malaysia. I would also like to express my gratitude to all of the participants who have contributed to this conference.

Ladies and gentlemen

This annual conference also serves to further the advancement and innovation in teaching and learning in the area. I do believe that the two days meetings and discussions have facilitated a platform as an opportunity for researchers to meet academics and practitioners from different parts of the world and to enlarge their networks with a person to person contacts in a high-quality academic convention.

I'd like to take the opportunity to say a big thank you to all the committee members that have worked hard to make this conference a success. A conference is only as good as the people that attend and the standard of the work that is presented, and I would like to thank you - the participants - for making it so.

Thank you very much, Assalamu'alaikum warahmatullahi wabarakaatuh

Malang, August 2019

Prof. Dr. Hadi Suwono, M.Si
Dean of FMIPA UM

Preface

To celebrate the 65th commemoration of Universitas Negeri Malang and the 13th lustrum, FMIPA UM has the opportunity to carry out this conference. Five fabulous keynote speakers including Dr. Kim Chwee Daniel Tan from Nanyang Technological University, Singapore; Dr. Saeed Almuntasheri from Albaha University, The Kingdom of Saudi Arabia; Prof. Peter Grootenboer from Griffith University, Australia; Prof. Lilia Halim from Universiti Kebangsaan Malaysia, Malaysia; Prof. Dr. Hadi Suwono, M.Si from Mathematics And Natural Sciences Faculty, Universitas Negeri Malang, Indonesia and over 300 participants with 313 orally presented articles joined to this conference.

The future contemporary and global society raises a massive challenge to all parties, including the mathematics and science education community, to have a significant impact on society. Therefore, the conference theme "strengthening mathematics and science education research for the challenge of global society" points out the need for continuous reconsideration of the links between mathematics and science education research and the contemporary professional, social and scientific challenges.

There is often a gap between mathematics and science education and research in mathematics and science. We need to improve and inspire mathematics and science education by taking into account research data in the relevant field. The development of mathematics and science education research should be grounded by the mathematics and science research results. Mathematics and science education research also brings those results to be more functional, well disseminated and well informed to the broader community. Therefore, although mathematics and science education research is the core of this conference, several mathematics and science papers are also welcomed.

The results of research in mathematics and science education should be adapted to the needs of mathematics and science educators and should be transferred and disseminated effectively to the teaching community in order to empower the development of mathematics and science knowledge and its contribution to the better civilization. Finally, I do hope that this proceeding may contribute to disseminating research results in the relevant area.

Malang, August 2019

Habiddin, PhD
Chairman

CONTENTS

The Relevance of Metacognition Strategies towards the Achievement of Biology Learning Outcomes of High School Students

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Abstract. Previous research has suggested that training students' metacognition strategy skills can improve student learning outcomes. This research examined the relevancy of metacognition strategies toward learning outcomes achievement of high school students in learning the human reproductive system, using descriptive method. The population was 11th-grade students from the subdistrict North Tambun, Bekasi. The sample consisted of 100 students of 11th grade high school students who had been studying the human reproductive system in biology major, with two-stage random sampling that combined cluster random sampling and individual random sampling. The data were collected by test method for student learning outcome with cognitive processes of Bloom's Taxonomy (C1 until C4) and Metacognition Strategy Questionnaire, to classify student into groups (students with Self-awareness Strategies (A), Modifying Strategies (B), Imitation Strategies (C), or other strategies finding (D, E, etc.)). There are three indicators of metacognition strategy (Planning, Monitoring, and Evaluating) that were assessed in this research. Those indicators were assessed to every student by using a rubric scale (1 to 5). The analysis found that: 1) Students used three types of metacognition strategies during learning of human reproductive system 2) Students who tended to use type A metacognition strategies (self-awareness) obtained higher score compared to Modifying (B) metacognition and Imitation (C) 3) Metacognition strategies has relevance with the score of the taxonomy of cognitive C1, C2, C3, and C4, in which the scores on cognitive C1, C2, C3 and C4 on Self-awareness strategies (A) were higher than Modifying given strategies (B) and Imitation strategies (C).

Introduction

Learning is part of the scientific process, which basically aims to develop the ability to think and instill a positive attitude. The learning process is actually difficult to observe because it occurs in the brain (mind) of each student. The aspect of learning that can be easily observed is the learning outcome. Each student comes to school carrying the contents of the mind, how to receive, process, and store different information. Basically, carrying out the teaching and learning process is creating an environment and

atmosphere that causes changes in cognitive structure in students [8]. Based on the cognitive development theory, students at the high school level have cognitive development which is in the last and highest period of formal operations and experiences puberty [7]. Students in this period already have their own mindset in trying to solve complex and abstract problems. In other words, students have metacognitive abilities that have developed very well.

Metacognition which consists of metacognitive knowledge and experience or metacognitive regulation, is part of the planning process, monitoring, and evaluating [10]. In learning, if students already have metacognitive abilities, students will know how students should learn, know their abilities and modalities, and know the best learning strategies for effective learning [15]. Metacognition strategy refers to a person's awareness in monitoring one of his cognitive strategies to achieve specific goals [12].

Based on the cognitive development period, even though students already have abilities and good knowledge of metacognition, nowadays, sexual deviance behavior still occurs, such as free sex among teenagers, early marriage, infection of sexually transmitted diseases, and the occurrence of abortion. This is possible because they are not trained in metacognitive processing at the monitoring stage (self-monitoring) [1]. In the monitoring phase, there is a process of how to manage cognitive activities effectively and design activities that will be done, so that the metacognitive skills that students have can direct them to have better behavior. Miranda and Yula (2010) stated that metacognitive knowledge would shape student's behavior in raising awareness about the processes of thinking and learning that occur. It is necessary to investigate more deeply how the role of teachers in schools, especially in North Tambun district, can increase students' metacognitive awareness of reproduction so that they are not only aware of the environment but also aware of the effects of learning outcomes in the classroom. Practicing metacognition involves metacognitive abilities that are pointed out in metacognitive strategies. The metacognition strategy used by students depends on internal and external factors such as values and motivation in students, their perceptions of demands of the task, and how to teach the teacher [20].

The use of metacognition strategies in learning the human reproductive system makes students assess what they understand from the learning process that has occurred, and things that have not been understood. After that, students are expected to find ways to understand what is not yet understood. Students learn to think about the right strategies to overcome their learning difficulties when studying about the human reproductive

system. Students can also assess the learning process itself to understand things that have not been understood.

Previous research has suggested that metacognitive awareness can be improved through the application of problem-based learning [5]. Other researchers found that there were significant differences between the average scores of metacognition awareness based on gender and location (between urban and rural high school students) [21]. In addition, students' metacognitive knowledge about reproductive health has a positive correlation with the perception of students' sexual behavior in daily life [1]. Metacognitive strategies in learning can be improved to improve learning achievement. Ngozi (2009) conducted a research to improve learning achievement in high school students in science learning through experimental methods, and the results showed that there were differences in the average posttest scores among the control class, class with Think-Pair-Share learning, and class with metacognitive questions. Thus, metacognition used by students in learning has the potential to improve student learning outcomes [10].

Based on the description above, it is necessary to conduct research that aims to find out "The Relevance of Metacognition Strategies towards the Achievement of Biology Learning Outcomes of High School Students."

Research method

The research was conducted at SMAN 1 Tambun Utara, SMAN 2 Tambun Utara, Zam-zam Kurnia Health Vocational School, and Satria Nusantara Vocational School of Nursing, North Tambun District, Bekasi who were in biology class in school. The sample was 100 students of class XI who have studied the concept of the human reproductive system. The samples were obtained using a two-stage random sampling technique, combined between cluster random sampling with individual random sampling.

The type in this research is a descriptive method to describe and see the relevance of metacognition strategies towards student learning outcomes. In this research, the researcher did not give treatment, and learning planning was also left entirely to subject teachers without any intervention from the researcher. The independent variable involved in this research is a metacognition strategy while learning outcomes are the dependent variables.

Data was collected using the instrument as follows:

a. Questionnaire. The questionnaire was given to the student to classify the tendency of students' usage of metacognition strategies. It was prepared based on the theory of metacognition strategies from Flavell, Brown and

adaptations from Bairac, which includes: indicators of Self-awareness Strategies, Modifying Givens Strategies, and Imitation Strategies (Ghasempour, Bakar, & Jahanshahloo, 2013).

b. Test Questions. Test questions were multiple choice to use for student learning outcomes with cognitive processes of Bloom's Taxonomy (C1 until C4).

The questionnaire of metacognition strategies is a semantic differential scale, with a range of values of 1 to 5 as an alternative answer. Each answer chosen by students were categorized according to the metacognition strategy selection indicators used by students. Metacognition strategy A is the tendency of students in planning, monitoring, and evaluating of learning using self-awareness strategies on learning the human reproductive system. Metacognition strategy B is the tendency of students in planning, monitoring, and evaluating of learning using modifying strategies on learning human reproductive system. Metacognition strategy C is the tendency of students in planning, monitoring, and evaluating learning using imitation strategies on learning the human reproductive system. Metacognition strategy D, or etc are metacognition strategies consisting of a combination of metacognition strategies A, B, or C. It should be emphasized, in this research, that group naming was formed based on findings in the field after students were observed. These were indicators of metacognition strategy, according to Flavell.

TABLE 1. Indicator of metacognition strategies

Indicator	Metacognition Strategies		
	Self-Awareness Strategies (A)	**Modifying Given Strategies (B)**	**Imitation Strategies (C)**
Planning learning objectives (Planning)	Learning goals based on own desires	Learning goals from experience and class	Teacher oriented learning goals
Monitoring during learning activities (Monitoring)	a. Study time according to own needs b. Effective learning strategies are self-designed	a. Learning time in accordance with learning needs in class b. Reuse, change, or add new strategies	a. The time needed in learning is teacher oriented b. Use learning strategies from friends or teachers
Evaluating goals, time, or strategies used in learning (Evaluating)	Self-evaluation	Evaluation with friends and teacher	Evaluation of the teacher

Validation of content and construction are assessed to determine the suitability between metacognition strategy indicators, material of human reproductive system, and the questions prepared. Then the metacognition strategy questionnaire was tested to get valid value that will be used in this research. There are 27 items of metacognition strategy statements that can be used in this research.

Data collection techniques in this research are the provision of an explanation of metacognition strategies carried out the day before data collection in each school. Then, during the next meeting students were given a test item on the concept of human reproductive system. The data obtained were analyzed descriptively to determine the tendency on the use of metacognition strategies that emerged at the time of the research. The results obtained were converted to percentage form. The analysis was to divide the total score of each indicator from all students and divided by the ideal score.

Results and Discussion

Data collected from the questionnaire was used to group students based on the tendency of metacognition strategies used. The findings of the tendency of metacognition strategies used by students can be seen in TABLE 2.

TABLE 2. The tendency of metacognition strategies

Descriptive Statistics	Metacognition Strategies		
	Self-Awareness Strategies	Modifying Given Strategies	Imitation Strategies
N	45	20	35
$\overline{X}$	76.94	76.83	75.75
SD	10.61	9.98	6.93

Based on TABLE 2, it was found that students used 3 types of metacognition strategies. Most of the students (45 of 100) tended to use metacognition strategy A (self-awareness strategy). However, the usage was not significantly different among the three types of metacognition strategies, around 75-76.

TABLE 3. The average score of metacognition strategy components

Component	The Tendency of Metacognition Strategy	Score (Mean% $\pm$ SD)
Planning		
1. Learning goals based on own desires	A	74.37 $\pm$ 11.80
2. Learning goals from experience and class	B	74.00 $\pm$ 13.14
3. Teacher oriented learning goals	C	71.43 $\pm$ 10.54
Monitoring		
1. Study time according to own needs	A	79.11 $\pm$ 17.47
2. Learning time in accordance with learning needs in class	B	70.50 $\pm$ 14.32
3. The time needed in learning is teacher-oriented	C	75.14 $\pm$ 13.58
4. Effective learning strategies are self-designed	A	75.56 $\pm$ 16.73
5. Reuse, change or add new strategies	B	80.50 $\pm$ 18.77
6. Use learning strategies from friends or teachers	C	69.43 $\pm$ 16.26
Evaluating		
1. Self-evaluation	A	79.11 $\pm$ 16.35
2. Evaluation with friends and teacher	B	81.00 $\pm$ 12.94
3. Evaluation of the teacher	C	82.29 $\pm$ 16.26

Findings show that the average score of students when using metacognition strategies at the planning stage generally tends to plan learning goals based on self-awareness (74.37% of students). Other students used learning goals from experience and class (74.00% of students), the rest used the planning stage based on teacher-oriented learning goals (71.43% of students). This happened because the students had prior knowledge about the human reproductive system, either obtained through mass media or in daily life, according to the level of development of the students. Lou, Cheng, Gao, Zuo, Emerson, and Zabin (2012) stated that the media have associations with adolescents' and young people's sexual behavior that may be as important as family, school and peers. Other findings on the analysis of the tendency of metacognition strategies used by students were the tendency when monitoring. In general, students were more likely to monitor time and effective strategies that were self-designed according to their learning needs (77.33%).

Based on the analysis of the statement of the metacognition strategy questionnaire of students, when studying the human reproductive system, students stopped learning for a moment to check their understanding and record the knowledge they acquired. NCREL's (1995) statement, that in monitoring activities students will dig up information and record important

things that they find. By monitoring the time and learning strategies themselves, students could monitor the progress achieved and used to control cognitive activities and guarantee the cognitive goals they have achieved.

According to the analysis of the evaluation component used by students, it was found that in general, students were more likely to evaluate teacher-centered learning (82.29%). Students had more confidence in their teacher in evaluating each stage of their metacognitive (planning and monitoring), such as rewriting the conclusions given by the teacher or asking the teacher to check the correct answers to the questions the students are working on. This is because students were not confident with their ability to evaluate the improvement of the learning process. In this case, the teacher can help and provide opportunities for students to reflect on their learning activities so they were able to diagnose weaknesses and strengths that can be used to improve learning time, learning strategies, and monitoring in the learning process [14].

Student learning outcomes were obtained from multiple-choice test scores given after students learned the human reproductive system from the teacher in each school. Based on the data of student learning outcomes, the percentage of classical completeness of all students is still classified in the low category (≤ 65%), which is only 24% of 100 students who completed with the average score of ≥ 65. This occurred because students in this research have not been able to regulate metacognition when studying the human reproductive system. This is in accordance with research by Diella (2014), which stated that if the cognitive of the human physiology system concept is low, then the cognitive arrangement tended to be low.

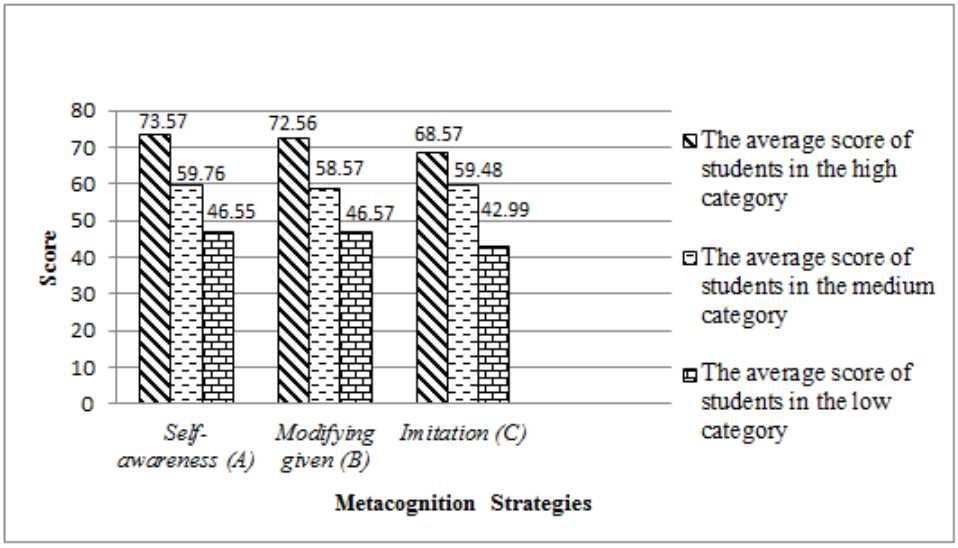

FIGURE 1. Comparison chart of student learning outcomes based on metacognition strategies

Based on FIGURE 1, the average scores of student learning outcomes with a high category in the three tendencies of students' metacognition strategies are significantly different. While the average score of student learning outcomes in the category of medium and low shows the difference in the average score, which is not much different on the three metacognition strategies. Overall, the use of metacognition strategy A gives a higher score of learning outcomes compared to the tendency of metacognition strategies B and C.

Score differences of students learning outcomes in the three metacognition strategies can also be seen from the acquisition of scores at each cognitive level about the human reproductive system. Analysis of the acquisition of the score of learning outcomes at each cognitive level can be seen in TABLE 4.

TABLE 4. The average score of student learning outcomes based on the cognitive level

Metacognition Strategies	Cognitive Level			
	C1	C2	C3	C4
Self awareness strategies (A)	61.21	60.26	63.33	49.33
Modifying given strategies (B)	58.64	54.71	60	49
Imitation strategies (C)	56.36	51.26	58.57	36

The low student learning outcomes can be seen from the average cognitive achievement of students in TABLE 4. Low student learning outcomes could be because the content mastery was from memorization. Although students have implemented a metacognition strategy, some

students were less able to deal with questions that required deeper understanding and cognitive abilities such as analytical skills. This can be seen in the acquisition of scores at C4 cognitive level (analyzing) which is lower than the questions with C1, C2, and C3 cognitive levels on all tendencies in student metacognition strategies.

In analyzing a concept, students must be able to break the problem (problem) into smaller or specific parts and detect those parts and arrange them [2]. In this case, the ability was needed where students associate prior knowledge with new information obtained in accordance with the metacognition strategies used.

Students with high metacognition awareness could make plans to understand concepts according to what was needed and their cognitive abilities. If at the beginning of planning, students are not based on their own desire to understand concepts, it will be difficult for students to solve new problems when students are fixated on what has been instructed in the class by the teacher. Students do not explore additional knowledge to deal with problems that might arise in learning. Therefore, students with imitation metacognitive strategy tendencies obtained C4 cognitive level results, which are smaller than other metacognitive strategy tendencies.

Another finding analysis at the cognitive level shows that C3 (applying) is a higher average than the cognitive levels of C1, C2, and C4 that is 63.33. When students work on C3 cognitive level questions, students with self-awareness strategies carry out monitoring activities by giving more attention to the problems, understanding problems and linking them with prior knowledge that students identified when planning. Students with a tendency for self-awareness strategies will stimulate their malacological abilities by controlling their ability to apply problem-solving strategies successfully [22].

In working on questions with a cognitive level of C3, students with self-awareness strategies carry out monitoring activities by giving more attention to the problem at hand, understanding the problem and connecting them with the initial knowledge that students have identified when planning to achieve their learning goals.

This finding is similar to the research of McLoughlin and Hollingworth (2003), which showed that effective problem-solving in applying concepts could be obtained by giving students the opportunity to apply their metacological strategies when solving problems, faster learning demands allowing students to learn more actively with specific strategies involving self-designed metacognition. Based on these findings, self-awareness strategies are important factors in the learning process because metacognition has a direct positive relationship with academic achievement,

which means that the higher the awareness of metacognition students, the better the learning outcomes. This is confirmed by Rahman and Phillips (2006), the research results show that there is a positive relationship between metacognition awareness and student academic achievement.

Conclusions

Based on the results of data analysis and discussion obtained, high school students in the subdistrict of North Tambun used three types of metacognition strategies during learning the human reproductive system, which is Self-awareness strategy (A), Modifying given strategy (B), Imitation strategy (C). The use of metacognition strategies has relevance to the acquisition of student learning outcomes significantly but with a low category.

Previous research shows that the use of metacognition strategies improves student learning outcomes, but in this research, the researcher developed an analysis of metacognition strategies such as what can improve student learning outcomes, and saw the relevance of the use of metacognition strategies with the cognitive levels in the content of the human reproductive system.

There is a difference between C1, C2, C3, and C4 cognitive levels in the three tendencies of students' metacognition strategies, scores of cognitive level on Self-awareness metacognition strategy tendencies are higher than cognitive levels in the Modifying and Imitation metacognition strategies. Based on the four cognitive levels in all tendencies of metacognition strategies, it can be seen that C3 (applying) obtained higher scores than those of C1 (remembering), C2 (understanding), and C4 (analyzing) levels. Future research should be done not only on human reproductive system material but also for other biological material.

Acknowledgments

The author would like to thank Universitas Pendidikan Indonesia, Bandung, for supporting this research, Ana Ratna Wulan, M.Pd. Dr. as a lecturer in the Department of Biology Education, School of Postgraduate UPI Bandung and all school principals, biology teachers, and students in the environment where the research takes place.

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Needs analysis of development genetics flash flipbook multimedia based on improving learning models in IKIP Budi Utomo Malang

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Abstract: The purpose of this study were to: (1) analyze the use of learning media used in genetic subjects at the Biology Education Study Program at IKIP Budi Utomo Malang; (2) identify the appropriate genetic learning media in the perspective of lecturers, and (3) identify the appropriate genetic learning media in the perspective of students. This study involved 40 biology education students class of 2016 and two genetics lecturers, IKIP Budi Utomo Malang. The research instrument consisted of a questionnaire for lecturers and students. The results showed that (1) the lacked learning media as a reference for students in genetic subjects, (2) the learning process still used simple powerpoint and discussions (2) lecturers needed appropriate genetic learning media to improve students understanding (3) students needed appropriate genetic learning media based on Improve learning models, (4) most students supported the development of flash flipbook media based on improving learning models.

Introduction

Genetics, including classical genetics (Mendel genetics) and molecular genetics (chromosomes, DNA, genes, and the processes associated with it such as replication, transcription and translation), is a compulsory subject at the university level, including Biology students of IKIP Budi Utomo. The learning process and the learning outcomes of genetics was still a problem in many Education Institutions (Fadri, et al. 2018). Hera (2017) and Mahmudati (2015) stated that the subject of genetics has a high difficulty level for students of biology education. This is due to the lack of ability of the students in understanding the genetics concepts that are abstract and cannot be observed directly.

Based on the interviews with lecturers at IKIP Budi Utomo, students showed a lack of interest in genetics subjects and understanding is also quite low. This can be seen from several things. First, almost all students just study in the semester examination. Second, students sometimes cheat at the test because they were not confident about their abilities or lack of preparation. That means student's learning motivation was low. Also,

students pay less attention to lecturers, and there are still those who speak on their own when lecturers provide lessons so that students' understanding of genetic concepts was low. The lack of specific learning resources is felt to be one of the factors causing low learning outcomes. So that researchers want to make a learning product that can provide information related to genetic material more deeply for students. One product that might be able to answer this problem is teaching materials in the form of learning media.

Teaching materials are a set of materials or lessons arranged in a coherent, systematic manner and display competencies that will be mastered by students in learning activities. Teaching materials that consist of printed and non-printed materials allowed students to hold all competencies in deeply. Media was one of the non-printed teaching materials that contained text, images, animation, sound, and film or video (Asandhimitra, et al., 2004). Ivers and Ann (2010) stated multimedia was the use of media for presenting information that contains text, graphics, animation, images, video and sound. According to Rizky (2016), multimedia was the use of various types of media that presented sequentially or simultaneously to convey the topic or information.

Some research showed that using instructional media give a significant difference in the learning outcome compared without learning media. Hence, the use of instructional media was highly recommended to enhance learning quality (Sudjana & Rivai, 2011). According to Arsyad (2002), the use of instructional media in the learning can evoke new desires and interests, motivation and stimulation of learning activities and even bring psychological influence on students".

One learning media that expected to make an interesting and conducive learning atmosphere was Flash Flipbook multimedia. The Flash FlipBook media expected to increase student motivation and affected various student’s competencies. The development of Flash Flip Book media based on metacognitive learning models, namely IMPROVE (Introducing New Concept, Metacognitive Questioning, Practicing, Reviewing and Reducing Difficulty, Obtaining Mastery, Verification, Enrichment) learning models.

The purpose of this study was to: (1) analyze the use of learning media used in genetic subjects at the Biology Education Study Program at IKIP Budi Utomo Malang; (2) identify the appropriate genetic learning media in the perspective of lecturers, and (3) identify the appropriate genetic learning media in the perspective of students.

Methods

This study involved two genetic's lecturer and 40 biology education students at IKIP Budi Utomo Malang. Data collection used questionnaires for lecturers and students. Data was collected through interviews with the lecturer to determine problems in the learning process. It also conducted interviews and questionnaires to students to know the difficulties of learning and teaching materials used by students. Research Procedure, namely the first stage of this research, was to compile a questionnaire on the Need for Analysis of the Development of Genetic Teaching Materials in the form of a Genetic's Flash Flip Book Focused Based Improve Learning models. The questionnaire consists of 12 questions. The second stage was distributing questionnaires to Biology Education Study Program students who have taken Genetic and the lecturers in genetic courses. The third stage was to analyze the questionnaire that has been filled. Data collection used questionnaire analysis of teaching material needs in the form of media that were distributed to genetic lecturers and students of the Biology Education Study Program. Data obtained through subsequent questionnaires were analyzed in descriptive percentages.

Results and Discussion

The results showed that the learning media commonly used by lecturers in teaching the genetic subject are powerpoint slides that contain brief material about genetic. In the learning process, as many as 88.24% of students got difficulties in learning genetic. As many as 100% of students want genetic learning by using media alternatives. As many as 88.24% of students answered that teaching materials were not available in genetic learning and 11.76% of students answered that genetic teaching materials were available. As many as 88.35% of students expect teaching materials that contain material whose language is easy to understand and able to make students construct their concepts. The results of the questionnaire to the lecturers showed that the availability of genetic teaching materials for the past three years was the absence of teaching materials in the form of clear and specific modules used in the learning process in the classroom.

The results showed that (1) the lacked learning media as a reference for students in genetic subjects, (2) the learning process still used simple powerpoint and discussions (2) lecturers needed appropriate genetic learning media to improve students understanding (3) students needed appropriate genetic learning media based on Improve learning models, (4)

most students supported the development of appropriate genetic learning media.

The results of the questionnaire to the lecturers showed that the availability of genetic teaching materials for the past three years was the absence of teaching materials in the form of learning media in the learning process in the classroom. The lecturers of genetic hope that teaching materials can be developed, which contain genetic materials specifically that can facilitate students in studying genetic.

From the results of the questionnaire based on the availability of teaching materials, it was seen that 58,82% of students did not have a textbook or another book of genetic material, and 41.18% of students have a textbook or another book of genetic material. 94.12% of students were looking for other genetic material sources from the internet, and 88.24% of the respondents had to get difficulties to learn genetic material. 88.24% of students were enthusiastic in genetic learning, and 11.76% were not enthusiastic. 100% of students agree to develop a flash flipbook in genetic material. This shows that the availability of teaching materials is still lacking. Based on the results of interviews with students, information was obtained that the teaching materials used by students came from powerpoint collected by students during the teaching and learning process in the classroom. Student awareness in finding other learning resources or references was high. So it showed that students need attractive genetic material for learning. Student motivation and awareness in finding other reference sources were high.

From the results of the needs analysis questionnaire given to students, it can be seen that Genetic's learning has been using powerpoint media which was considered to be unable to provide learning motivation for students, here students hope some videos and images that support and supplement the description or discussion related to images. Most of the students studying genetic by reading and memorizing for that needed teaching materials or learning resources that support the learning process, so that students can learn well and the material delivered optimally.

Students have difficulty in understanding the material DNA, chromosomes, genes, DNA replication. This is because the material is abstract or difficult to observe directly, so we need a media that can describe or visualize the material to be more easily understood. Munandi in Asyhar (2012) explains that instructional media enable learners to gain a clear picture of objects or things that are difficult to be observed directly.

Teaching materials that are considered capable of being a reference and learning resource in genetic courses are teaching materials in the form of

Flash Flip Book. The Genetics Flash Flip Book media is a teaching material consisting of specified material topics and supporting images, video and sound. Hamalik in Nurseto (2011) explained that the use of media in the learning process could generate new desires and interests, increase motivation and stimulation of learning activities, and even have a psychological effect on students.

The above is in line with the opinion of Sudjana (2010) teaching will be more effective if the objects and events that become the teaching material can be visualized realistically to resemble the real situation whereas Sungkono (2011) states that audio messages in learning are needed to focus student attention. So that teaching that has audio and visual dimensions will give the message given will be stronger thanks to the two delivery systems. Sukiman (2012) explains the practical use of instructional media in the teaching and learning process that is learning media can clarify the presentation of messages and information to facilitate and improve the process and learning outcomes.

Conclusion

The results of the research and discussion showed that The results showed that (1) the lacked of learning media as a reference for students in genetic subjects, (2) the learning process still used simple powerpoint and discussions (2) lecturers needed appropriate genetic learning media to improve students understanding (3) students needed appropriate genetic learning media based on Improve learning models, (4) most students supported the development of appropriate genetic learning media.

Acknowledgments

We would like to express our gratitude for the support of Directorate of Research and Community Service Directorate General of Strengthening Research and Development of Ministry of Research and Technology Ministry of Higher Education, which has funded this research and P2M IKIP Budi Utomo Malang, Indonesia for the place of research. We also appreciate the participation of students and lecturers of the university.

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Students' difficulties in completing geometry tasks based on spatial ability

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Abstract. Spatial ability is needed to understand spatial objects. But there are still difficulties in understanding spatial objects when completing geometry tasks. The purpose of this research was to describe students' difficulties in completing geometry tasks. This research was a qualitative descriptive study consisted of two stages, namely tests and interviews. The study was conducted at SMPN 1 Ngantang, Kabupaten Malang. The participants consisted of 63 seventh grade students, specifically 39 women and 24 men. This study used a test instrument consisted of two tiers, namely the determination of the truth of a statement and giving reasons for choosing answers. Questions designed based on the components of spatial ability were spatial visualization, spatial orientation, and spatial relations. After completing the questions, several students were interviewed to complete the data. The results showed that 1) there were weaknesses in the ability of students in spatial orientation, 2) students did not recognize the characteristics of triangles, and 3) there were limitations in mastering geometry terms. It can be concluded that there were difficulties in students solving mathematical problems.

Introduction

Mathematics and spatial ability have strong correlations. In learning mathematics, especially in geometry, the spatial ability is needed to recognize geometry objects, find out the relationships between objects, and the shape of objects seen from a different perspective. In material geometry, objects studied include two dimensions and three dimensions and both require spatial ability to understand it [1], [2]. In completing geometry tasks, support is needed for students so that they master in using their spatial intuition [3].

Research related to spatial ability has been carried out, but spatial ability research on two-dimensional objects is still limited. Spatial ability test includes three-dimensional spatial objects such as cubes, blocks, spheres, a combination of two shapes, and other three-dimensional objects [4], [5] and it is presented in the form of two-dimensional images. Most spatial ability

studies use three-dimensional objects because the characteristics of spatial ability are more easily observed in the mastery of three-dimensional objects [6]. However, the three-dimensional concept requires mastery of the concept of two-dimensional objects [1]. Likewise, the two dimensions shape in space also requires spatial ability. This is supported by Hawes et al. (2015), that there is a link between the two dimensions shape with three dimensions shape.

Spatial ability is the ability that underlies someone to think spatially. Spatial ability is used to find out objects in space, use presentation and perform spatial reasoning. Spatial ability refers to one's ability to represent two-dimensional and three-dimensional [4] mentally. Whereas someone who has the spatial ability, when receiving nonlinguistic information, would be able to present, modify, construct and recall symbolically.

Someone who has spatial ability experiences mental processes to recognize, store, remember, improve and communicate spatial imagery based on three factors, namely mental rotation, spatial visualization and spatial perception [6], [7]. Based on these two definitions, the spatial ability is a mental process to recognize, store, remember, improve and communicate spatial shadows in the form of two dimensions and three dimensions. Spatial cognitive skills make a person have the possibility to imagine the mental representation of real-world objects from different perspectives [8]. Spatial ability consists of spatial visualization, spatial orientation and spatial relations [9]. Spatial visualization is the ability to imagine the movement of objects and spatial shapes [8], [10]. Spatial relation is a person's ability to determine the relationship between spatial objects, and spatial orientation is one's ability to see an object seen from a certain perspective [7].

The spatial ability of students at several school levels is in a low category. This can have an impact on his career in the future, especially in the fields of science, technology, engineering, and mathematics [5], [10]. The study shows that the spatial abilities of students in grades 7-9 are in a low category [11].

In learning geometry, two-dimensional and three-dimensional objects were studied. For this reason, through spatial ability, students can communicate spatial objects well even if the object is not in front of them [12]. Communication of spatial information needs to be done so that what is meant by someone will be in accordance with what is understood by others. However, there are difficulties in completing geometrical tasks based on spatial ability [13], [14]. These difficulties are related to solving problems related to spatial tests. Difficulties of students in completing geometry tasks

need to be addressed so that learning practitioners can take steps to master spatial abilities in learning mathematics.

Spatial abilities related to two-dimensional objects need to be owned by students as it is needed to support spatial ability on three-dimensional objects. However, the spatial ability of students is in a low category. Studies need to be done to describe the errors and difficulties in completing the geometry task, as seen from its spatial ability. This research can be used as material to improve geometry learning strategies in the classroom. The purpose of this study was to describe student's errors and student's difficulties in completing geometry tasks based on their spatial ability.

Method

This research was a qualitative descriptive study. This type of research is used to describe the phenomenon of an event [8]; in this case, the students' errors and difficulties in completing geometrical tasks. The study was conducted on grade VII students in junior high schools in Kabupaten Malang. Participants aged between 12 and 14 years consisting of 63 students (39 females, 24 males). In this study, participants have studied the triangle, which consists of the types of triangles and the area and circumference of a triangle. Data collected in this study consisted of student's responses to items on geometry tasks and interview results. Tasks were given to participants and completed within a maximum of 80 minutes. The test instrument was developed by researchers.

The instrument was developed by researchers through the following stages:

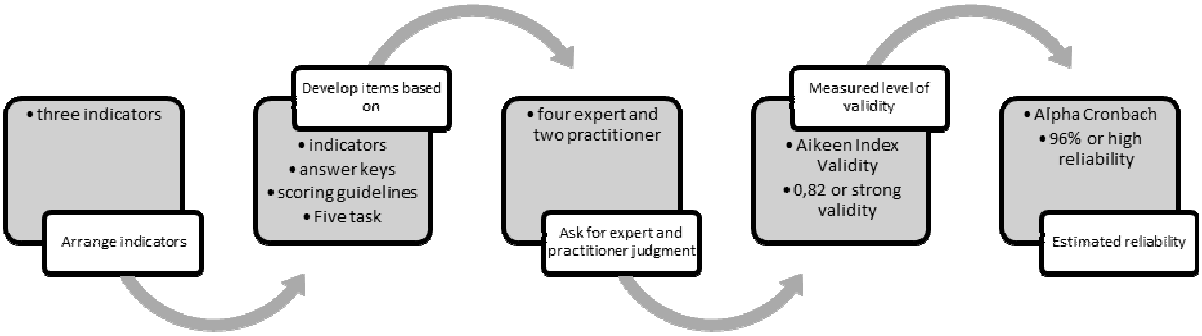


FIGURE 1. Instrument Development Flow

The instrument used was the task of geometry. Figure 1 shows the instrument development flow. Based on the assessment of two experts, the geometry task is a valid and reliable instrument. The validity of the

instrument is shown from the assessment on the construction of tasks, language, and compliance with indicators of spatial ability that is 0.86 with a high validity category. Reliability is shown from the level of reliability, which is 87% with a very reliable category.

Five geometry tasks, namely 1) knowing the length of the sides forming the triangle, 2) recognizing the type of triangle through the image, 3) knowing the relation between the triangle and the rectangle, 4) determining the type of triangle through the length of the two sides 5) knowing the relation between the triangles. Of the five task items, student's responses focused on the characteristics of triangles and the relation of triangles with other objects. The component of spatial ability observed was seen from a written representation that states the reasons why they agree or disagree with the statement given. Figure 2 is an example of a mathematical assignment regarding two congruent triangles. The geometry tasks asked students to determine whether the statements that the two triangles are incongruent are true or false. After giving answers, students wrote the reasons for determining the truth of their statements. When viewed from the component of spatial ability, the task in Fig. 2 dominantly contains the components of spatial relations and spatial orientation. Spatial relation appears in determining the relationship between two triangles, while spatial orientation appears in the position of the two triangles viewed from a certain point of view.

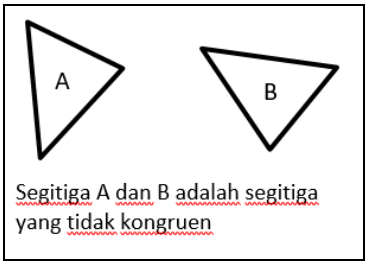


FIGURE 2. Example Statements on Geometrical Task

On each task item, students were asked to determine whether the statements provided were true or false statements by giving a checkmark in the column provided. Then students were asked to write the reasons why determining the choice of these answers. Students who made an error were interviewed to complete information on the type of difficulty. Data analysis steps were: 1) coding the student responses; 2) identified the error and difficulties; 3) the errors were grouped according to the type of error and the types of difficulties; 4) described what the difficulties for students were.

Result and Discussion

In the task of triangular characteristics, spatial visualization is needed when determining whether a triangle can be constructed from edges that have a certain size. Students would imagine the position of the three edges of a certain size, then imagine the shape of a triangle that is formed while the spatial relation appears in the relation item between the triangle and other objects. By completing the task, students used their ability to relate relationships between objects by mentioning the type of relationship, whereas spatial orientation is required for all tasks. Orientation is needed when students imagine the position of the edges of a triangle.

The results showed that in completing geometry tasks, most students answered incorrectly on the triangle characteristic items. The incorrect answer was on determining the type of triangle with two edges of length. In this statement, most students stated that the triangle, which is known to be two edges long, is 4 cm and 6 cm must be a right triangle. They gave an argument based on the Pythagorean rule that the two-edges were 4 cm and 6 cm. In fact, from the two edges, the triangle formed was not only the right triangle, but the formed triangle can be an isosceles triangle and an arbitrary triangle.

TABLE 1. The Percentage of Students Who Answer Incorrectly on Mathematical Task

Item	Description	False Responses
Triangles characteristic	Determine triangles from the length of three edges	**47%**
	Identify triangular shapes	**14%**
	Determine the type of triangle from the length of two edges	**84%**
The relation between triangles and other objects	The relation between triangle and quadrilateral	**6%**
	The relation between the two triangles	**50%**

Table 1 also shows that the smallest mistake is in the task of determining the relation between triangles and squares. In this assignment, most students know that two congruent right triangles can form rectangles. But when asked to give reasons, some students answered that two congruent right triangles could form a square. Whereas two congruent right triangles don't just form a square, they can form a rectangle and parallelogram.

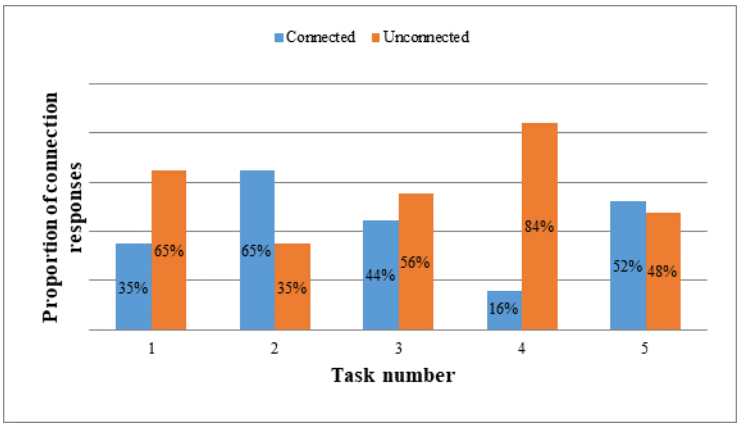


FIGURE 3. Connection Reason in Each Item Number

Figure 3 shows the relationship between the answer and the reason. Connected means that there is a match between the answer and the reason was given, and vice versa. Fig. 3 shows that there is a discrepancy in tasks 1,2 and 4. For example, in task 4 students stated that the statement was true, but the reason given was incorrect. The statement in the question is that a triangle that has 4 cm and 6 cm sides must be a right triangle. Students answered right, but the reason given was just repeating the statement on the assignment. In other words, students could not give reasons for the statements.

The researchers seek error answers on student's worksheets in order to assess difficulties experienced by the students when solving geometry problems. The difficulties related to students' spatial abilities.

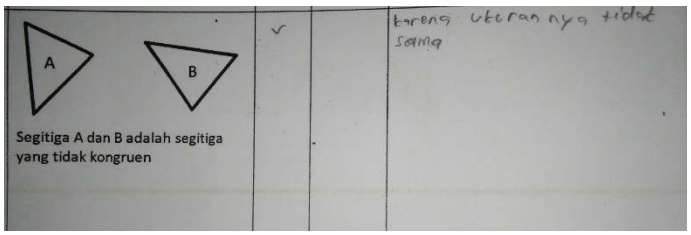
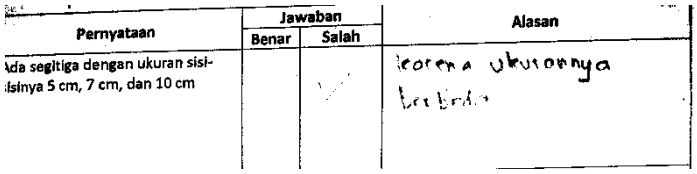


FIGURE 4. Student Work on Relationships between Two Triangles

Figure 4 shows that the student did not know that the two triangles were congruent. The student conveyed that the two triangles were incongruent on the grounds that the size of the edges was not the same. The student did not realize that one of the triangles was a triangle viewed from a different perspective. In this case, students do not use their spatial orientation skills. When confirmed about the reasons stating that the sizes were not the same, students said that "the left edge is not the same size."

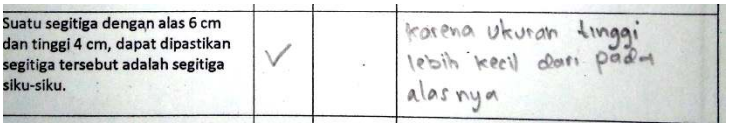


Pernyataan	Jawaban		Alasan
	Benar	Salah	
Ada segitiga dengan ukuran sisi-sisinya 5 cm, 7 cm, dan 10 cm		✓	karena ukurannya berbeda

FIGURE 5. Student Work on Triangles Characteristics

The difficulty of students in recognizing the characteristics of triangles were also observed in this study. Figure 5 shows that a student could determine that triangles can be formed with edges measuring 5 cm, 7 cm and 10 cm. The students gave the reason that because the sizes of the three edges are different, so they could not form triangles. The student stated that a triangle has an edge size with a certain pattern, for example, a right triangle with patterns 3, 4 and 5, an equilateral triangle has the same side size and the two sides of an isosceles triangle have the same size. The student's ability to recognize the characteristics of a triangle is the ability of spatial visualization.

Figure 6 also shows that a student did not recognize the characteristics of a triangle when given information about the size of two edges of a triangle. The student's difficulties can be seen from the reasons written by the student. The reason stated is that the height is smaller than the base, so it must form a right triangle. In this case, the student imagines the position of two edges that are perpendicular. So the third edge connects the other two edges and acts as the hypotenuse. In this condition, the triangle formed could be an isosceles triangle and an arbitrary triangle.



Suatu segitiga dengan alas 6 cm dan tinggi 4 cm, dapat dipastikan segitiga tersebut adalah segitiga siku-siku.	✓		karena ukuran tinggi lebih kecil dari pada alasnya

FIGURE 6. Student Work on Determination of Triangles Formed with a Two-Edges Length Known

The third difficulty is limited mastery of geometrical terms. This is shown in Fig. 6 that there are limitations in mastering the terms associated with the size and relation between two objects. The term "lebih besar" was used by students to show that there was an edge that was larger in size. The term

larger denotes terms related to the area of an object, while the term longer denotes terms for things related to the length of an object.

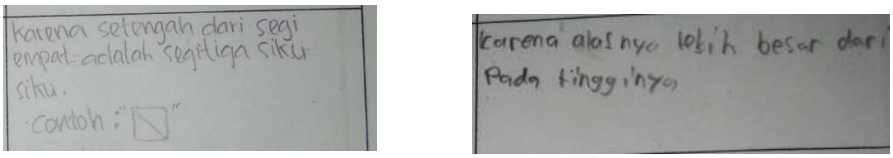


FIGURE 7. Inaccuracy in the Use of Geometry Terms

Figure 6 also shows that the term limitations experienced by students when showing the relationship between two triangles with a rectangle. In that case, students use the term rectangle, but what they mean is square.

Discussion

Spatial ability is needed by students in completing mathematical tasks related to triangles. In this study, students made mistakes on assignments related to the characteristics of a triangle and the relation between two spatial objects. In the task of determining the characteristics of a triangle, it required students' ability in spatial visualization. In this task, students could determine the shape of a triangle through information on the size of three edges. In this case, students imagine the length of the edges according to the problem and decide whether they form a triangle or not. Students who have difficulty in spatial visualization cannot imagine the length of an edge, and only on the condition that a triangle consists of three edges, students stated three edges could form a triangle or not. Another difficulty experienced by students was related to spatial visualization was recognizing the characteristics of triangles. In this case, students only focused on the statement that a triangle consists of three edges, other conditions such as the angle and position of the edges were not considered. This is in accordance with what was done by Hawes et al. and Mix et al. that in completing mathematical tasks, students dominantly use spatial visualization skills [1, 9].

Another difficulty that arises is the mastery of the term geometry. Students can state the truth of a mathematical statement, but when asked to write the reason, most had difficulties due to the limitations of geometry terms. The inaccuracy of the terms that appear is related to the edge size comparison and considers the same terms as rectangles with squares. The accuracy of the terms is very necessary for learning mathematics [2], [7] . The use of appropriate geometry terms is needed in spatial representation

[10]. Through the right terms, one can communicate what is in his imagination to others appropriately.

The difficulty of students in completing geometry tasks is the weakness in imagining an object seen from a current perspective. This was apparent when students did not know that the two triangles A and B were the same two triangles, looking different because the position of triangle B is the rotation of triangle A. In this case, students have difficulty in spatial orientation. Students' difficulties in completing spatial ability tasks are in accordance with research, which states that students have difficulty in determining the position of an object and difficulty in reasoning spatial relations [10].

Summary

The results showed students' errors in completing the geometry task. The error found was that the students could not: determine triangles by looking at the length of three edges, identify triangular shapes, could not relate between a triangle and a quadrilateral, and could not relate between two triangles. The difficulties were that the student did not have an ability in spatial orientation, students did not recognize the characteristics of triangles, and limited mastery of geometric terms. Therefore, it can be concluded that the student's difficulties were in solving geometry problems. Previous research on spatial ability tests was conducted on three-dimensional objects, whereas in this study, the spatial ability task was on two-dimensional objects. Based on this research, it can be said that spatial ability is important for understanding two-dimensional objects. Research recommends spatial training to improve spatial ability

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Developing ethnomathematics-based mathematics learning module on quadrilateral material for class 8 junior high school students

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Abstract. This study aimed to develop and determine the advisability of modules based on ethnomathematics on Quadrilateral material for class 7 junior high school students. The development model referred to the Plomp development model, which consisted of 3 phases: preliminary research, prototyping phase, and assessment phase. The research results showed that the module was declared valid with a module validity score of 3.86, a validity score of RPP (lesson plan) of 3.87, a validity score of the student response questionnaire of 3.57, and a validity score of the test questions of 3.74. The module also met practical criteria based on the results of the student questionnaire response resulting in an overall percentage score of 89.8%. The developed module also met the effective criteria; namely, 87.5% of students got scores above minimum studying mastery (KKM). Thus, the developed module is feasible because it meets valid, practical, and effective criteria.

Introduction

The curriculum is a set of plans and arrangements regarding the purpose, content and material of the lesson and the methods used as guidelines for the implementation of learning activities to achieve certain educational goals [1]. The current curriculum in Indonesia is the 2013 curriculum, which is based on competency (*competency-based*) with constructivist learning [2]. Furthermore, Akbar also stated that the implementation of a *competency-based* curriculum is largely determined by the ability of educators to develop learning tools, one of which is teaching materials.

In this 2013 curriculum the government prints teaching materials, namely textbooks in the form of student's books and teacher's books as a complete set of teachers in learning, in accordance with the Republic of Indonesia Minister of Education and Culture Regulation Number 71 of 2013 concerning Textbooks and Teacher's Handbook for Primary and Secondary Education. However, these teaching materials cannot be utilized optimally. Based on an interview with Ms. Lilis, a grade 7 mathematics teacher at SMPN 2 Malang, it was found that teaching students with the existing student books had not

given optimal results because students' books were difficult to understand by students in understanding material concepts.

Mathematics learning at SMPN 2 Malang was also still using the lecture method and exercises. This contrasted with the 2013 curriculum, which was developed with several improvements in mindset, including student-centered learning patterns, interactive learning, and active learning to search (Appendix of Minister of Education and Culture Regulation No. 68 of 2013 concerning Basic Framework and Structure of Junior High School Curriculum).

Based on the description of the problem above, the existence of teaching materials in the form of student's books still made students not understand because it was difficult to find material concepts and mathematics learning. It did not make students much construct knowledge and there was no module as teaching materials at SMP 2 Malang, so researchers developed teaching materials in the form of a module. Devesh & Nasseri [3] said there are many students saying that they are easier, more interested in learning mathematics because they use modules and the use of mathematical modules is very effective in learning. Depdiknas [4] reveals that modules are teaching materials that are arranged in a systematic and interesting manner that includes the content of materials, methods, and evaluations that can be used independently.

In 2013 curriculum, there is an achievement of KI 3: "understanding knowledge (factual, conceptual, and procedural) based on the curiosity about science, technology, art, culture related to phenomena and occurrences of visible eyes". In the curriculum it is clear that cultural elements need to be emphasized so that students can better understand the contents of mathematics. However, in learning mathematics, cultural element has not become a part of the emphasized content. This can be seen from student's books that still lack of showing examples of real applications of mathematics in daily life, one of which has not yet been linked to existing and developing cultures in society.

One that can bridge culture and education is ethnomathematics. Zhang & Zhang [5] stated that ethnomathematics is defined as a research that connects education and culture. According to Wahyuni [6] through the application of ethnomathematics in education, especially mathematics education, it is hoped that later students can understand mathematics better, and understand their culture better, and later educators are easier to instill cultural values in students, so that cultural values that are parts of character of the nation are embedded early in students.

According to Biber [7] geometry can be used to solve problems related to other branches of mathematics, solve problems in everyday life, and can be used in disciplines other than mathematics. In relation to other branches of mathematics, geometry representation helps students to understand area and fractions, histograms, *scatter plots* for data representation, and coordinate graphs that make students easier to associate algebra and geometry [8]. One of the geometry concepts learned at school is Quadrilateral. Based on interviews to students of SMPN 2 Malang, many students considered geometry as a difficult material and as a material that memorized many properties and formulas as in Quadrilateral. Quadrilateral material is a basic concept or prerequisite material for polyhedron material in class VIII or further education. Cooper & Hanmer [9] explained the function of the module, one of which is that it can make students understand the concepts that must be investigated and analyzed. Thus, the development of ethnomathematics-based modules on Quadrilateral material is expected to facilitate students in learning such as being able to activate and facilitate students in understanding material concepts and minimizing the difficulties being faced.

Based on the explanation above, it is important to develop an ethnomathematics-based mathematics learning module for class VII junior high school students on Quadrilateral material.

Method

This research was development research. The development model used was the development of ethnomathematics-based module namely Plomp development model [10]. Rochmad [11] stated that each step in Plomp model contains development activities that can be adapted to the characteristics of the research so that Plomp model is more flexible. This development model consists of three phases, namely preliminary research, prototyping phase (development stage), and assessment phase.

In this research, the phase of preliminary research (initial research) was the phase of analyzing needs and contexts, reviewing literature, developing conceptual and theoretical frameworks for research. The researcher conducted interviews and discussions with the teacher who taught mathematics and seventh grade students at SMPN 2 Malang. In addition, the researchers also identified learning problem, analyzed teaching materials used so far, namely student's books, analyzed curriculum, examined student's characteristics, identified learning material, conducted theoretical studies on module development and good module quality.

In prototyping phase (development stage) a solution design of the problem at preliminary phase was carried out in the form of product development. The products produced were ethnomathematics-based module on Quadrilateral, lesson plans, and research instruments which included: validation sheets, questionnaires, and final test questions. The module was arranged based on the results of literature review from the preliminary research phase. The module was used to make students easier to understand the material learned through activities carried out to build their own knowledge.

In the assessment phase, a quality assessment (validation) on the prototype (Module, lesson plan, and research instrument) was carried out. The prototype had to meet the criteria of validity, practicality, and effectiveness. Validity was that the developed product was said to be valid if it was based on material or science, and all components had to be arranged consistently and connected to each other. Validity criteria were seen from the acquisition of the average score of the overall results of the validation test which was three or more than three. The practicality was that the products developed in real terms could be applied in the field. Practical criteria were seen from the acquisition of the percentage of the overall score of the student response questionnaire which was more than 60.00%. Effectiveness was that by using the developed product, the increased results, namely supporting student learning activities, would be obtained. In this study, the evidence that the module could support student learning was indicated by 80% subjects or more tried to obtain score above minimum studying mastery (KKM) namely 75.

Besides, at the assessment phase, validation and field trials on a module, lesson plans, and research instruments were carried out. Validation was done after the module, lesson plans, and research instruments were arranged by the validator. Then, an analysis on the validation results was carried out. The analysis was conducted to determine the validity of the module, lesson plans, and research instruments. If the results obtained were not valid, then revisions were made until a valid product was obtained. After the module, lesson plans, and research instruments were valid and had been revised, they were ready to be used for the field trial, which was used in classroom learning. The trial was conducted to assess the practicality and effectiveness of the developed module.

This research was conducted at SMPN 2 Malang with the subjects of trial were 24 students of class VII F of SMPN 2 Malang, who had not studied Quadrilateral material. This class had heterogeneous student abilities. Data obtained from trial were qualitative data obtained from the validation results

in the form of suggestions and comments/ improvements provided by the expert validator and practitioner validator on the validation sheet, suggestions and comments provided by students on student response questionnaires. Quantitative data were in the form of assessment scores provided by expert validators and practitioner validators on the validation sheet, scores on student response questionnaires, and student scores in the learning outcomes test. Quantitative data were analyzed based on quantitative data analysis techniques adapted from Hobri [12] and Akbar [2].

Results

The data of validity test were obtained from the validation result of one mathematics lecturer as an expert validator and one mathematics teacher of class VII SMPN 2 Malang as a practitioner validator. The sheet to be validated consisted of LKS (worksheet) validation sheet, lesson plan validation sheet, test question validation sheet, and student response questionnaire validation sheet. The data obtained consisted of quantitative data and qualitative data. Quantitative data were in the form of assessment scores on each indicator and qualitative data were in the form of comments/improvements from the validator.

The development product was in the form of an ethnomathematics-based module on Quadrilateral with a lesson plan as a complementary module that had been tested for validity, practicality, and effectiveness. The module was declared valid with a validity score of 3.86 from the validation sheet that had been filled in by the validator. The data of module validation that has been developed is presented in Table 1.1.

TABLE 1.1 Data of Module validation results

No.	Indicator	Validator Rating		I_i
		1	2	
1.	**Format**			
	a. Completeness of module identity (containing title, introduction, table of contents, module usage instructions, learning activities).	4	4	4
	b. Systematic arrangement of modules.	4	4	4
Number of indicators = 2		$A(i)$		4
2.	**Content of Module**			
	a. Clarity of Basic Competencies and Indicators of Competence Achievement.	4	4	4
	b. Ease of understanding module usage instructions.	4	4	4
	c. Ease of understanding instructions (questions/commands).	4	3	3.5
	d. Suitability of Instruction (questions/commands) that allow students to draw conclusions.	3	4	3.5
	e. Suitability of the activity arrangement in module in guiding students to be actively involved in learning process.	4	4	4
	f. Suitability of the activity arrangement in the module in guiding and directing students to find material concepts and understand concepts.	4	4	4
	g. Suitability of activities in module with the time provided.	4	3	3.5
Number of indicators = 7		$A(i)$		3.79
3.	**Ethnomathematics-based Guided Discovery Activities**			
	a. Suitability of activities in module that allows students to associate the phenomenon of East Javanese culture with Quadrilateral material.	3	4	3.5
	b. Suitability of activities in module that allows students to conduct experiments.	4	4	4
	c. Suitability of activities in module that allows students to make observations and data collection.	4	4	4
	d. Suitability of activities in module that allows students to do data analysis.	4	4	4
	e. Suitability of activities in module that allows students to make conclusions.	3	4	3.5
Number of indicators = 5		$A(i)$		3.8
4.	**Language, Writing, and Display**			
	a. Ease of understanding sentences used.	4	4	4
	b. Clarity of language used so that it does not cause double meaning.	3	4	3.5
	c. Ease of understanding symbols or terms used.	4	4	4
	d. Module is accompanied by illustrations, tables, diagrams, or images relating to the material being studied.	4	4	4
	e. The appearance of colors, size, letters, and images used is interesting, clearly legible, so that it is easy for students to understand.	4	4	4
Number of indicators = 5		$A(i)$		3.9
5.	**Benefits of Module**			
	a. Module can be used as a guide or guidance for students in learning.	4	4	4
	b. Module can encourage students to be active and more independent in learning.	4	4	4
	c. Module can facilitate teachers and students in learning activities.	4	3	3.5
Number of indicators = 3		$A(i)$		3.83
Number of aspects = 4		$V(r)$		3.86

Information

$I(i)$: average score of all validators for the i indicator
$A(i)$: average score of the i aspect
$V(r)$: total average score

The result of data analysis indicated that the module developed had met valid criteria with module revisions for improvement and completeness of the products produced. The module revision was based on suggestions and comments provided by the validator of developed product. The following is a revised example in finding the concept of polygon. Not Polygon in Fig. 1. 1 in module can make multiple interpretations. Therefore, it needs to be replaced as in Fig. 1.2 so that students are easier to understand.

The image of batik Tuban is not polygon Because there are three adjacent points that because it is concave (there are line are laid in one line segments out of the area)

FIGURE 1.1 Example Not Polygon before revision

FIGURE 1.2 Example Not Polygon after revision

This ethnomathematics-based module product received comments from the practitioner, namely the teacher of SMPN 2 Malang stating that the developed module was good, and the pictures of East Java culture could be an attraction for students to learn. In learning mathematics that was associated with culture, even though the students just knew the East Java culture, they became interested and eager to learn mathematics. This is similar to the opinion of [13] who argue that the culture included in mathematics learning will create learning to be meaningful and can improve the cognitive domain of students.

Figure 1.3 and Figure 1.4 below are examples of displays on ethnomathematics-based modules on Quadrilateral material for class VII Junior High School in finding concepts.

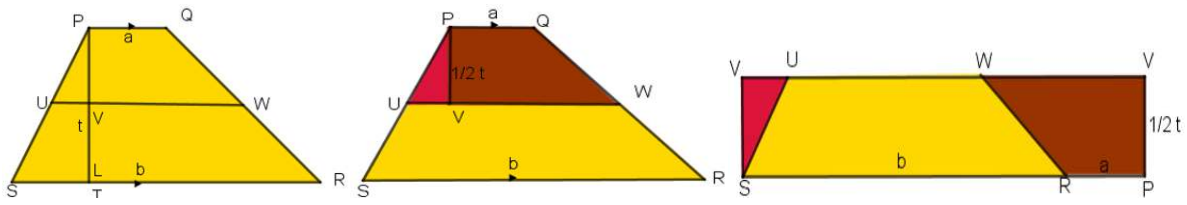
Now you know the shapes whose surfaces are in the shape of polygon. Thus, polygon or many facets are closed curves consisting of straight and convex lines. After knowing what polygon is, the next activity is to find out the meaning of the Quadrilateral, namely by answering the following question.

Pay attention on the following images of Quadrilateral batik-shaped.

Batik Sidoarjo *Batik Madura* *Batik Mojokerto*

1. *Is Quadrilateral a polygon?*
2. *How many sides does a Quadrilateral have?*
3. *Based on the above question, what can you conclude about Quadrilateral?*

FIGURE 1.3 Module in the section of Finding the definition of Polygon and Quadrilateral



Step 1	Step 2	Step 3
Look at PQRS trapezoid image. Drag the perpendicular line from point P to T. Divide PT line into two equal lengths. Drag the parallel line to PQ that passes through V.	Obtained PV=½t	Move PUV triangle and PQWV parallelogram so that VSPV' rectangle is formed. SP = SR + RP = b + a PV=½t

FIGURE 1.4 Module in the Section of Finding the Concept of Trapezoidal Area Formulas

Practicality test analysis was obtained based on student response questionnaire sheet. The following is an analysis of the data from the student response questionnaire. The quantitative data is obtained as follows.

$$P = TS\square e\square\square TS\square h\square\square \times 100\% = 949\square 1056\square \times 100\% = 89{,}8\%$$

Based on the practicality criteria, the module was included in the very practical criteria.

The percentage of studying mastery from all students as a trial was calculated using the following formula,

$$\text{Percentage} = \frac{\text{Number of subjects achieving studying mastery}}{\text{Number of sub trial}} \textbf{ x } 100\%$$

Based on (1), the result of the effectiveness trial that had been done, the percentage obtained was $21\square 24\square \times 100\% = 87{,}5\%$. Therefore, the module that had been developed could be said to be effective for class VII junior high school students of the 24 trial samples, three students got score under minimum studying mastery (KKM) or below 75.

Ethnomathematics-based module product that was developed by linking mathematics and culture was declared effective. This is in accordance with Lev Vygotsky's constructivist theory which states that the role of society and culture can develop children's mental functions so that learning outcomes can be increased as stated by Ormrod [14]. Irawan [15] stated that learning done based on culture in the classroom will be more meaningful for students so that they can improve students' abilities in learning from various aspects ranging from cognitive, affective and psychomotor. It can be concluded that ethnomathematics product-based module teaching materials that are developed effectively can improve student learning outcomes.

Discussion

The results of data analysis obtained from validity tests, practicality tests, and effectiveness tests showed that the developed module met valid, practical and effective criteria. Thus, the module was feasible to be used for VII grade students of junior high school in mathematics learning, especially in circumferential and area of Quadrilateral material. The ethnomathematics-based developed module could transform learning into student-centered and could enable students to discover concepts and introduce East Java culture. In learning using developed module, students were directly involved in the discovery of a concept. Students did not only memorize the material. The

module discussed 6 regular Quadrilateral shapes consisting of rectangles, squares, parallelograms, rhombus, kites and trapezoidal. Each sub-section of plane material had activities to identify traits and two problems related to ethnomathematics in finding area concepts and circumference of Quadrilateral. The use of ethnomathematics, in accordance with the diversity of student culture and with the practice of mathematics in their daily lives, brings mathematics close to the student environment [16].

The developed module had advantages and disadvantages. The advantages of the developed module were (a) module in accordance with the 2013 curriculum, could be applied in learning Quadrilateral material in class VII of SMPN 2 Malang, and effectively solve classroom learning problems, (b) activities carried out and problems solved by the students in module opened the opportunity for students to be able to construct their own knowledge so as to provide a good understanding of the material, and students were able to associate the material being studied with the East Java culture. It was because the developed module was based on ethnomathematics, which guided students to be able to find concepts by linking East Java culture to Quadrilateral material. It is in line with Massarwe, Verner, & Bshouty [17] concluding that understanding of geometry of students increases and they understand the importance of ethnomathematics learning activities related to culture, (c) module can increase knowledge about regional cultures in Indonesia so they can enhance the student nationalism spirit. In line with it, Irawan & Kencanawaty [18] stated that the application of ethnomathematics-based mathematics learning could make students become more enthusiastic in learning and foster a character of love in local culture so that students can become more familiar with, preserve and be able to connect culture with mathematics in accordance with the learning material of plane, (d) the developed module can encourage students to play an active role in the learning process and build communication among students to solve the contextual problems presented, and (e) the module is equipped with interesting images and colors, so students are more interested in learning. In addition to the advantages mentioned above, the module also had disadvantages, namely (a) the module only focused on Quadrilateral material for seventh-grade junior high school students, (b) the module was limited to East Java culture related to plane, (c) the module had a less obvious use of language in the introduction of Quadrilateral using East Java batik so that it created a double meaning, and (d) the module had properties using measurements, so that it was necessary to find the properties

abstraction so that without measuring, students could find the Quadrilateral properties.

Conclusion

Based on the validity test, the module is declared valid based on the validity score of the module, which is 3.86 with valid criteria. The practicality test using the student response questionnaire is declared practical with a module practicality score of 89.8%. While the effectiveness test is declared effective based on the result of the student test, which shows 87.5% of students get a score above 75 (KKM). Thus, developing an ethnomathematics-based mathematics learning module on Quadrilateral material for VII grade students is declared valid, practical, and effective.

The ethnomathematics-based module is expected to be used as an alternative to Quadrilateral material learning for seventh-grade junior high school students in the even semester and can be used as an example or consideration by junior high school teachers in developing modules.

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Innovation of an integrated timer learning media to support inquiry-based physical learning in kinematics competence for senior high school

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Abstract. Physics learning for kinematics sub-competence in high schools is expected to use a scientific approach by means of inquiry-based learning models. In order to implement the scientific approach for learning kinematics, we need an integrated good-quality ticker timer in such a way that students are able to observe straight-line motion phenomena. In this study, we have developed an integrated ticker timer with the following characteristics: valid, efficient, easy, safe, high durability, and visually eye-catching. As the results, compared to commercial ticker timer, our integrated ticker timer have the same frequency with better temperance and 2.30% margin of errors. In addition, our developed ticker time only requires a relatively small electrical power. Furthermore, the integrated ticker timer as an innovative learning medium can improve better performance in physics teaching and learning process, with these characteristics: (1) Fast to obtain measurement data, precise and accurate; (2) easy to use, safe, and high durability; (3) able to help and motivate teachers and students to learn kinematics.

Introduction

Integrated circuit (abbreviated as IC) is a basic component comprises of resistors, transistors and others in one single chip. The IC was first discovered by Jack Kilby and Robert Noyce who worked at Texas Instruments and Fairchild Semiconductor Corporation, The main objective of the IC discovery was to improve the performance of the discrete circuits of the previous transistors. The combination of several transistors on a semiconductor chip called chip is expected to be(a) more stable, compact and reliable because it only requires very few and uncomplicated interconnection connections, (b) able to perform more complex and complicated functions, (c) smaller and lighter. The IC is still being developed to improve its performance [5]. Therefore, the development of simpler and easier instruments is obviously important, as well as the development of integrated ticker timer for physics teaching and learning needs.

Nowadays, physics learning media available in the school or university laboratories, in general, are still separately in installation in which are not yet compact, specific and proportionate so that they have poor performance. The impact of learning media with poor performance forces teachers to be relatively unpleasant and reluctant to use the media during their teaching time. Teachers did not facilitate students to find knowledge through their own experiences, and therefore they did not carry out inquiry-based learning. In other words, using media that has integrated supporters is expected to have better performance.

Theoretically, inquiry-based learning is one of the learning models developed for the purpose of teaching students how to think and to discover knowledge from their own experiences. Student-centered inquiry-based learning shows significantly better learning achievement compared to teacher-centered classes [1][8]. The results showed that inquiry learning could improve scientific mastery, productivity in creative thinking, and drill students skills in analyzing information and solving problems [4]. Previous research has shown that the application of innovative models, such as inquiry-based learning in physics learning, has proven to be effective in developing students' mastery concepts and problem-solving strategies [3]. The main role of the teachers when carrying out inquiry-based learning is to facilitate students to be able to engage in the process of inquiry and the thought process is always attentive and reflective to find their own knowledge.

The facilities needed by students to be able to find the knowledge of particularly kinematics competencies are easy to use instruments. Hence, we developed an integrated ticker timer as a good learning medium. Students can learn kinematics through measurement by watching videos on Youtube and accessing quality free videos [7]. The learning media for wireless force sensors and accelerometers are very well used for demonstrations in preliminary physics programs [10]. Good media quality is valid (relevance and consistency), i.e. relevance (content validity) is a media validity criterion based on need (need) and sophisticated (state-of-the-art). Consistency (construct validity) is a media validity criterion which states that logically designed media, according to the expert, includes the shape, size and specification [2][6].

Method

The integrated ticker timer is determined through laboratory activities as follows:

1. Measurement of input and output power of the ticker timer

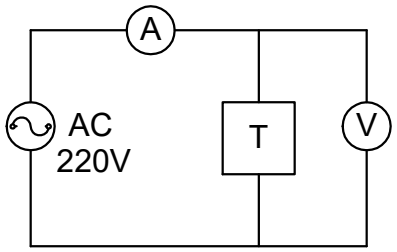


Figure 1. Input Power Measurement (Sutrisno, 1986)

Note:
Ampermeter AC (A) 100A
Voltmeter AC (V) 220V
Ticker-timer (T)

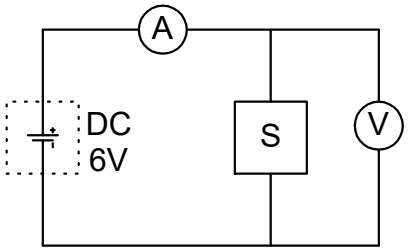


Figure 2. Output Power measurement

Note:
Ampermeter DC (A) 500 mA
Voltmeter DC (V) 12 V
SpolTickertimer (S)

The measurement of input power is arranged, as shown in Figure 1, when the ticker timer is switched on the voltage and the currents are measured. This activity is repeated 10 times and data are recorded in Table 1. The measurement of output power is arranged as in Figure 2, when the ticker timer operates, the voltage and the currents are measured. This activity is repeated 10 times and data are recorded in Table 2.

2. Measurement of Frequency and Reliability of the Integrated Ticker Timer

The measurement and frequency of the ticker timer are arranged, as shown in Figure 3. Turn on the ticker timer then run the motorized train while the gliding time is measured. Record the glide time (t) and length of the train glide (L). The frequency and the severity can be determined based on the track beats on the resulting tape.

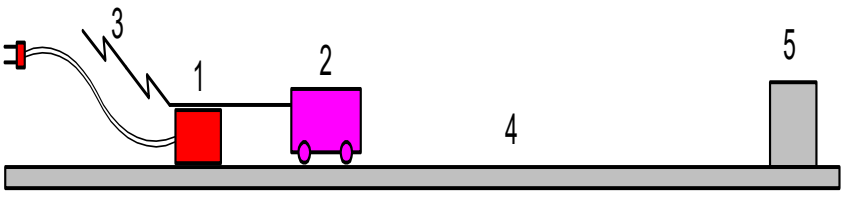


Figure 3. Frequency and Reliability Measurement

Note:
1. Tickertimer, 3. Tickertimer Tape, 5. Barrier
2. Motorized Train, 4. Slides/tables, 6. Stopwatch

Results

1. Specifications of the Integrated Ticker Timer

a. Input Power and Output Power

Table 1. Input Power Measurement

No.	I (mA)	V (V)	Pi (W)	DPi
1	48	221	10.61	0.09
2	48	221	10.61	0.09
3	48	221	10.61	0.09
4	48	221	10.61	0.09
5	47	221	10.39	0.13
6	47	221	10.39	0.13
7	48	221	10.61	0.09
8	48	221	10.61	0.09
9	47	221	10.39	0.13
10	47	221	10.39	0.13
PiR			10.52	0.11
TPi(%)				1.01

Table 2. Output Power Measurement

No.	I (mA)	V (V)	P_o (W)	DP_o
1	1333	5.54	7.38	0.04
2	1351	5.61	7.58	0.23
3	1313	5.54	7.27	0.07
4	1317	5.49	7.23	0.11
5	1340	5.39	7.22	0.12
6	1318	5.51	7.26	0.08
7	1387	5.38	7.46	0.12
8	1336	5.37	7.17	0.17
9	1362	5.52	7.52	0.17
10	1331	5.51	7.33	0.01
P_oR			7.34	0.11
TP_o(%)				1.55

The measurement results of Input Power (Pi) with 10 repetitions we re obtained as Pi = (10.52 W ± 1.01%). The measurement results of Input Power (Po) with 10 repetitions we re obtained as Po = (7,34 W ± 1,55%)

b. Frequency and Reliability

Table 3. Frequency Measurement

No	**t (dt)**	**L (cm)**	**N (10 cm)**	**N (Total)**	**F (Hz)**	**DF**
1	2.98	87.1	17	148.07	49.7	0.67
2	3.20	89.2	18	160.56	50.2	1.15
3	3.25	88.3	18	158.94	48.9	0.12
4	3.15	87.6	17	148.92	47.3	1.75
5	2.90	83.7	17	142.29	49.1	0.04
FR					49.02	0.75
TF(%)						1.52

The results of frequency measurement (F) with 5 repetitions we are obtained as F = (49.02 Hz ± 1.52%).

Table 4. Reliability Measurement

No	K (10 cm)	DK
1	17	0.71
2	18	0.29
3	17	0.71
4	18	0.29
5	18	0.29
6	18	0.29
7	18	0.29
KR	17,71	0.41
TK(%)		2.30

The results of reliability (K) with 7 repetitions for 10 cm of tape length are obtained as K = (17,71 ± 2.30%).

2. Size and Shape of the Integrated Ticker Timer

a. Integrated Ticker Timer Schema

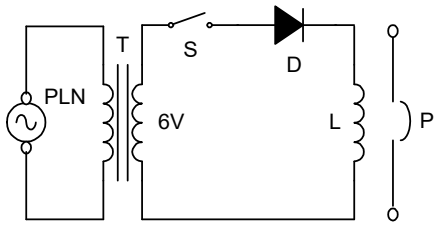


Figure 4. Integrated Ticker Timer Schema

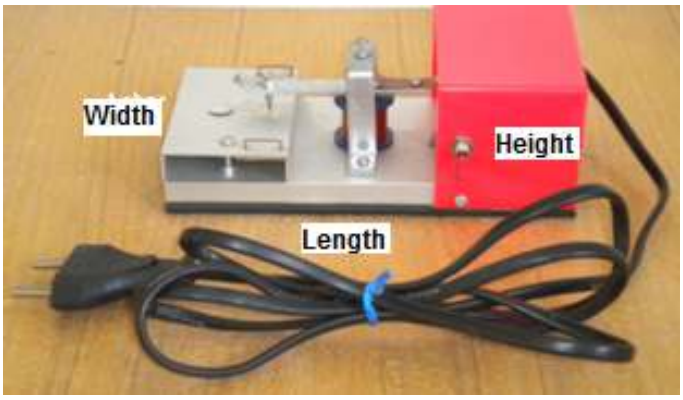
PLN : Ticker Timer power source from PLN 220V
T : Transformator Step down with output 6 V, 1A
S : Switch on/off
D ; Diode 3 A
L : Inductor
P : Knock plate/vibrator

b. The Working Principle of the Integrated Ticker Timer

The voltage of 220V by the Transformer(T) is reduced to 6V, the electric current flows in the diode circuit and the coil is determined by the position of the On/Off (S) switch. AC electricity with a voltage of 6V is directed by a

half-wave rectifier by a diode (D) without a leveler in such a way that there is still a ripple strong enough to produce a changing magnetic field in the coil (L). The changing magnetic field pulls and releases the knocker plate (P) to produce a knock. The knock is fed to carbon and paper to record a trace of motion.

c. The Shape and Size of the Integrated Ticker Timer



Note:
Length : 19 cm
Width : 7.5 cm
Height : 5.5 cm

Figure 4. Integrated Ticker Timer Schema

Discussion

The integrated ticker timer requires input power Pi = 10.52 W and output power Po = 7.34 W, which is much smaller than the power provided by the 10 A × 6 Volt power supply = 60 W for the common ticker timer. The integrated ticker timer requires a low power source to activate the device. Therefore, the operation of the integrated ticker timer is much simpler and easier than the use of commercial ticker timers in general, economically saving operation and procurement costs. Teachers and students will be happy to operate this integrated ticker timer because they just need to plug the jack into the socket and press the on/off button without being burdened with assembling with other devices, which often causes difficulties. Using the Integrated Ticker Timer can get data quickly, help and motivate teachers and students to use it.

The integrated ticker timer has a frequency F = 49.02 Hz, which is the same as the commercial ticker timer used in the laboratory but has better clarity/reliability because its tolerance is only 2.30% less than 5% tolerance of electronic devices in general. Simply put, this device can be used with high accuracy so that it can obtain precise and accurate data. The integrated ticker timer has a much smaller dimension (19 × 7.5 × 5.5) cm^3, which is much smaller than the ticker timer volume and power supply in general so

that it can save storage. During the study, there was no damage and heat found on the device, this device was equipped with a voltage safety cap so that it did not endanger the user, so this device was durable and safe to use.

Conclusions

The integrated ticker timer has been successfully developed with valid, efficient, easy, safe, high as durability and visually good characteristics. The results of the integrated ticker timer show that it has the same count as the commercial timer ticker commonly used in the laboratory but has better clarity/readability with an error of 2.30%. Thi integrated ticker timer innovation development can improve good performance in physics learning to obtain these following characteristics: (1) Fast to obtain measurement data, precise and accurate; (2) easy to use, safe, and high durability; (3) able to help and motivate teachers and students to learn kinematics.

Acknowledgments

This research has been supported by the grant from PNBP Universitas Negeri Malang.

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Android-based mobile learning media: strategies to improve botanical literacy skills

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Abstract. Student's botanical literacy skills are often excluded and less empowered in the learning. The aim of the research was to develop a valid, practical and effective android-based mobile learning media for plant cell material to improve botanical literacy skill. This research was using Lee and Owens development research model. The data for this research was collected from validity test, practicality test and effectiveness test. Subjects for validation test were material experts, media experts and field practitioners while the practicality and effectiveness test subjects were 170 biology students from 2018/2019 academic year attending Plant Structure Development course. The research began in February to July 2019. Validation test was conducted by giving the test subjects a validation questionnaire. Practicality test was conducted by giving practicality questionaire while effectiveness test was conducted by giving pretest and posttest to the subjects. The result of validity test, after several revisions, showed the amount of 90% for the media validation and 100% for the material validation. The results of the practicality test showed the amount of 96.5%, while the effectiveness of media showed the amount of n-gain score of 0,7 which mean the media was in medium category.

Introduction

Plants have an important role in life on earth but are less concerned; this phenomenon is called botany illiterate and is one of the important problems in biology education [1]. In order to be able to study botany deeply and entirely, it is necessary to begin studying cellular biology to understand the smallest unit in an organism. Cell material is an important concept for managing available information effectively and making better decisions in daily life for preventing and treating disease, nutrition, and reproduction issues [2]. Considering cell material is an abstract concept, biology students need to be provided a meaningful learning experience to improve botanical literacy skills. Botanical literacy skills are part of biological literacy, which has been defined in many different ways. The biological literacy scale has

four levels of literacy, namely nominal, functional, conceptual and multidimensional. Learning in higher education emphasizes vocabulary training, focuses on definition, labeling, and recognizing the correct answer. Students with high memory capability will be great, while their thinking, analysis, and evaluation skills have not yet been empowered. Therefore student's botanical literacy skills cannot achieve the functional level [3]. The observations of students attending Plant Structure and Development (PSD) course using the botanical literacy skills test generally showed a low literacy level, namely the nominal level.

Mobile learning (m-learning) is generally defined as e-learning using mobile devices such as smartphone (android and iPhone), laptops, and tablet PCs that allow students to obtain learning material anywhere and anytime [4,5]. Android is an operating system technology that has been widely used by students in daily life, so it is important for educators to catch up with the development of technology in learning. Thus, the development of mobile technology through Android-based mobile learning is necessarily needed. Multimedia can be developed in through several aspect such as animation, images and videos as a part of meaningful learning strategies. The concept of meaningful learning is often contrasted with rote learning, which can be found in the cognitive structure process. Meaningful learning occurs when the information that will be learned by students is arranged by student according to their cognitive structure so that students can associate new information with their previous knowledge, while in the rote learning, cognitive structures that are in accordance with the new phenomena do not exist yet and the new information is given directly and must be learned through memorization [6-9].

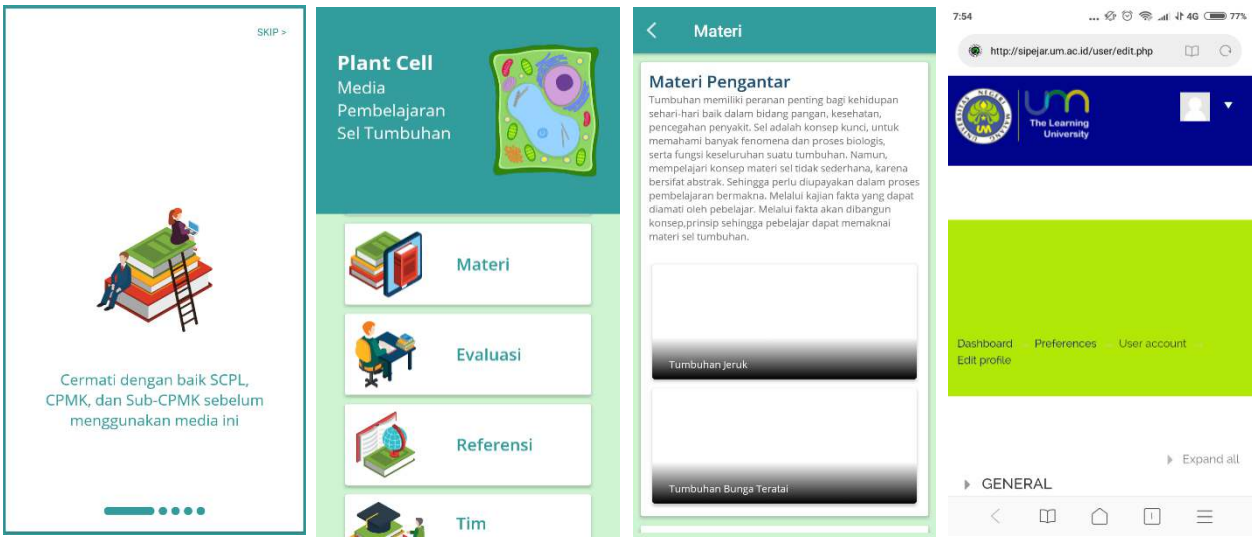

FIGURE 1. Example of the media, a) is the manual appears whenever the user log in to the media, b) is the main menu of the media, c) the learning material menu consist of brief explaination of the subjects and some supporting learning video which is connected to youtube and d) the evaluation from the media is directly connected to the campus academic system

Method

This research is an Android-based interactive multimedia development research, using Lee and Owens' development model [10]. The design stage was done by designing an android-based interactive multimedia storyboard and flowchart on the structure and function of plant cells material. At the development stage, validation test was carried out for both material and media validation The instrument used for validatin test was a validation questionnaire sheet by material experts, media experts, field practitioners, with qualification evaluation criteria according to Akbar [11]. The test subjects were 1) material experts as competent parties in PSD course 2) media experts as competent parties in the media field, 3) field practitioners as competent parties in PSD learning. S several revisions will be carried out based on the validation result to achieve the expected quality. Field trials were conducted to determine the practicality and effectiveness of the media for botanical literacy skills. The subject for practicality and effectiveness test was 170 students attending PSD course. The practiality test was conducted by giving practicality questionary sheet while the effectiveness test was conducted by giving presetest and posttest to the subjects. Data obtained from the pretest and posttest were then analyzed using the n-gain score technique. Below are provide examples of the media.

Results and Discussion

The first conducted test was the validation test from material expert, media expert and field practionaire using validation questionaire. The overall result of validation is shown in Fig. 1.

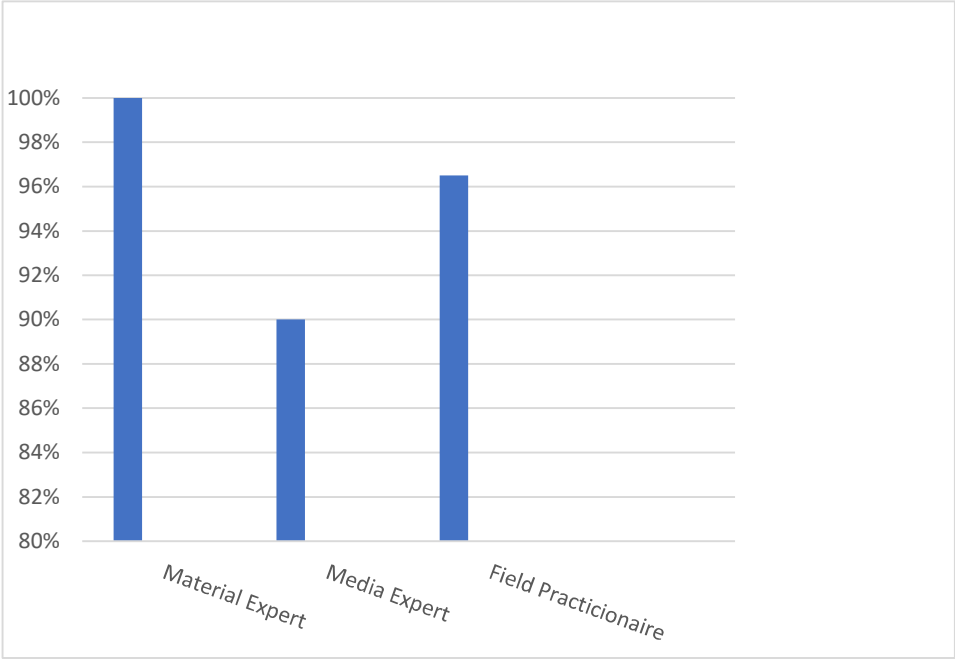

FIGURE 2. Result of Overall Media Validation Test

The results of the validation of material experts are 100%, media experts are on average 90% while those from field practitioners are 95.50%, so that it can calculated that the average is 95.50% which means that the media was very appropriate criteria according to Akbar [11]. Revisions were made several times, especially from the material expert validator to maintain the trustworthiness of information from users. The use of m-learning is cheaper and easier to disseminate information, but it is important to pay attention to the quality of the material because whenever a material is serverd wrongly it can decrease and obstruct the user's trust in using the m-learning. Trust as one of the factors contributing to the acceptance of cellular applications or services [12]. The results of validation test from field practitioners in PSD lecturers emphasized in assessment indicators in meaningful learning strategies for developing of android-based media. Criteria used for Meaningful learning strategies in this research was according to Angela which include 1) focus on the construction of knowledge 2) contextual

learning 3) relevant tasks 4) focus on problem solving 5) collaborative activities are shown in Fig. 2.

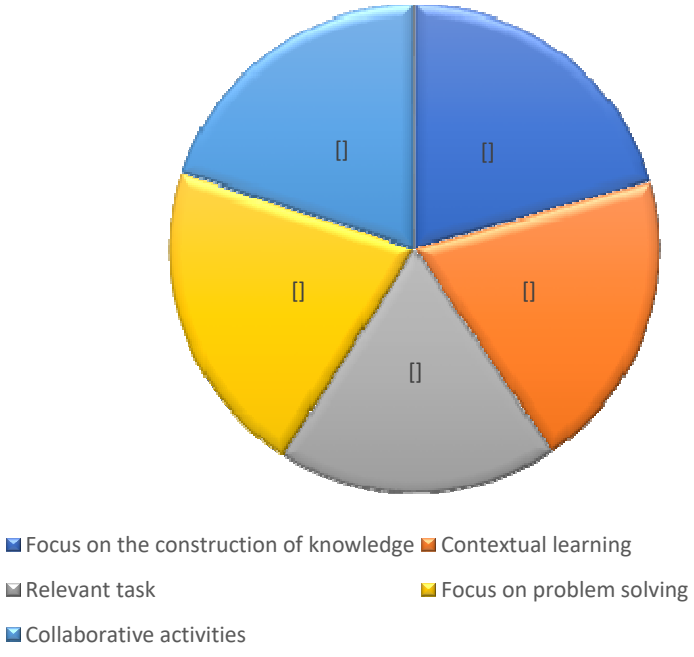

FIGURE 3. Quality of Appliying Meaningful Learning Criteria

Figure 2 shows that mobile learning media in the form of an application can develop meaningful learning strategies. The application is developed by adding a video showing facts material about plant cells from Hydrilla leaves microscopically. Through fact material, students can construct their material into concepts and principles. The information could be constructed by conducting five principles of meaningful learning that complement each other. This finding is in line with the opinion of Ozdamli [4], a constructivist which helps in describing learning with mobile technology. Applying constructivist learning is centered on students and needs to collaborate with their peers in actively building information from relevant assignments through problem solving [4].

The effectiveness test of media was analyzed using n-gain score from the results of the pretest and posttest. From the n-gain analysis, it was obtained an average of 0.7 which means that the efectiveness of media belong to medium category. The results showed that android-based interactive multimedia on plant cell material can improve botanical literacy skills even though it is in the medium category, students need to be more adapted to meaningful learning strategies through mobile learning media. The

statement was supported by [13] that adopting a new learning strategy is a major change and it is necessary to naturally change the management techniques to move towards a new era with more confidence. Android-based mobile learning media applications have advantages including 1) implementing a meaningful learning strategy; 2) the application developed has gone through a test of the validity of the material so that it has a level of trust as one of the factors that contribute to the acceptance of cellular applications or services; 3) an Android-based mobile learning application is a learning medium that is easy to use anywhere and anytime. The limitations of the results of media development applications can only be applied to phones with Android operating system.

Conclusion

Based on the result and discussion above, it can be concluded that the android-based mobile learning media for plant cell material in PSD course is effective to improve botanical literacy skill. The effectiveness of this media is caused the quality of applying meaningful learning criteria which is served in the media. An authentic assessment for assessing botanical literacy skill therefore was also needed to be developed properly in order to help improving botanical literacy to the next level in the future.

Acknowledgment

First of all, our gratitude toward ALLAH SWT for the mercy and guidance in giving us full strength to complete this fullpaper. Even facing some difficulties in completing this fullpaper, we still managed to complete. It's a lot of thanks to our colleagues for all of their support and guidance in helping us finishing this paper.

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Higher-order thinking process of junior high school students with linguistic intelligence, logical-mathematical intelligence, and visual-spatial intelligence in solving mathematical problems

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Abstract: Higher order thinking process of Indonesian students can be seen from the results of the National Examination and the results of the PISA and TIMSS test. However, the results of these tests are not satisfactory because the values obtained are still low. To overcome this, it's necessary to explore the higher order thinking process at the students in solving mathematical problems. This study is aimed to describe the higher order thinking process of junior high school students in Indonesia in solving mathematical problems. The research subjects consist of 3 students with the type of linguistic, logical-mathematical, and visual-spatial intelligences. The research results show that (1) student with linguistic, intelligence has been able to analyze the interrelationship between information, find relevant ideas/facts to the problem, choose information, modify the wrong conjecture to be correct, submit conjectures, investigate and provide possible ways of solving/other answers, and always check each step of the solution; (2) the student with logical-mathematical intelligence has been able to analyze the interrelationship between information, find relevant ideas/facts to the problem, choose information, modify the wrong conjecture to be correct, submit conjectures, and investigate and provide other possible solutions completely; (3) the students with visual-spatial intelligence has been able to analyze the interrelationship between information, find relevant ideas/facts to the problem, choose information, modify the wrong conjecture to be correct, submit conjectures, and investigate and provide possible ways of solving and other answers completely.

Introduction

The problem that Indonesia is facing lately is the decreasing in the results of the National Examination in 2018. According to the Minister of Education and Culture, Muhadjir Effendy, "there was a decreasing in scores because there were HOTS problems (Higher Order Thinking Skills) and even junior high schools more severe (decrease in score) " [8]. In addition, based on the PISA and TIMSS test results, Indonesia is still in the lower rank. In fact,

PISA and TIMSS questions are a matter of HOTS that requires higher order thinking skills (analyzing, evaluating, creating) in its completion. So, it can be concluded that Indonesian students' higher order thinking skills are very low. One effort to improve higher order thinking skills is exploring higher order thinking processes in solving mathematical problems. Thomas & Thorne (2011) states that HOT can be learned and HOT can be taught to students by learning how higher order thinking process students in solving mathematical problems [9].

Thinking is a process that forms new mental representations through information transformation by complex interactions of mental attribution which include consideration, abstracting, reasoning, drawing, logical problem solving, concept formation, creativity, and intelligence [7]. According to Anderson & Krathwohl (2001), thinking is divided into two, namely lower order thinking (remembering, understanding, applying) and higher order thinking (analyzing, evaluating, and creating) [1]. So, it can be concluded that a higher order thinking process is all of mental activities which include analyzing, evaluating, creating so that it builds new knowledge and experiences involving complex interactions of mental attributions to solve problems.

To explore the higher order thinking process can use the thinking phases initiated by Mason, et al and modified with understanding of higher-order thinking according to Anderson & Krathwohl. Mason, et al (1982) divided the thinking process into 3 phases, namely entry (aspects of know, want, introduce), attack (aspects of try, maybe, why), and review (aspects of check, reflect, extend) [5]. Aspect of know is answered by describing informations that is known from the problem and relevant information. The want aspect contains what must be done to answer or prove something true. Aspect of introduce is answered by presenting diagrams, tables, graphs, or other tools. In the try aspect, a lot of experiments will be done to create conjectures and test the truth of a conjecture. In the aspect of maybe there is a test of the allegations in all cases. Aspect of why is answered by explaining the logical reasons for each step of completion. The check aspect is the examination step. Reflect aspect contains activities to reflect or identify important ideas and events in progress. While the extend aspect is done to expand the thinking.

Everyone’s thinking process is different. There are two factors that influence these differences, and one of them is internal factors. According to Djaali (2007), internal factors that influence students' higher-order thinking processes are intelligence [3]. Gardner (2011) divides intelligence into nine types of intelligence (multiple intelligences) consisting of: (1) linguistic

intelligence, abilities related to language and words; (2) logical-mathematical intelligence, abilities to the use of number numbers, and logic in thinking; (3) visual-spatial intelligence, the ability to describe something in his mind or draw sketch form; (4) kinesthetic intelligence, ability to use gestures; (5) musical intelligence, abilities related to the world of music; (6) interpersonal intelligence, a person's ability to be sensitive to others; (7) intrapersonal intelligence, ability to recognize himself; (8) natural intelligence, abilities related to nature; and (9) existential intelligence, abilities related to sensitivity to the existence of an object [4].

From the explanation of the 9 bits of intelligence that have been explained, linguistic, logical-mathematical, and visual-spatial intelligence are types of intelligence that play an important role in the mathematics world. The importance of these three types of intelligence makes researchers raise various mathematical themes that related to the types of intelligence. However, in previous studies there are no studies that examine the higher order thinking processes of students based on their type of intelligence [2,10]. For this reason, there is a need for research that related higher-order thinking processes of students with these three types of intelligence.

Method

This study uses a qualitative approach and this research is descriptive. This study has the following research framework: (1) preparation and validation of instruments; (2) subject selection; (3) data collection; (4) data analysis; and (5) make a reports.

The instruments in this study included researchers as the main instruments, MIR (Multiple Intelligences Research) tests, test questions, interview guidelines, and validation sheets. Validated instruments are test questions and interview guidelines. The given test consists of three questions with the HOTS type. The interview guide contains a list of questions to explore the higher-order thinking process of students. The research subjects were three students of class VIII M who had linguistic, logical-mathematical, and visual-spatial intelligence.

The data in this study is a description of the higher-order thinking process of students. The data includes (1) data from the validation of research instruments; (2) intelligence type test results data; (3) student test results data in solving mathematical problems about data presentation; and (4) data recorded by interviews with students. After the data is obtained, the data analysis is performed according to Miles & Huberman (1992) which include data reduction, data presentation, and verification [6].

Research Result

This is a test question given to the three research subjects.

Test Questions

Instructions:

1. Solve the following problems in detail and if possible use a variety of solutions!
2. Time: 75 minutes.

Memory Card

Sandy has memory card with a capacity of 2 GB (1 GB= 1024 MB).
The memory card is filled with some music files, documents, and photos until there is a quarter remaining of the total memory capacity.
Sandy fills a half of total memory capacity with music files and another quarter is filled with document and photo files.
Total size of photo files is twice the total size of document files.

a. Make a pie chart to illustrate the files size in Sandy's memory card!
b. Examine the size of each file (music, document, and photo) in MB size!

A month later, Sandy wants to add some music albums with a total size 170 MB, documents with a total size 280 MB, and photos with a total size 112 MB to his memory card. Due to insufficient memory capacity, Sandy will delete some of his documents (at most two documents) so that new files can be added to the memory card.

c. According to the following table, which documents might Sandy be able to delete so that new files can be added to the memory card?

Document	Size	Document	Size
Document 1	10 MB	Document 6	18 MB
Document 2	28 MB	Document 7	13 MB
Document 3	25 MB	Document 8	10 MB
Document 4	15 MB	Document 9	15 MB
Document 5	32 MB	Document 10	20 MB

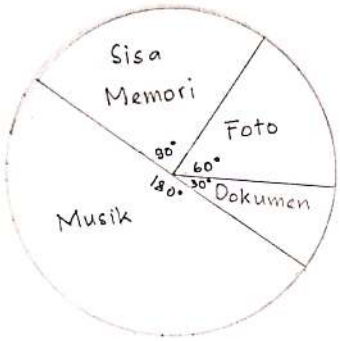
(Note: you can round up the results which you get to simplify the calculation)

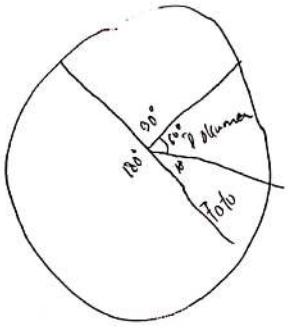
Picture 1. a Test Question

From solving problems that have been done by students with linguistic, logical-mathematical, and visual-spatial intelligence on the point of the question (a), (b), and (c) obtained the following results.

1. Higher Order Thinking Process of Student with Linguistic Intelligence in Solving Mathematical Problems

a.





b. Musik $= \frac{1}{2} \times 2\,GB$
$= 1\,GB$
$= 1024\,MB$

Foto $= \frac{60^\circ}{180^\circ} \times 1024\,MB$
$= \frac{1}{3} \times 1024\,MB$
$= 341,3\,MB$

Dokumen $= \frac{30^\circ}{180^\circ} \times 1024\,MB$
$= \frac{1}{6} \times 1024\,MB$
$= 170,6\,MB$

Musik $= \frac{1}{2} \times 2\,GB$
$= 1\,GB$
$= 1024\,MB$

Foto & Dokumen $= 1024\,MB : 2$
$= 512\,MB$

Foto : Dokumen $= 2 : 1$

Foto $= \frac{2}{3} \times 512\,MB$
$= 2 \times 170,6\,MB$
$= 341,2\,MB$

Dokumen $= \frac{1}{3} \times 512\,MB$
$= 170,6\,MB$

c. Total ukuran file yg akan ditambahkan $= 170\,MB + 280\,MB + 112\,MB$
$= 562\,MB$

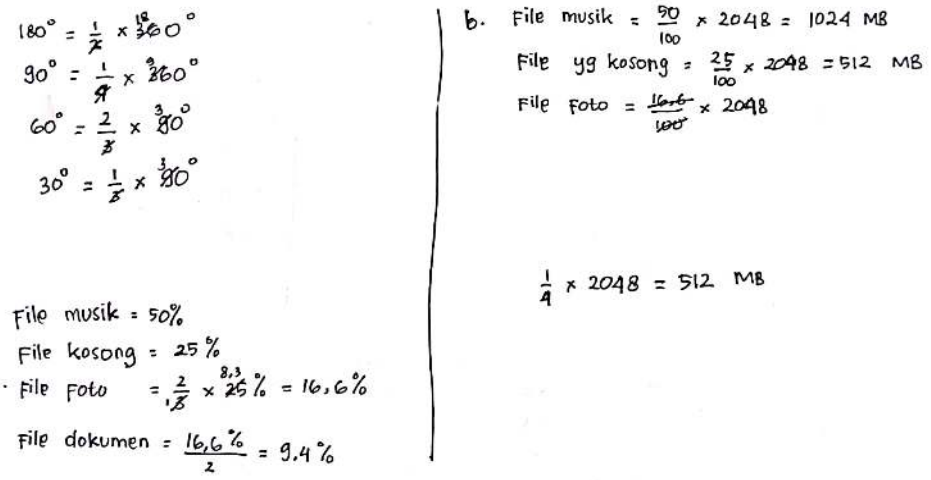
Sisa memori $= \frac{1}{2} \times 1024\,MB$
$= 512\,MB$

Ukuran file min. yg dihapus $= 562\,MB - 512\,MB$
$= 50\,MB$

$170 + 280 + 115$
$= 565$

$565 - 512$
$= 53$

Dokumen yg dpt dihapus:
- ~~Dokumen 2 & 7 $= 28\,MB + 13\,MB =$~~
- ~~Dokumen 5 & 6 $= 32\,MB + 18\,MB =$~~
- Dokumen 2 & 3 $= 28\,MB + 25\,MB = 53\,MB$ ✓
- Dokumen 5 & 10 $= 32\,MB + 20\,MB = 52\,MB$
- Dokumen 5 & 3 $= 32\,MB + 25\,MB = 57\,MB$ ✓
- Dokumen 5 & 2 $= 32\,MB + 28\,MB = 60\,MB$ ✓
- Dokumen 5 & 6 $= 32\,MB + 18\,MB = 50\,MB$



Picture 2. The Answer of Student with Linguistic Intelligence

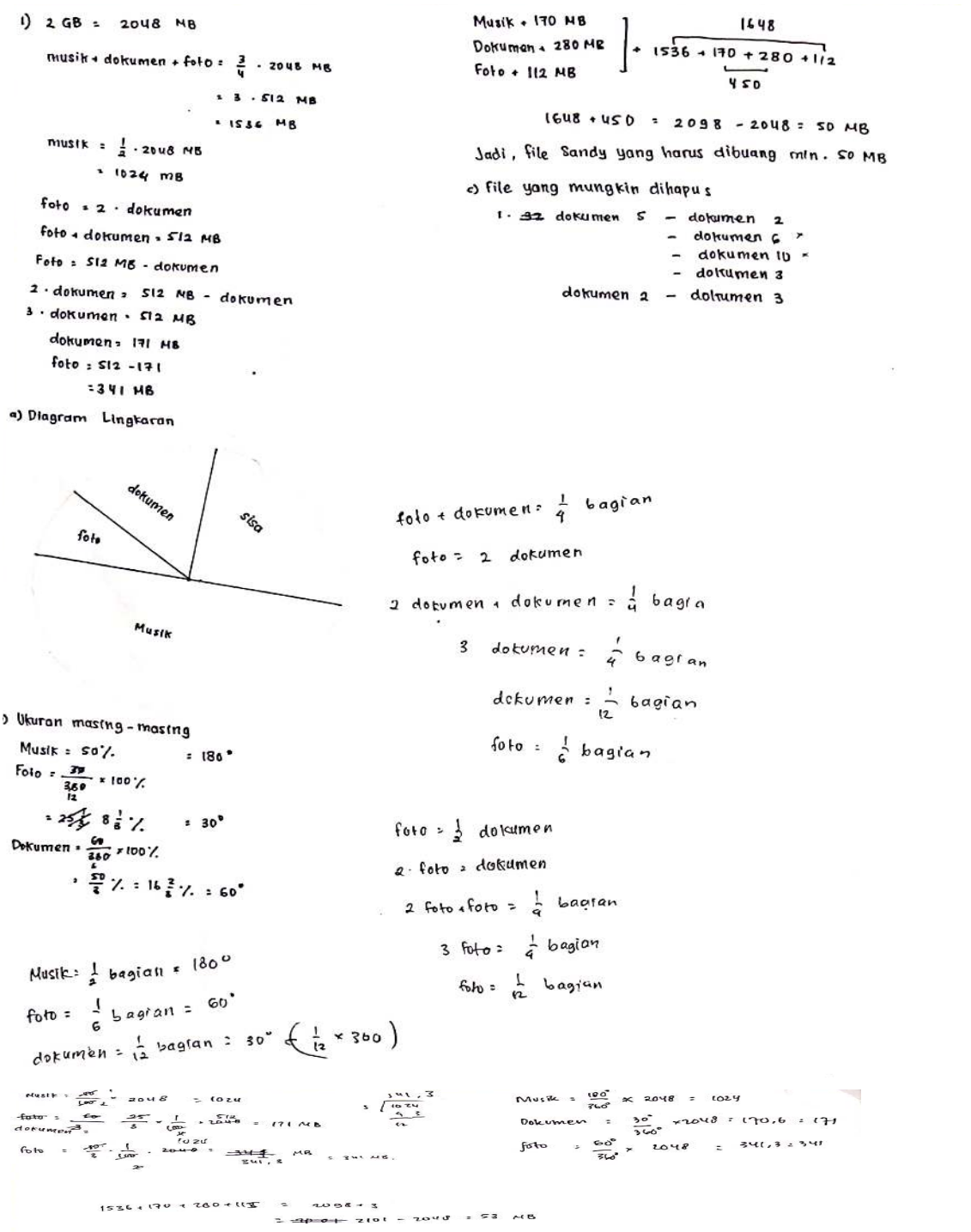
In solving point questions (a), students with linguistic intelligence have been able to analyze the relationship or interrelationship between information so that it is found that photo size is greater than the size of the document. He also can find ideas/facts that are relevant to the problem, namely in drawing a circle diagram. The size of the angles for each file is needed and the size of the full circle angle is 360°. For evaluating categories, this student can choose the information that will be used to solve the point questions (a), where each information is used to solve problems except information that is 1 GB$= 1024$ MB. He can also convince verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. In addition, he also checks every calculation, reason, and suitability of the completion, and can investigate other possible answers. In the category of creation, this student proposes a conjecture for solving problems, namely by looking for angles for each file. In addition, he can also solve questions in different ways, namely by using the concept of angles and percentages.

In solving the problem points (b), students with linguistic intelligence have been able to analyze the relationship or interrelationship between information so that a comparison of the size of photos and documents is obtained. In addition, he can also find a link between the points (a) and (b), namely to find the size of each file, the magnitude of the angle of each file in the answer to the question points (a). For evaluating categories, these students can choose information that will be used to solve the problem points (b), where each existing information is used to solve the problem. He

can also convince verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. In addition, he also checks every calculation, reason, and suitability of the completion, and can investigate other possible answers. This other answer is caused by the decimal number approaching each other. In the category of creation, these students submit two conjectures for solving problems, namely by using the concept of angles and parts. Initially he also used the percentage concept. However, because it involves complex calculations of decimal numbers, it cannot complete it completely.

In completing the question points (c), students with linguistic intelligence have been able to analyze the relationship or relationship between existing information. In fact, he can find links between points (a), (b), and (c), where the answers to questions (a) and (b) are needed to solve the points (c) such as the angle and size of each file. For the evaluating category, this student can choose the information that will be used to solve the points (c). He can also convince verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. In addition, he also checks every calculation, reason, and suitability of the completion, and can investigate other possible answers. In solving the point (c) problem, the student can also modify the wrong conjecture to be correct so that he can determine the document that must be deleted. In the category of creation, this student submitted a conjecture for solving the problem, namely by finding the total size of the file to be added and looking for the size of the memory card that is still empty, so that the total size of the document must be deleted at least 50 MB. In addition, it can also provide solutions in different ways to determine the size of a memory card that is still empty.

2. Higher-Order Thinking Process of Student with Logical-Mathematical Intelligence in Solving Mathematical Problems



Picture 3. The Answer of Student with Logical-Mathematical Intelligence

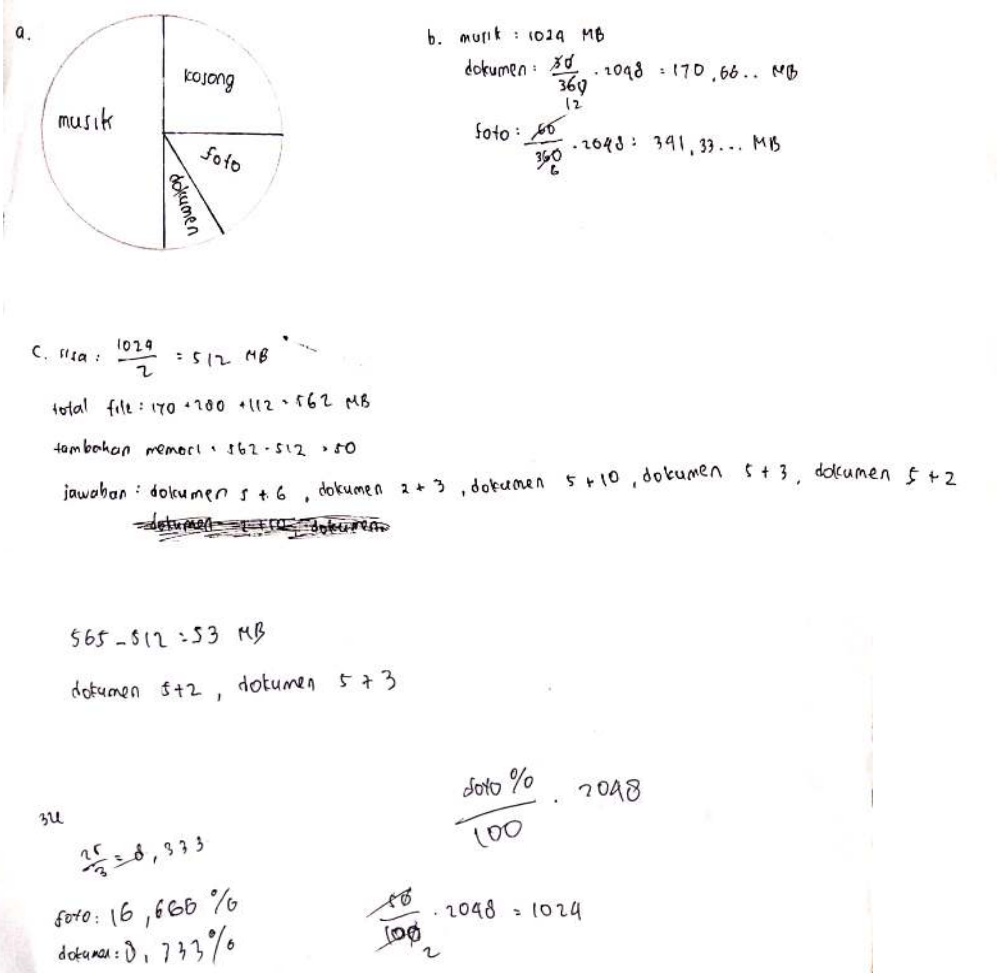
In solving point questions (a), students with logical-mathematical intelligence have been able to analyze the relationship or interrelationship between information so that they get the size of each file. He can also find ideas / facts that are relevant to the problem, namely in drawing a circle diagram. It takes the size of the angle for each file and the size of the full circle angle. For the evaluating category, this student can choose the information to be used to solve the points (a), where every information is used to solve problems except information that ^{1} GB$^{=1024}$ MB. He can also convince verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. However, this student does not check the resolution he has done, so he misrepresents the pie chart. However, he can modify the wrong conjecture to be true. In the category of creation, this student proposes a conjecture for solving problems, namely by looking for angles for each file. In addition, he can also solve questions in different ways, namely by using the concepts of angles, parts, and percentages.

In completing the question points (b), students with logical-mathematical intelligence have been able to analyze the relationship or relationship between information. In fact, he can find a link between the points (a) and (b), namely if in the question (a) can use the concepts of angles, parts, and percentages, then in question (b) can also use the concept where the information in the answer (a) needed. For evaluating categories, these students can choose information that will be used to solve the problem points (b), where each existing information is used to solve the problem. He can also convince verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. However, this student does not check the completion that has been done. However, he can investigate the possibility of another answer. This other answer is caused by a decimal number. In the category of creation, this student proposed various conjectures for solving problems, namely by using the concepts of angles, parts, and percentages (although there are complex calculations involving decimal numbers).

In completing the question points (c), students with logical-mathematical intelligence have been able to analyze the relationship or the relationship between existing information. In fact, he can find links between points (a), (b), and (c), where the answers to questions (a) and (b) are needed to solve the points (c) such as the angle and size of each file. These students use different resolution strategies from students with linguistic and visual-spatial intelligence. For the evaluating category, this student can choose the information that will be used to solve the points (c). He can also convince

verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. In the matter of point (c), he checks each calculation, reason, and suitability of the completion, and can investigate the possibility of another answer. In solving the point (c) problem, the student can also modify the wrong conjecture to be correct so that he can determine the document that must be deleted. In the category of creation, this student submits a conjecture for solving problems, namely by searching for the total of all files, then reducing the total available memory capacity.

3. Higher Order Thinking Process of Student with Visual-Spatial Intelligence in Solving Mathematical Problems



Picture 4. The Answer of Student with Visual-Spatial Intelligence

In solving point questions (a), students with visual-spatial intelligence have been able to analyze the relationship or relationship between information so that the photo size is greater than the size of the document. He also can find ideas / facts that are relevant to the problem, namely in drawing a circle diagram, the size of the angle or part for each file is needed. For evaluating categories, these students can choose information that will be used to solve the points (a), where each information is used to solve problems except information that 1 GB$= 1024$ MB. He can also convince verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. This student does not check each calculation, reason, and suitability of completion. However, he can investigate the possibility of another answer. In the category of creation, this student proposes a conjecture for solving problems, namely by looking for parts and angles for each file. In addition, he can also solve questions in different ways, namely by using the concepts of angles, parts, and percentages.

In completing the problem points (b), students with visual-spatial intelligence have been able to analyze the relationship or relationship between information. In fact, he can also find a link between the points (a) and (b), that is, to find the size of each file, the magnitude of the angle of each file is needed in the answer to the question points (a). For evaluating categories, these students can choose information that will be used to solve the problem points (b), where each existing information is used to solve the problem. He can also convince verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. However, he did not check every calculation, reason, and suitability of completion. However, he investigated the possibility of another answer involving decimal numbers. In this case, students have been able to estimate that a solution with a percentage will involve a complex calculation of a decimal number. In the category of creation, this student submits a conjecture for solving problems, namely by using the concepts of angles, parts, and percentages.

In solving point questions (c), students with visual-spatial intelligence have been able to analyze the relationship or the relationship between existing information. In fact, he can find links between points (a), (b), and (c), where the answers to questions (a) and (b) are needed to solve the question points (c) such as the size of each file. For the evaluating category, this student can choose the information that will be used to solve the points (c). He can also convince verbally that every step of completion has been done correctly by giving a logical reason for the steps to resolve it. In the

matter of point (c), he checks each calculation, reason, and suitability of the completion, and can investigate the possibility of another answer. In solving the point (c) problem, the student can also modify the wrong conjecture to be correct so that he can determine the document that must be deleted. In the category of creation, this student submitted a conjecture for solving the problem, namely by finding the total size of the file to be added and looking for the size of the memory card that is still empty.

Based on the results of study, overall each subjects has gone through each phase (entry, attack, review), but there are still aspects that have not been satisfied. However, subjects have satisfied the higher order thinking indicator. Subjects have been able to find relations between information, connect one concept to another concept, choose the right strategy, and can provide arguments for other possible answers.

Conclusions and Suggestions

Based on data that has been obtained and analyzed by researchers, conclusions can be taken as follows.

1. Student with linguistic intelligence in solving mathematical problems has met the analyzing indicators, which is able to find links between information and find ideas/facts that are relevant to the problem. For evaluating categories, he has been able to choose information that will be used to solve the problem, modify the wrong conjecture to be correct, test the conjecture and the relationship between concepts, ensure that each step of completion has been done correctly, and can investigate other possible answers. In addition, the subject always check each calculation and the suitability of the answers to the questions. In the category of creation, he can submit conjectures to solve problems, find solutions in different ways, and investigate other possible answers.
2. Student with logical-mathematical intelligence in solving mathematical problems has met the analyzing indicators, which is able to find links between information and find ideas/facts that are relevant to the problem. For evaluating categories, she has been able to choose information that will be used to solve the problem, modify the wrong conjecture to be correct, test the conjecture and the relationship between concepts, ensure that each step of completion has been done correctly, can investigate other possible answers, and the subject examine each calculation only when completing the question points (c). In the category of creation, she can submit conjectures to solve problems, find solutions in different ways, and investigate other possible answers.

3. Student with visual-spatial intelligence in solving mathematical problems has met the analyzing indicators, which is able to find links between information and find ideas/facts that are relevant to the problem. For evaluating categories, he has been able to choose information that will be used to solve the problem, modify the wrong conjecture to be correct, test the conjecture and the relationship between concepts, ensure that each step of completion has been done correctly, can investigate other possible answers, and the subject examine each calculation only when completing the question points (c). In the category of creation, he can submit conjectures to solve problems, find solutions in different ways, and investigate other possible answers.

Based on the results of research, the writer gives some suggestions as follows.

1. Mathematics teachers should give HOTS questions more often to improve students' higher order thinking skills, especially in open-ended questions and involve more complex calculations (such as calculations involving decimal numbers).
2. Mathematics teachers need to familiarize students to check/examine every step of completion (check) to minimize the occurrence of errors when solving a problem. In addition, students need to be accustomed to carrying out introducing aspects so that the reader understands the steps that have been taken.

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Development of Module for Remedial Learning at High School on Biology Subject

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Abstract. Permendikbud (2013) in 2013 Curriculum learning, students who have not reached KKM must be completed through remedial learning before continuing on to the next competency. Based on research conducted in 2017 by Adawiyah at SMAN 8 and Brawijaya Smart School High School in Malang City, Siti Sariyah at SMAN 1 and SMAN 2 Kota Batu, Lailil Hidayah in MAN 1 and MAN 3 Malang City, it is known that teachers have difficulty implementing remedial learning due time so that remedial learning is not preceded by a discussion of the material but is immediately retested or given a task. To overcome the limitations of time the development of modules for learning biology remedies is carried out. Module development research was conducted in 2018 by Ihda Wardah Faradina at SMAN 1 Pandaan-Pasuruan on animal tissue structure material, Anisa Kurniasih at SMAN 2 Kota Malang on digestive system material and Aulia Ayu Suryanitha at SMAN 2 Lamongan on plant tissue structure material. Determination of biological material developed into modules based on remedial cases that occur in the material. Modules are developed using the ADDIE development model which consists of analyze, design, develop, implement and evaluate phases. The results of the development research in the form of 3 modules for learning remedies that have been revised based on the results of validation, practicality test and effectiveness test so that it is feasible to use. Apart from being printed, modules can also be shared (share) with students via smartphones.

Introduction

Permendikbud (2013) states that in tests students have not reached the minimum completeness criteria (KKM) must be completed through remedial learning before proceeding to the next competency. Based on research conducted in 2017 by Adawiyah at SMAN 8 and Brawijaya Smart School High School in Malang City, Siti Sariyah at SMAN 1 and SMAN 2 in Batu City, Lailil Hidayah in MAN 1 and MAN 3 Malang City, it was concluded that teachers

had difficulty implementing remedial learning in accordance with technical guidance of Juknis Direktorat SMA (2010) due to time constraints so that remedial learning is not preceded by discussion of material but is immediately retested or given assignments. The technical directorate of the SMA (2010) Directorate requires that remedial learning be preceded by a discussion of material between the teacher and the students, then re-testing. Through discussion of material students who experience remediation are expected to be able to understand the material better so that they can retest better and reach KKM.

Likewise, a preliminary study in 2018 conducted by Ihda Wardah Faradina at SMAN 1 Pandaan-Pasuruan, Anisa Kurniasih at SMAN 2 Malang City and Aulia Ayu Suryanitha at SMAN 2 Lamongan; all of them also show the limitations of the teacher's time to carry out remedial learning so that the remedies are carried out without prior discussion of the material but immediately provide retesting or assigning assignments. Based on this fact a module was developed in 2018 by Ihda Wardah Faradina at SMAN 1 Pandaan-Pasuruan on animal tissue structure material, Anisa Kurniasih at SMAN 2 Kota Malang on digestive system material and Aulia Ayu Suryanitha at SMAN 2 Lamongan on plant tissue structure material. Determination of material to be made into modules based on the fact that in the material students experience remedies. Modules are expected to help teachers overcome the limitations of time in implementing remedial learning. Discussion of material by students through modules. Students are expected to understand the material better and be able to retest. Purpose of this development research to produce modules for remedial learning in biology subjects that validated and have tested in practicality and effectiveness.

Module is a complete and standalone learning package consisting of a series of learning activities and arranged to help students achieve their intended learning goals (Nasution, 2013). So modules are teaching materials arranged systematically and interestingly which includes the content of the material methods, and evaluations that can be used independently by students to achieve established competency indicators. Asyhar (2014) added that the module is a teaching material that can function as a teacher on face-to-face learning in class. Modules can be said as teaching materials that can be used independently by students because in addition to the contents of the material and evaluation, the module is also equipped with learning instructions (Depdiknas 2008). Orlich et al. (2012) states that modules can be used for independent or individual learning because the module contains objectives, instruction sheets (usage instructions), reading material, evaluation tools and answer keys. Statement of Orlich et al. (2012)

reinforced by Direktorat Tenaga Kependidikan (2008) who stated that the module is a medium for independent learning because it is equipped with learning instructions so that students can carry out learning activities without being accompanied by a teacher.

According to Direktorat Tenaga Kependidikan (2008) the module has characters:

1. Self instructional, students are able to teach themselves, not dependent on other parties. To fulfill the self instructional characteristics, in the module there must be several components which will be explained as follows.
   a) Clearly defined objectives
   b) Learning material arranged in specific sub units so as to facilitate learning thoroughly
   c) Displays practice questions, assignments, and the like that allow students to respond and measure their level of authority
   d) Using language that is simple, communicative, and easily understood by students
   e) There is a summary of learning material
   f) There are instruments that can be used to measure or evaluate the level of mastery of the material after learning to use the module
   g) There is feedback on the assessment so students know the level of mastery of the material that has been achieved
   h) Available information about supporting references or references learning materials
2. Self contained, all learning materials on the basic competencies learned are contained in one complete module. The purpose of this concept is to give students the opportunity to study learning materials that are completed because the material is packaged into one whole unit.
3. Stand alone, the module developed is not used in conjunction with other learning media.
4. Adaptive, modules should have high adaptive power to the development of science and technology. Modules can be said to be adaptive if the content of learning materials can be used up to a certain period of time and can be used flexibly and able to adjust the development of knowledge and technology.
5. User friendly, modules as teaching materials can be friendly or can be used easily by users (students). The use of language that is simple, easy to understand and uses grammar according to students' cognitive development is one of the user friendly forms.

6. Consistency, consistent use of fonts, spaces, and layout that includes the layout of titles, images and paragraphs.

One of the objectives of the module set by Direktorat Tenaga Kependidikan (2008) and related to the module for remedial learning is to overcome the limitations of time, space, and sense power, both learning participants and teachers. The development of modules for remedial learning in this study adapts to the characteristics of the module determined by the Direktorat Tenaga Kependidikan (2008).

The following are the results of the development of a biology learning module cited in several learning journals. Setiyadi (2017) through research with the title Development of Biology Learning Module Based on Scientific Approaches to Improve Student Learning Outcomes, showing valid, practical and effective results. Nurul Ika Noviyanti with the research title Development of Biology Learning Module Based on Reading, Questioning and Answering for Class XI High School Students on Excretion System Material, shows that the excretion system module based on RQA has reached the validity criteria and most qualified for use. Ardan (2016) through research. The Development of Biology Teaching Material Based on the Local Wisdom of Timorese to Improve Students Knowledge and Attitude of the Environment in Caring the Perseverance of the Environment, also shows valid, practical and efficient results

Remedial learning is an improvement learning from the teacher for students who have difficulty learning in certain basic competencies (KD) in order to understand the material better so that they can reach the KKM. According to Juknis Direktorat SMA (2010), remedial learning provides two main steps, namely first diagnosing learning difficulties, and the second giving remedial learning treatment. The treatment step consists of 1) discussion of the material by students guided by the teacher so that students better understand the material, and 2) retest in the hope that students reach KKM. In the implementation of teacher remedial learning rarely or never discuss material with students because of time constraints. Through the module students can learn more material that is not yet understood so that they can work on repeat tests and reach KKM.

Development Method

Modules are developed through a development model consisting of analyze, design, develop, implement and evaluate phases, or the ADDIE model (Branch, 2009). As the name implies, the ADDIE model has 5 stages of sequential development. The analysis phase includes analysis of module

requirements as well as student analysis and context which is carried out through interviews with teachers, giving questionnaires to students. In general, the reason for not holding remedial learning is the lack of time so that remedial learning is done by giving assignments or giving a retest. One alternative solution is the use of teaching materials in the form of modules. The module design stage is carried out based on the results of the analysis phase.

The design phase is preceded by an analysis of basic competencies (KD) that will be used as modules. Based on the KD analysis, a competency indicator (IK) will be formulated to be used in the module. The module draft is then written using a format from the Direktorat Tenaga Kependidikan (2008). At the design stage a module validation instrument is also made for media experts, material experts and field practitioners (teachers). The practicality test questionnaire was also prepared for students and the pre-test and post-test questions to test module effectiveness.

The next stage is the develop stage. At this stage validation of the module draft by media expert validators, material expert validators and teachers using the validation instruments that have been prepared. Validation results were analyzed to determine module validity. In addition, input or suggestions from the validator are used to revise the module. Analysis of validation data using a formula that refers to Akbar (2013)

Expert validation = total empirical score achieved/expected total score X 100%

The results of the calculation of the percentage of each validator are compared with the criteria in Table 1 so that the validity level can be known.

Tabel 1 Module Validity Criteria

Level of achivement	**Criteria**	**Follow-Up Remarks**
100%	Very valid	Without revision
75% - <100%	Valid	Revision
50% - <75%	Enough valid	Revision
25% - <50%	Less valid	Revision
0% - <25%	Unvalid	Revision

(Source: Arikunto, 2013)

The revised module based on input from the validator will enter the next stage, namely the implementation stage. The implementation phase is carried out in the following steps: 1) remedial students are collected in one class, 2) remedial students are given a pre-test, 3) remedial students read the module and ask questions that are not understood by the teacher

(student researcher), 4) students fill out the module practicality questionnaire, 5) students carry out a post-test. Analysis of implementation results to determine the practicality and effectiveness of the module. Practical tests are used to determine which modules are developed are practical and easy to use or not. Practical test data obtained from student response questionnaires. Rating the level of practicality using the following formula:

$$\text{Practicality score} = \frac{\text{Total empirical score achieved}}{\text{Expected total score}}$$

The calculation results are compared with the practicality criteria listed in Table 2.

Table 2. Module Practical Criteria

Level o Achievement	**Criteria**	**Follow up Remarks**
100%	Very practical	Without revision
75% - <100%	Practical	Revision
50% - <75%	Enough ractical	Revision
25% - <50%	Less practical	Revision
0% - <25%	Unpractical	Revision

(Source: Arikunto, 2013)

In addition to knowing the practicality of the module, implementation is also to find out the effectiveness of the module, which is the effectiveness of the module when applied in the learning process. Practical test data were obtained from the pre-test and post-test scores. Assessing the level of effectiveness using the following formula:

$$\text{N gain} = \frac{\text{(\% of post test score - \% of pre test score)}}{\text{(\% of maximum score - \% of pre test score)}}$$

The effectiveness of the module refers to Table 3.

Table 3 Module Effectiveness Levels

Level of score achievement	Effectiveness criteria
n-gain ≥ 0,7	High
0,3 < n-gain < 0,7	Medium
n-gain ≤ 3	Low

(Source: Hake,1999)

Practicality and effectiveness test results are the basis for module revisions. The final stage of module development is evaluating. This stage is carried out to assess the quality of modules developed both before and after implementation. The first step of the evaluation stage is to determine the evaluation criteria which include the validity criteria of the module, the criteria for practicality of the module and the effectiveness criteria of the module. As already explained in the previous section, the validation results are compared with the criteria on Table 1. Practicality test results are compared with the criteria in Table 2, and the effectiveness test results are compared with the criteria in Table 3. The summary of the validation results from the three modules is presented in Table 4. So, base on the result ofvalidity test, practically and efectivity test, three modules producted are valid, practic and efective. The modules can use as media for remedial teaching in SMA. Then a comprehensive revision of the module was carried out so that the final results of the module for biological remedial learning were obtained.

Table 4 Summary of Validation Results, Practical Tests and Effectiveness Tests

No	Module aspect	Name of module writer					
		Anisa K		Ihda Wardah		Auliya Ayu	
		%	Criteria	%	Criteria	%	Criteria
1	Validity						
	material	100	Very valid, without revision	100	Very valid, without revision	100	Very valid, without revision
	media	89,73	Valid with revision	87,30	Valid with revision	84,44	Valid with revision
	learning (by teacher)	100	Very valid, without revision	92,68	Valid with revision	96,80	Valid with revision
	Mean	96	Valid with revision	93	Valid with revision	93	Valid with revision
2	Practically	98,75	Valid with revision	91,30	Practic with revision	89,20	Practic with revision
3	Efectivity	N-gain 0,80	High	N-gain 0,49	Medium	N-gain 0,85	High

Based on Table 4, it can be seen that there are several things that need to be revised. For the module written by Anisa Kurniasih, revisions were made to the media and based on advice from a practical test questionnaire. For the module made by Ihdah Wardah and Aulia Ayu, revisions need to be made to the media, learning by teachers and revisions based on suggestions

from the practicality questionnaire. Revisions have been made at the evaluation stage.

Based on Table 4 it is known that the aspect that needs to be revised in the three modules is the selection of media. Research conducted by Widayat (2009) shows that the use of image media has an effect on student learning outcomes. Therefore a revision of media selection was carried out using clearer picture / photo media and supporting text. Likewise, based on practicality tests, three modules have been revised based on student input and suggestions.

Conclusion

Through research on the development of the ADDIE model, 3 modules were produced for the learning of the remedies of biology subjects in the 11th grade high school which were validated and had been tested for practicality and effectiveness. The module titles are:

1. Development of Module for Human Digestive System Material for Class XI of SMAN 2 Malang to Assist in the Implementation of Remedial Learning
2. Development of Module Material for Plant Network Structure Class XI SMAN 2 Lamongan for Learning Remedies
3. Module Development of Animal Network System Structure Module Class XI SMAN 1 Pandaan for Learning Remedies

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The Influence of Inquiry Learning Integrated Nature of Science Toward Critical and Creative Thinking Skills

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Abstract. Critical and creative thinking skills are very important to develop the students to meet the demands of 21st Century life skills. These skills can be developed through learning that involves active students in physical and mental activities, such as inquiry. The purpose of this study was to determine the effect of inquiry learning integrated the nature of science towards critical and creative thinking skills. This study is a quasi-experimental non-randomized pretest-posttest control group design involving students at 7th-grade private middle school in Malang Indonesia. The class used as the experimental class is class 7d with 30 students who are taught inquiry learning integrated science essence and 7c class as a control class with 30 students to be taught using the verification practicum module. The data about critical and creative thinking skills were taken using description questions given before and after learning. The data were analyzed using ANCOVA test. The results showed that there is a significant difference between the critical and creative thinking skills of the experimental class and the control class with a value of p (0,000) <α (0.05). This shows that inquiry integrated nature of science is one of innovative learning that can improve critical and creative thinking skills.

Introduction

The XXI century requires high-quality human resources who have the expertise to be able to work together, think at a high level, be creative, be skilled, understand various cultures, smoothly communicate, and be able to learn throughout life (lifelong learning) [1]. Improving the quality of human resources is one of them by increasing the level of high-level thinking that will bring changes to the education system, economy, science and technology, behavior, and habits of a nation [2] - [4]. High-level thinking includes critical and creative thinking which are aspects of XXI century skills [5]. Critical and creative thinking skills are very important to be developed in

students to compete in the global era, both the world of education and the world of work [5], [6].

Critical thinking skills can make a person understand himself, how to see the world, and how to relate to others [7], [8]. Through critical thinking, a person can analyze his thoughts to ensure that he has made a choice and draw conclusions precisely and efficiently [9] - [11]. Thinking skills are built by concepts that are already embedded in students and then existing concepts and principles are applied to solve problems [12]. These skills have measurable skills indicators such as interpretation, analysis, evaluation, inference, explaining, and self-regulation skills [13].

The next thinking skill is a creative thinking skill [5]. Thinking skills in the form of a person's skill using objects or ideas that will be created or already exist are combined into a solution [14]. This process does not have always to create a new concept, although the result can be seen as something new from the merging of two or more existing concepts [15], [16]. This skill has several indicators of skills that can be measured, such as fluency, flexibility, authenticity, elaboration, and metaphorical thinking [17].

Education is intended to prepare students for competition in the XXI century, which is considered to be the age of knowledge [5]. Changes in education and mindset of teachers must be based on what skills that will be needed by students in the XXI century to be able to achieve full participation in society [18]. Education in the XXI century needs to consider various things, both the competence of graduates, the content / educational content and the learning process [5]. Education in the XXI century must also pay attention to the use of technology, the strategic role of teachers and students, creative teaching and learning methods, contextual teaching materials, and individual-based independent curriculum structures [18]. Learning for students should develop and empower critical and creative thinking skills [19]. These competencies and thinking skills must be developed integrated with learning and not with individual learning [20].

One of the lessons in the 2013 curriculum is integrated science learning [21]. The main purpose of learning science is to promote scientific thinking in students including generating research questions, designing a study, making observations, explaining, developing theories, and studying other people's research [22], [23], understanding science correctly and meaningfully, and being able to utilize in life [23], [24], it is necessary to stress the understanding of the nature of science in learning [24]. Understanding of the nature of science is appreciated as one of the characteristics expected for a student, where the person is generally able to

titrate science, develop an understanding of concepts, principles, theories, and scientific processes [24], [25].

The problems obtained are based on the results of questionnaires and interviews with the teachers of UM Lab Middle School, including 1) students from various backgrounds who are mostly not accepted in favorite schools, 2) students' habit of learning to watch videos, 3) students learning from modules provided by teachers contains material, learning activities, and practice exercises, 4) teachers always use modules that have been there a long time ago, and do not often make new tools, 5) students are accustomed to working on multiple-choice questions and have never been given questions about thinking skills or those related to improvement Life skills of the XXI century, 6) students are not accustomed to self-study and inquiry. This explains that learning in SMP Lab UM still tends to be conventional and has never been tested or even improved the skills demanded in the XXI century or life today.

Students' perceptions and opinions about learning science in junior high school lab show that 100% of students say learning science always uses modules, the teacher explains at the beginning of learning, then students work on the modules, activities carried out in collecting data in the form of practical work or demonstrations from the teacher. Students also revealed difficulties in learning science, as many as 80% of students had difficulty in writing data on the results of experiments, confusion in connecting data, and 90% of students still did not understand how to conclude an experiment. All students said that learning science in SMP Lab UM was boring, they were happy if studying science went outside the classroom or studying outside the room. This shows that science process skills and students' understanding of science are still very shallow or low.

The results of the needs analysis conducted on 30 students to find out how critical and creative thinking skills of students in SMP Laboratorium UM showed quite low grades. The mean score of students 'critical thinking skills was only 44.55 while the value of students' creative thinking skills was lower at 32.55. Besides, some students do not answer the questions in whole or in part. Based on the scope of the study, the purpose of this study is to investigate the effect of integrated inquiry learning on the nature of science on critical and creative thinking skills.

Method

The study was conducted at the SMP Laboratorium UM in 7D and 7C classes, each class consisting of 30 students. This research is a quasi-experimental study with a nonrandomized pretest-posttest control group

design, as in Table 1. Class 7D as an experimental class and class 7C as a control class. The experimental class will be taught using inquiry integrated NoS and the control class will use module-based learning and verification practices. The determination of the class uses the equality test. This research was conducted in March-April 2019 with 12 meetings. Data collection techniques use test questions critical and creative thinking skills, before the questions are used have been tested for validity and reliability with valid results so that the questions can be used. These skills are measured using indicators of critical thinking skills according to Facione (2011) and creative thinking skills using indicators Trefingger (2002). The learning performance is measured using a learning implementation observation sheet. The data obtained will be analyzed using the ANCOVA test.

TABLE 1. Research Design

Class	Pretest	Treatment	Postest
Experiment Class	Q1	X	Q2
Control Class	Q1	-	Q2

Source: [1]

Information:

X : inquiry-based learning integrated Nature of Science (NoS)

- : module based learning and verivication pratice

Result and Discussion

The results of tests of critical and creative thinking skills between the Inquiry based learning integrated NOS and module based learning with verification practices have differences, the average posttest increases greater than the mean pretest scores in the experimental class, as in Table 2.

TABLE 2. Summary of Average Student Test Scores

Test	Control Class		Difference	Experiment Class		Difference
	Pretest	Postest		Pretest	Postest	
Critical Thinking Skill	41.60	47.22	5.62	57.12	84.23	27.11
Creative Thinking Skill	38.00	40.21	2.21	48.24	74.59	26.35

Data normality test is performed on residual data of pretest-posttest critical and creative thinking skills. Based on the results of the normality test of the dependent variable (critical and creative thinking skills) successively

have p (0.089 and 0.150)> α (0.05). Thus, the data can be said to be normally distributed.

Data homogeneity test is performed on data from all dependent variables (critical and creative thinking skills). Based on Table 4, it can be ascertained that the homogeneity results of the posttest data on critical and creative thinking skills from the control class and controversial experiments are related p (0.282 and 0.319)> α (0.05). This value indicates that the posttest data were homogeneous or had the same variants as those received from the same participant.

The summary of the ANCOVA test results for learning the difference in critical thinking skills in the second grade used in this study improved Table 3, while the creative thinking skills in Table 4.

TABLE 3. Summary of ANCOVA Test Results of Critical Thinking Skills

Dependent Variable: Kritis					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10891,277a	2	5445,638	93,257	,000
Intercept	3526,417	1	3526,417	60,390	,000
Pretest	3139,210	1	3139,210	53,759	,000
Pembelajaran	5745,912	1	5745,912	98,399	,000
Error	3328,457	57	58,394		
Total	224972,000	60			
Corrected Total	14219,733	59			
a. R Squared = ,766 (Adjusted R Squared = ,758)					

TABLE 4. Summary of ANCOVA Test Results of Creative Thinking Skills

Dependent Variable: Kreatif					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10114,587a	2	5057,293	90,849	,000
Intercept	904,269	1	904,269	16,244	,000
Pretest	6557,187	1	6557,187	117,793	,000
Pembelajaran	1168,575	1	1168,575	20,992	,000
Error	3173,013	57	55,667		
Total	162090,000	60			
Corrected Total	13287,600	59			
a. R Squared = ,761 (Adjusted R Squared = ,753)					

Based on Table 5, it is known that the significance value of the difference in mean scores between control and experiment (p = 0.001) < (α = 0.05).

This value means that there is a significant difference between the critical thinking skills of control class students who are taught by using modules and verification practices with the experimental class that uses NoS integrated inquiry learning. Based on Table 6, it is known that the significance value of the difference in mean scores between control and experiment (p = 0.001) <(α = 0.05). This value means that there is a significant difference between the creative thinking skills of control class students who are taught by using modules and verification practices with the experimental class that uses NoS integrated inquiry learning.

Influence of Inquiry Based Learning Integrated NOS on Critical Thinking Skills

Based on the results of the analysis, it is known that the difference between the pretest and posttest values of the experimental class is greater than the control class (27.11> 5.69). This value means that there is a significant difference between the critical thinking skills of control class students who are taught by using modules and verification practices with the experimental class that uses NoS integrated inquiry learning. That is, integrated inquiry learning NoS significantly influences the level of critical thinking skills. When learning students are accustomed to getting open questions relating to data obtained by students as a guide for students in conducting data analysis. Open-ended questions are one way to practice critical thinking skills [27]. Inquiry learning is also able to improve students' critical thinking skills, because there is training in it, for example conceptualizing and analyzing information that has been collected [9]. Inquiry learning emphasizes the process of critical thinking and analysis to find and find answers to existing problems [28].

Critical thinking skills need to be trained and developed since students are in elementary school [29]. Critical thinking needs guided practice to train students' critical thinking because critical thinking is not a direct result of teaching a field of study [27], [29]. The stages in inquiry make students investigate a case systematically, critically, logically and analytically, and formulate their findings independently and confidently [30], [31]. Inquiry learning is inherent in understanding the nature of science (NoS) [32] able to develop students' higher-order thinking skills [33]. Integrated inquiry NoS makes students active and disciplined because they build intellectual and skills, make questions and find out answers that come from student curiosity [34], [35]. Based on the explanation, inquiry learning can improve critical thinking skills [28], [36] - [40].

Influence of Inquiry Based Learning Integrated NOS on Creative Thinking Skills

Based on the analysis, it is known that the difference between the pretest and posttest values of the experimental class is greater than the control class (26.35> 2.21). This value means that there is a significant difference between the creative thinking skills of control class students who are taught by using modules and verification practices with the experimental class that uses NoS integrated inquiry learning. That is, integrated inquiry learning NoS significantly influences the level of creative thinking skills.

NoS integrated inquiry learning can improve students' creative thinking skills because when learning students are accustomed to looking for problems around the real world and looking for their solutions. Students more easily develop thinking and enhance the ability to think creatively if the problems are presented around the real world [41]. Students are also trained to make essays/posters as a form of solution to a problem, for example, pollution and global warming. These results are a form of student creativity which is one of the efforts to recognize or identify students' creative thinking skills, as well as understanding the strengths and creative potential of students [17], [42]. Besides through integrated inquiry activities, NoS students can gain knowledge, develop creative thinking and reasoning skills, improve metacognitive skills, and build positive attitudes [25], [30]. Based on studies of inquiry learning known to be able to improve creative thinking skills [43] - [46].

In the control class using module-based learning and verification practices, there was no increase due to students not actively learning. Practicum activities are not given usually only from video observations. Less optimal learning because students are not directly involved so the learning experience they have is lacking [1], [32]. Many students are passive because of the answers to the exercises/questions that are all contained in the module. Students are also less creative because they are not free to access information. They are all fixated only on the modules that have been given. The questions presented are also lacking to develop critical and creative thinking skills. Questions given are limited to remembering and explaining.

Modules are designed to reduce verbal explanation and free students to learn independently to increase knowledge and measure or evaluate their understanding [47]. However, if given at the beginning of learning seems to be less effective because students lack learning inquiry, this is because the module presents complex and detailed material. Usually, students lack

discipline so when working on their work or practice questions they will open the material that has been presented, especially if all the exercises in the answer module contained in the material [48].

In learning that uses modules and verification practices also lack contextual problems so that students are less interested in learning. Students also do not conduct investigative activities to solve problems. Though learning must focus on displaying thinking skills rather than learning knowledge [49].

Conclusion

The results of this study indicate that integrated inquiry learning nos has an influence on critical and creative thinking skills. Evidenced by the average value of students who are higher than in the classroom using module-based learning and verification practices. Suggestions for teachers who want to develop 21st-century skills can use NoS integrated inquiry learning as an alternative.

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The Effect of Android-Based Interactive Multimedia in Respiratory System Materials to Improve Science Literacy Skills of Class XI Students in SMAN 02 Batu

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Abstract. The study aims to determine the effect of android-based interactive multimedia on respiratory system material in improving the scientific literacy skills of students of class XI MIPA SMAN 02 Batu. The research design used was the true experiment with the Pretest-Posttest Control Group Design approach. This design describes two groups randomly selected and then given a pretest to find out the initial situation is there a difference in the group treated and the control group, then after knowing the results of pretest given treatment (learning using interactive learning multimedia) in the experimental class and not given treatment to the control class. The analysis of the effect of the test on scientific literacy skills was analyzed using ANCOVA data analysis techniques, which aimed to test the hypothesis of the influence of the use of interactive multimedia on students' literacy skills. The influence of interactive multimedia on scientific literacy of class XI MIPA 2 and 3 students at SMAN 02 Batu was analyzed using the ANCOVA analysis technique to obtain significant results of 0,000 < 0.050 that there is the influence of interactive multimedia use on increasing students' science literacy skill.

Introduction

Education in the 21st Century requires students to have 4C skills (Critical, Creative, Collaborative and Communicative thinking) and scientific literacy(Partnership For 21st Century Skills (P21)). 4C skills and scientific literacy can train students to think scientifically and train students in addressing and making decisions related to science issues in life(Ratnasari et al.). The scientific literacy skills of junior high school students in Indonesia were examined by PISA in 2015 is low, Indonesia in ranking 62nd out of 70 countries. It shows that the achievement of scientific literacy is still low.

The skills of scientific literacy can train students in addressing, making decisions related to science issues in life, and developing knowledge, skills and using science as citizens and individuals. Students are said to have the skills of scientific literacy if they are able to apply concepts or facts taught in schools with natural phenomena in everyday life [1]. Students with low scientific literacy skills are considered less able to solve problems in simple situations, while students with high scientific literacy skills are able to solve problems in complex situations [2].

The results of the scientific literacy skills of students on respiratory system material given to 12 students of class XII MIPA 2 (January 17, 2018) showed the average value of students is 12 (100 is maximum score). It states that the scientific literacy skillsof students are still low. One of the factors that increase scientific literacy skills is media selection [3]. Interactive multimedia is the media chosen to improve scientific literacy skills because in there is an exercise in mastering indicators of scientific literacy skills and there is a combination of images, video, and audio that can improve students 'understanding of concepts and student motivation, so interactive media they can improve students' scientific literacy skills. It is in line with the results of research from Rosandi [4] at SMPN 32 Surabaya insertion of indicators of scientific literacy skills in exercises in interactive multimedia can train students to improve students' scientific literacy skills.

Based on the description above, researchers tried to solve the problem with interactive Android-based interactive multimedia in the respiratory system. The purpose of the research is to improve scientific literacy skills and conceptual understanding of Class XI students in SMAN 02 Batu.

Method

This research is Research and design research. To measure the effectivity of the media use quasi-experimental design. The research design used was true experiment with the Pretest-Posttest Control Group Design approach (Figure 3.1).The quasi-experimental design use two groups. Group A used interactive learning multimedia and group B which learned without using interactive learning multimedia. Groups A and B were taught by the same teacher, with different lesson plans and the same learning model, but group B was not given interactive learning multimedia.

This design depicted two randomly selected groups then given a pretest (O1) to find out the initial conditions are there differences in the groups treated and control groups, then after knowing the results of the pretests given treatment (taught using interactive learning multimedia) in the experimental class (X) and no treatment was given to the control class

(C). After being given treatment in one group continued with the administration of posttest in the two sample groups used. The effect of treatment is symbolized by the letter O2 (Figure 3.1).

Treatment group	*R*	*O*	*X*	*O*
Control group	*R*	*O*	*C*	*O*

Figure 1 Pretest-Posttest Control Group Design, Source: Fraenkel & Wallen (2009: 266)

Explanation:
R: randomized group
O1: the results of the pretest
X: class given treatment
C: control class
O2: posttest results

The analysis of the effect of the test of scientific literacy skills and the effectiveness of interactive learning multimedia was carried out by ANCOVAdata analysis technique to test the hypothesis and N-gain o see the comparison of the effectiveness values. Data on the pretest and posttest values were analyzed using covariance analysis (ANCOVA) a significant level of 5%.

Results

The implementation of interactive multimedia is carried out in class XI MIPA 2, consisting of 32 students. The implementation was carried out during three meetings, namely on 25 March 2019, 29 March 2019 and 1 April 2019 with 2 hours each meeting. The result of the ANCOVA test of this research is shown in Table 1.

Table 1. Results of ANCOVA Test Results of Pretest-Posttest Multimedia Class and without Multimedia

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9679.739	2	4839.870	30.828	.000
Intercept	53608.614	1	53608.614	341.465	.000
Pretest	2308.210	1	2308.210	14.702	.000
Interactive Multimedia	5695.21	1	5695.521	36.278	
Eror	10204.731	65	156.996		
Total	349176.000	68			
Corrected Total	19884.471	67			

The results of the ANCOVA test (Table 1) are significant .000 ($p < 0.05$). Itmeans that Ho is rejected that there is influence of the use of multimedia learning towards increasing students' scientific literacy. A summary of the improvement of students 'scientific literacy skills in the classroom using interactive multimedia is presented in Table 2, and a summary of improving students' scientific literacy skills in the classroom without interactive multimedia is presented in Table 3.

Table 2. Summary of Improving Students' Literacy Capskills in Classes Given Interactive Interactive Multimedia

No.	Indicator	Average Pretest	Average Posttest
1.	Recall and apply scientific knowledge.	1,00	2,28
2.	Identify and use simple model descriptions to explain scientific phenomena.	0,29	1,93
3.	Make and provide suitable predictions.	0,60	1,92
4.	Offering explanatory hypotheses.	1,08	2,86
5.	Explain the involvement of scientific knowledge for the community.	0,50	2,64
6.	Make a graph of data interpretation.	0,64	2,68
7.	Read and interpret data.	0,39	2,46
8.	Change data from one representation to another.	0,25	2.03
9.	Evaluating arguments from several sources (journals and the internet).	0,17	2,67
10.	Analyze, interpret data and draw conclusions.	0,17	2,14

Table 3. Summary of Improving Students' Literacy Skills in Classes without Interactive Interactive Multimedia

No.	Indicator	Average Pretest	Average Posttest
1.	Recall and apply scientific knowledge.	0,74	0,84
2.	Identify and use simple model descriptions to explain scientific phenomena.	0,60	1,90
3.	Make and provide suitable predictions.	0,74	1,47
4.	Offering explanatory hypotheses.	1,03	1,66
5.	Explain the involvement of scientific knowledge for the community.	2,43	2,51
6.	Make a graph of data interpretation.	0,29	1,03
7.	Read and interpret data.	1,11	2,66
8.	Change data from one representation to another.	1,03	1,67
9.	Evaluating arguments from several sources (journals and the internet).	0,21	2,67
10.	Analyze, interpret data and draw conclusions.	0,50	2,14

Discussion

The influence of interactive multimedia on the scientific literacy of students of class XI MIPA 2 and 3 at SMAN 02 Batu analyzed using ANCOVAanalysis techniques obtained a significant result of 0,000 <0.050, it means thatthere is an influence of the use of interactive multimedia on improving skills student scientific literacy. Interactive multimedia that was developed contains 10 indicators of scientific literacy skills. Improvement of students' scientific literacy skills can be seen from the difference in post-test scores and each pretest divided by post-test scores. Increasing the score on the recalling and applying students' scientific knowledge indicator in classes taught using interactive multimedia shows a figure of 128.57%, while those taught without interactive multimedia only experienced an increase of 13.47%. That is because in interactive multimedia there are practice questions to achieve indicators of scientific literacy to recall and apply scientific knowledge.

Indicators of scientific literacy "recall and apply scientific knowledge" can be achieved in the material structure of organ-building tissues in the respiratory system and its functions. It is because students have studied the material in junior high school so that students can easily remember and re-

apply the material of the structure of organ-building tissues to the respiratory system and its functions so that students 'understanding of concepts increases, and increases students' scientific literacy skills. Romaisyah [5] stated that the students' understanding of concepts in the tissue material making up organs in the respiratory system and their functions was higher than other material because students had studied the material at the previous level.

Increasing the score on the second indicator (identifying and using simple model images to explain scientific phenomena) in classes learned using interactive multimedia shows a number of 575.00%, while in classes learned without interactive multimedia experienced an increase of 216.67%. That is because in interactive multimedia there are exercises to achieve scientific literacy indicators identifying and using simple model images to explain scientific phenomena. Indicators of scientific literacy "identify and use simple model images to explain scientific phenomena" can be achieved in the constituent tissue material of bronchial organs in the respiratory system and its function, where students are given news about bronchopneumonia that attacks infants due to cigarette smoke. The use of phenomena around students' environments can attract students' interest in learning so that students' understanding of concepts increases and indicators of scientific literacy are achieved. According to Rizkyanda [6] understanding of student concepts will be further improved if learning is associated with everyday phenomena.

Increasing the score on the third indicator (making and giving appropriate predictions) in the class taught using interactive multimedia shows a figure of 217.65%, while in the class taught without interactive multimedia has increased 98.84%. That is because in interactive multimedia there are practice questions to achieve scientific literacy indicators to make and provide predictions accordingly. Scientific literacy indicators make and provide predictions that can be achieved well because in all respiratory system materials are given phenomena and news, from these phenomena and news students are led to write problem formulations and provide appropriate predictions in answering problem formulations. This is in accordance with the statement of Putra [7] that the phenomena given by the teacher or sought by students in their environment can train students to improve their skills to make predictions.

Increasing the score on the fourth indicator (offering explanatory hypotheses) in classes learned using interactive multimedia showed a figure of 162.3%, while those in classes learned without interactive multimedia experienced an increase of 61.11%. That is because in interactive

multimedia there are practice questions to achieve indicators of scientific literacy offering hypotheses that are explanatory. Scientific literacy indicators offer explanatory hypotheses that can be well achieved in the matter of respiratory mechanisms, factors that influence the frequency of breathing and the dangers of smoking to the structure of tissues that make up respiratory organs.

Before studying about breathing mechanism, factors that influence the frequency of breathing, and the dangers of smoking to the structure of the tissues that make up the respiratory organs, students are given a phenomenon that is in the student environment such as video smokers, then students are trained to make hypotheses that are explaining the impact of people who smoke on respiratory structures and organs. The selection of this phenomenon aims to make students know the possibility of explanation based on their knowledge. It is in accordance with the statement Rahmasiwi, et al. [8] to train the skills of the hypothesis the teacher must choose a phenomenon that is known to students so that students can determine the likelihood that occurs based on the knowledge they have.

Increasing the score on the fifth indicator (explaining the involvement of scientific knowledge for the community) in classes that were taught using interactive multimedia showed a figure of 428.57%, while those in classes that were taught without interactive multimedia experienced an increase of 3.25%. It is due to the interactive multimedia there are exercises to achieve indicators of scientific literacy explaining the involvement of scientific knowledge for the community. Indicators of scientific literacy explain the involvement of scientific knowledge for the community achieved well on the material effects of air pollution and its impact on the structure, the function of the constituent organ tissues in the respiratory system.

After studying the material, the effects of air pollution on the respiratory system, students are asked to make posters that are then uploaded on the social media that they have. Students make posters about the effects of air pollution, especially cigarette smoke, and vehicles. This is consistent with Wulandari's statement [9] that poster media can be used to educate the public and provide knowledge to the public. Increasing the score on the sixth indicator (making graphs of interpretation of data) in classes learned using interactive multimedia shows a figure of 316.67%, whereas in classes learned without interactive multimedia has increased 260.65%.

Increased scores on the seventh indicator (changing data from one representation to another) in the class taught using interactive multimedia shows the number 714.20%, while in the class taught without interactive multimedia has increased 62.27%. That is because in interactive multimedia

there are practice questions to reach indicators to interpret data graphs and change data from one representation to another. Indicators graph data interpretation and change data from one representation to another in the material can be achieved with both the material volume and lung capacity. That is because this material contains numbers that explain the volume of air in the lungs, and makes it easier to understand the volume and capacity of the lungs to improve understanding of concepts so that students' scientific literacy is achieved. Subali, et al [10] explain that changing data into graphs and diagrams serve to facilitate students in understanding the material.

The increase in scores in the eighth indications (reading and interpreting data) in classes learned using interactive multimedia showed a number of 527.27%, while those in classes learned without interactive multimedia experienced an increase of 139.28%. That is because in interactive multimedia there are practice questions to achieve indicators of reading and interpreting data. According to Murni & Widoretno [6] data interpretation can be done through the process of making graphics or pictures of observations that involve efforts to write observations, make inferences, interpret data and make conclusions. Indicators of reading and interpreting data are achieved in the sub-material volume and lung capacity, and factors that influence the frequency of breathing because in learning students are required to make graphs, interpret data and make conclusions.

Increasing the score on the ninth indicator (evaluating the arguments from several sources: journals and the internet) in classes learned using interactive multimedia shows a figure of 1470.00%, while those in classes learned without interactive multimedia experienced an increase of 328.57%. This is due to interactive multimedia there is a question exercise to evaluate arguments from several sources (journals and the internet). Indicators evaluating arguments from several sources (journals and the internet) are achieved in the sub-material of respiratory system disorders. Before studying the material of respiratory system disorders, students are asked to read news about diseases Pneumonia and explain how the bacterium Streptococcus pneumoniae process attacks the human lung tissue. In order for students to explain the process the teacher gave some references, but students must choose the correct references and gave reasons why choosing those references so that the understanding of the concepts obtained was also correct. Probosari, et al [12] explain that evaluating arguments from several important sources to form true material concepts in students.

Increasing the score on the tenth indicator (analyzing, interpreting data and drawing conclusions) in the classes that were taught using interactive multimedia showed a figure of 1100.00%, while those in classes that were

learned without interactive multimedia experienced an increase of 328.57%. This is due to the interactive multimedia there are exercises to analyze, interpret data and draw conclusions. Indicators analyze, interpret data and draw conclusions reached on all sub-material contained in KD 3.8, namely analyzing the relationship between the structure of organ-building tissue in the respiratory system in relation to bioprocess and impaired function that can occur in the human respiration system. That is because in every material given a phenomenon, then students are asked to make predictions.

Students prove predictions and hypotheses by collecting data, then analyzing, interpreting and drawing conclusions. Probosari, et al [12] explain the application of the scientific process of analyzing, interpreting, and drawing conclusions can improve students' understanding of concepts. Wulandari & Sholihin [9] explained that if students 'understanding of concepts is good, students' scientific literacy skills are also good. Based on the statement the indicators analyze, interpret and draw conclusions reached throughout the respiratory system material that can improve students' understanding of concepts and scientific literacy skills.

The increase in scores on the first to tenth science literacy indicators was higher in the classes learned using interactive multimedia. This is due to the learning using interactive multimedia students are led to practice working on questions that are in accordance with indicators of competency achievement, and indicators of scientific literacy skills. Based on the description of the increase in the pretest and posttest scores per indicator described above, the increase in interactive multimedia classes is higher than classes without interactive multimedia. It is consistent with the statement of Holden [3] that the factors that influence the improvement of scientific literacy are the media used by teachers. Fan & Gellan [13] explained that learning using interactive multimedia can attract students' interest and increase learning motivation because of the combination of images, video, and audio. So that students' motivation to learn increases, students' understanding of concepts and students' scientific literacy skills increase.

The effort to establish the skills of scientific literacy is achieved by training students to understand knowledge about science, the process of science, and the development of scientific attitudes so that students not only know the concepts of science but can also apply the skills of science to solve various problems and can make decisions based on scientific considerations [14]. The process of training students to understand knowledge about science, the process of science, and the development of scientific attitudes are developed through indicators of scientific literacy adopted from PISA

[15] and Gormally [16] applied as a matter of exercises in interactive multimedia so students can improve their scientific literacy skills.

Conclusion

The influence of scientific literacy skills of the students using interactive multimedia of class XI MIPA 2 and 3 at SMAN 02 Batu analyzed using ANCOVA analysis techniques obtained a significant result of 0,000 where <0.050 significant level which means Ho is rejected, the research hypothesis is accepted that there is an influence of the use of interactive multimedia on improving skills student scientific literacy.

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Variance, Number and Distribution of Cognitive Levels Class 10 Biology Subjects in Curriculum 2013

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Abstract. In the current era, learning biology and other subjects in SMA / MA uses the 2013 Curriculum which includes a competency-based curriculum (KBK). In simple terms, what is meant by KBK is after students finish participating in learning will receive or master a number of competencies or abilities which include 4 core competencies (IC), namely (1) spiritual attitude competencies, (2) social attitudes, (3) knowledge, and (4) skills. This paper only discusses knowledge (cognitive) competence which is basically biological material. The minimum cognitive competence in biology subjects that must be mastered in class 10 is listed in the basic competencies (KD) contained in the 2013 Curriculum content standards. Cognitive competence in KD is indicated by verbs used in KD formulations, for example describing, describing or analyzing. The number and diversity of cognitive levels can be seen further in the formulation of competency indicators (IK) and question indicators.

Introduction

This paper reveals the variety, number and distribution of cognitive levels in 10th-grade biology subjects in the 2013 Curriculum. The data uses research data on the development of multiple-choice tests in 10th-grade high school biology subjects conducted in 2017 by Hanifah, Wawan, Tania and Atika from the Educational Study Program Biology FMIPA Malang State University (UM). This paper also discusses the distribution of cognitive levels associated with the ability to think critically and creatively, which are 21st-century skills that students must master.

Content Standards, Basic Competencies, Competency Indicators and Item Indicators

According to the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, national education based on the Pancasila and the 1945 Constitution of the Republic of Indonesia (Article 2), functions to develop capabilities and shape the dignified character and

civilization of the nation in order to develop the life of the nation, aiming at to develop the potential of students to become human beings who have faith and are devoted to God Almighty, have good character, are healthy, knowledgeable, capable, creative, independent, and become democratic citizens and responsible (Permendikbud Number 021, 2016).). Furthermore, from the same referral source, it was stated that in an effort to realize the objectives of national education the Graduates Competency Standards were established which were criteria for qualifications of graduates' abilities that included attitudes, knowledge, and skills. In order to meet the future needs and meet the Indonesian Golden Generation in 2045, Graduates Competency Standards have been established based on XXI Century Competencies, Indonesian Demographic Bonuses, and Indonesia's Potential to become the Group 7 of the World's Largest Economic Countries, and at the same time strengthen Indonesia's contribution to the development of world civilization.

To achieve the competency of the graduates the government sets Content Standards which are criteria regarding the scope of the material and the level of competency of students to achieve graduate competencies at certain levels and types of education. Standard Formulation The contents of each subject contain the scope of the material and the level of competency of students that must be met or achieved at an educational unit in certain levels and types of education. The discussion of the standard content in this paper is limited to the realm of knowledge (cognitive) contained in the Basic Competence (KD) which is the minimum competency that students must master. Competence and cognitive level in KD are indicated by verbs used in KD formulation, for example explaining, describing or analyzing.

Based on Bloom's revised taxonomy, in Dolunay & Savas, 2016, thinking skills in the cognitive domain are divided into six cognitive levels, sorted from easy to difficult, namely remembering (C1), understanding (C2), applying (C3), analyzing (C3) C4), evaluating (C5), and creating (C6). The competence of C1 - C6 knowledge is mastered by students through the learning process and is measured by tests. To be able to compile a good test, the teacher describes the basic competency that has not been measured as an indicator of competence (IK) and then elaborated again into an indicator of the problem (IS). IK and IS formulas use operational verbs (KKO) that can be measured. Compilation of questions refers to IS. Therefore, the diversity of cognitive levels can be traced from the IK and IS listed in the problem grid.

Table 1 Definition and Operasional Verbs

No	Dimensions of Cognitive Process and Categories	Operational Verbs (KKO) for Formulation of Indicators / Objectives
1	Mengingat (C1)	Pengertian: Mengambil pengetahuan dari memori jangka panjang
	1.1 Mengenali	menyebutkan, menunjukkan, memilih, mengidentifikasi
	1.2Mengingat Kembali	mengungkapkan kembali, menuliskan kembali, menyebutkan kembali
2	Memahami (C2)	Pengertian: Mengkonstruk makna dari materi pembelajaran, termasuk apa yang diucapkan, ditulis, dan digambar oleh guru 2
	2.1 Menafsirkan	menafsirkan, memparafrasekan, mengungkapkan dengan kata-kata sendiri, mencontohkan, memberi contoh, mengklassifikasikan, mengkelompokkelompokkan, mengidentifikasi berdasarkan kategori tertentu, merangkum, meringkas, membuat ikhtisar, menyimpulkan, mengambil kesimpulan, membandingkan, membedakan, menjelaskan, menguraikan, mendeskripsikan, menuliskan
	2.2. Mencontohkan	mencontohkan, memberi contoh
	2.3 Mengklasifikasikan	mengklassifikasikan, mengkelompok-kelompokkan, mengidentifikasi berdasarkan kategori tertentu
	2.4. Merangkum	merangkum, meringkas, membuat ikhtisar
	2.5. Menyimpulkan	menyimpulkan, mengambil kesimpulan
	2.6. Membandingkan	Membandingkan, membedakan
	2.7. Menjelaskan	Menjelaskan, menguraikan, mendeskripsikan, menuliskan
3	Mengaplikasikan (C3)	Pengertian: Menerapkan atau menggunakan suatu prosedur dalam keadaan tertentu
	3.1 Mengeksekusi	menghitung, melakukan gerakan, menggerakkan, memperagakan sesuai prosedur/teknik, mengimplementasikan, menerapkan, menggunakan, memodifikasi, menstransfer
	3.2 Mengimplementasikan	mengimplementasikan, menerapkan, menggunakan, memodifikasi, menstransfer, mengurutkan
4	Menganalisis (C4)	Pengertian: memecah materi jadi bagianbagian penyusunnya dan menentukan hubunganhubungan antarbagian itu dan hubungan antara bagian
	4.1 Membedakan	membedakan, menganalisis perbedaan, mengorganisasikan, membuat diagram, menunjukkan bukti, menghubungkan, menganalisis kesalahan, menganalisis kelebihan, menunjukkan sudut pandang
	4.2 Mengorganisasi	mengorganisasikan, membuat diagram, menunjukkan bukti, menghubungkan
	4.3. Mengatribusikan	menganalisis kesalahan, menganalisis kelebihan, menunjukkan sudut pandang
5	Mengevaluasi (C5)	Pengertian: Mengambil keputusan berdasarkan kriteria dan atau standar 5
	5.1. Memeriksa	memeriksa, menunjukkan kelebihan, menunjukkan kekurangan, membandingkan, menilai, mengkritik

No	Dimensions of Cognitive Process and Categories	Operational Verbs (KKO) for Formulation of Indicators / Objectives
	5.2. Mengkritik	menilai, mengkritik
6	Mencipta (C6)	Pengertian: memadukan bagian-bagian untuk membentuk sesuatu yang baru dan koheren atau untuk membuat suatu produk yang orisinal
	6.1. Merumuskan	Merumuskan, merencanakan, merancang, mendisain, memproduksi, membuat 6
	6.2. Merencanakan	merencanakan, merancang, mendisain
	6.3. Memproduksi	memproduksi, membuat

Sumber: Panduan Penulisan Soal 2017 SMP/MTS

Guide to Writing Questions for 2017 SMP / MTS describes the understanding and types of KKO presented in Table 1. To be more stable, the KKO in Table 1 is integrated with the 2013 KKO Curriculum which was revised in 2018 (Table 2) to be used as a reference in determining cognitive levels.

Table 2. KKO at each Cognitive Level - Curriculum 2013 Revised 2018

C1.Mengingat (Remember)	C2.Memahami (Understand)	C3.Mengaplikasikan (Apply)	C4.Menganalisis (Analyze)	C5.Mengevaluasi (Evaluate)	C6.Mencipta (Create)
Mengutip Menerbitkan Menjelaskan Memasangkan Membaca Menamai Meninjau Mentabulasi Memberi kode Menulis Menyatakan Menyebutkan Menunjukkan Mendaftar Menggambar Membilang Mengidentifikasi Menghafal Mencatat Meniru	Memperkirakan Menceritajan Merinci Megubah Memperluas Menjabarkan (mendeskripsikan) Mencontohkan Mengemukakan Menggali Mengubah Menghitung Menguraikan Mempertahankan Mengartikan (mendefinisikan) Menerangkan Menafsirkan Memprediksi Melaporkan Membedakan	Mengaskan Menentukan (menetapkan) Menerapkan Memodifikasi Membangun Mencegah Melatih Menyelidiki Memproses Memecahkan Melakukan Mensimulasikan Mengurutkan Membiasakan Mengklasifikasi (mengelompokkan) Menyesuaikan Menjalankan Mengoperasikan Meramalkan	Memecahkan Menegaskan Meganalisis Menyimpulkan Menjelajah Mengaitkan Mentransfer Mengedit Menemukan Menyeleksi Mengoreksi Mendeteksi Menelaah Mengukur Membangunkan Merasionalkan Mendiagnosis Memfokuskan Memadukan	Membandingkan Menilai Mengarahkan Mengukur Merangkum Mendukung Memilih Memproyeksikan Mengkritik Mengarahkan Memutukan Memisahkan menimbang	Mengumpulkan Mengatur Merancang Membuat Merearasi Memperjelas Mengarang Menyusun Mengode Mengkombinasikan Memfasilitasi Mengkonstruksi Merumuskan Menghubungkan Menciptakan Menampilkan/ menyajikan

Source: KKO Kurikulum 2013 Revisi 2018

The ability to think critically

The ability to think critically is a person's ability to analyze ideas or ideas logically, reflectively, systematically and productively to help make, evaluate and make decisions about what is believed or will be done so that it is successful in solving a problem at hand. Setiadji (2012) states that in the ability to think critically the brain is forced to think seriously to solve problems faced by individuals or think of actions to be taken later. Everyone has a problem that is not to be avoided but to be solved, so everyone should also have the ability to think critically so they can think of what steps must be taken to solve the serious problems they face. Ministerial Regulation No. 23/2006, states that critical thinking skills are 21st century skills that students must master are ways of reasoning using higher order thinking processes (Higher Order Thinking Skills). Saido, et.al, 2015, stated that critical thinking skills can be developed using cognitive test questions that are included in the criteria of higher-order thinking skills (HOTS). Thus the KKO that shows the ability to think critically is the KKO for cognitive levels C4, C5 and C6. Critical thinking skills are used in activities to process information, make decisions, and provide solutions to a problem, so students can compete in competitive lives and be able to live independently. The ability to think critically must be mastered by students to face competition in the 21st century.

Creative thinking ability

The ability to think creatively is the ability to produce or develop something new; that is, something unusual that is different from the ideas produced by most people. According to Munandar (1999) the characteristics of creative thinking abilities include five thinking skills: (a) fluency thinking, which causes a person to be able to spark many ideas, answers, problem-solving or questions, (b) flexible thinking (flexibility) where people creative product ideas, answers or questions that vary because he is able to see the problem from different points of view, (c) rational thinking that encourages creative people to give birth to new and unique expressions, (d) the skills of elaborating includes the ability to enrich and develop an idea or product, and (e) the skill to evaluate (evaluate), that is, the ability to set benchmarks of one's own judgment and determine whether a question is true. Thus the KKO that shows the ability to think critically is the cognitive level KKO C6.

Research Method

This research data utilizes research into the development of a multiple choice subject matter of biology subjects in 10th-grade high school conducted in 2017 by Hanifa, Wawan, Tania and Atika from the Biology Education Study Program FMIPA State University of Malang (UM). The four students' research is the research umbrella of Drs. Triastono Imam Prasetyo, M.Pd, Lecturer in Biology Education Study Program FMIPA UM. In the research process the four students compiled a grid of questions from KD grade 10 biology subjects. The questions grid contains KD, IK and IS, components needed to determine the various cognitive levels. The questions made by the four students were validated by the evaluation expert validator, the material expert validator, and the teacher. Suggestions from the validator and the teacher are also used for the revision of the problem grid, so that the question grid is appropriate as a source of cognitive level data diversity. However, before being taken as data, a study was conducted on the KKO on the question indicators compared to the KKO in Table 1 and Table 2. The KKO on the question indicators was determined as the source of data because it was the elaboration of the PI so it was assumed to be more diverse. KKO data about the indicator of each class 10 KD was collected so that it can be known the variety, number and distribution of cognitive levels.

Research Result

The results of the study are summarized in Table 3. Based on the research, it is known that all cognitive levels of C1-C6, appear as competencies that must be mastered by 10th grade students, but the number and distribution are not spread across all KD. C4, C5, C6 cognitive levels which are competencies for critical and creative thinking skills also exist even though the numbers are not many. The highest number of cognitive levels in grade 10 is C2 (56); followed by C1 (32), C3 (24), C4 (17), C6 (6) and C5 (1). A large number of C2 is found in KD 3.2 (22), KD 3.3 (27). C3 is the most in KD 3.9 (11). C4 on KD 3.10 (6) and KD 3.11 (5). KD 4.1, 4.2, 4.3 only bring up C6 because the formulation requires students to convey ideas or work.

Table 3. Summary of Variance, Amount and Distribution of Cognitive Levels (Operational Verbs) in Biology Class 10 (KD 33.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.8, 3.9, 3.10, 3.11, 4.1, 4.2 , 4.3)

No	KD	Sebaran dan Jumlah KKO					
		C1	C2	C3	C4	C5	C6
1	KD 3.1	6	9	2	2	1	-
2	KD 3.2	7	22	-	-	-	-
3	KD 3.3	-	27	-	-	-	-
4	KD 3.4	6	3	2	1	-	1
5	KD 3.5	4	-	3	2	-	-
6	KD 3.6	6	1	4	1	-	-
7	KD 3.7						
8	KD 3.8						
9	KD 3.9	3	15	11	-	-	-
10	KD 3.10	-	6	3	6	-	-
11	KD 3.11	-	3	1	5	-	-
12	KD 4.1	-	-	-	-	-	1
13	KD 4.2	-	-	-	-	-	2
14	KD 4.3	-	-	-	-	-	2
JUMLAH		32	56	24	17	1	6

Conclusion

Amount: The number of cognitive levels (the number of KKO) in class 10 in sequence from the most to the lowest are: C2 (56), C1 (33), C3 (24), C4 (17), C6 (6) and C5 (1)See in full article

The distribution of cognitive levels is uneven. KD 3.1 has C1 - C5. C6 only exists in KD 4.1, 4.2. 4.3. More detail in Table 4.3

The cognitive level for developing critical and creative thinking skills, especially C5 and C6 is still very little

Discussion

Variance, number and distribution of cognitive levels class 10 Biology Subjects in Curriculum 2013 related to verbs used in the KD formula. For example KD 3.4 Menganalisis struktur, replikasi dan peran virus dalam kehidupan; allows the emergence of C1-C5. KD 4.2 Menyajikan hasil observasi berbagai tingkat keanekaragaman hayati di Indonesia dan usulan upaya pelestariannya ; allow the emergence of C6. It is expected that teachers develop / add cognitive levels which are still small in number, for example C5 and C6. This needs to be done because C5 and C6 are related to

the development of students' critical and creative thinking skills as competencies that students must master in the 21st century. KD is a minimum competency.

KD 3.5: Mengidentifikasi struktur, cara hidup, reproduksi dan peran bakteri dalam kehidupan, in the data not found C5. Items Indicators (C5) that can be formulated are: Siswa dapat menilai ketepatan upaya yang dilakukan untuk mencegah bahaya bakteri. Item can write: Pak Lurah menyarankan agar selalu mencuci tangan sebelum makan agar bakteri tidak terbawa makanan yang dimakan. Benarkah saran pak Lurah? Tuliskan pendapatmu/alasanmu.

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Development of Problem-based Learning Module Based on the Allium sativum's Potency in Hyperlipidemic Mice to Improve Student's Critical Thinking Skills and Cognitive Learning Outcomes

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Abstract. The learning module was developed based on the background of initial skills analysis of Biology undergraduate students at Universitas Negeri Malang that showed their critical thinking skills and cognitive learning outcomes need to be improved. This study aims to produce a module based on PBL syntax using a phenomenon that happens in the student's life basis. This study used ADDIE model to develop the module. Validity, practicality and readability of the module tested by the experts. The Students' critical thinking skills were tested with PBL worksheet inside the module for experiment class, while control class were using ordinary worksheet prepared by the lecturer. The cognitive learning outcome tested by students' gain score. The analysis result shows that the developed module could improve critical thinking skills and cognitive learning outcomes. The findings show that the average value of critical thinking skills in the experiment class was higher than control class (16.2 > 13.1). The average value of gain score in experiment class was higher than control class (0.75; high-g > 0.57; medium-g). ANACOVA results (P= 0.000) also prove that this difference is caused by the treatment. This result concludes that the developed module improved undergraduate student's critical thinking skills and cognitive learning outcomes in Universitas Negeri Malang.

Introduction

The qualification of graduation standard and learning achievement of an undergraduate student is set in the Indonesian national qualification framework curriculum (KKNI) [1] which is mastering theoretical concept, presenting solution of procedural problem, and selecting alternative solution based on the analysis result [2]. The KKNI qualification is achieved by undergraduate students of Biology Department in Universitas Negeri Malang is accompanied by an expectation that students have the 21st-century skills. One of the skills related to the achievement of Biology students is critical thinking skills. Critical thinking skills have the same achievement element as

KKNI's, i.e. demanding students to formulate, analyze, and solve problems [3].

The importance of critical thinking skills is supported by an analysis result in lectures activities of Animal and Human Physiology in the Biology Department of the Universitas Negeri Malang. The analysis activity consists of basic competencies analysis (analyzing the change in CPMK, which later know to be dominated by analytical skills/C4 and solving life-based problems), analysis of student's initial ability (the initial critical thinking skills and cognitive outcomes of students are tested and shows that the average score obtained is 57.51 which consider in low level/ need to be improved) [4] and learning need analysis.

The student's critical thinking skills and cognitive learning outcomes can be improved through the provision of student-centered [5] and a problem-based learning experience [6]. One of them is presenting teaching materials in accordance with the determined criteria, which is to provide a student-centered and problem-based learning module [7]. Problem-based learning modules could facilitate students to focus on problem-solving [8] through identification and investigation activities, present a systematic learning experience, and facilitate a constructive and self-directed learning process [9]. The module also self-instructed, self-contained, stand-alone, adaptive, and user friendly [10]; therefore, it supports learners' contribution and active interaction in the learning process [11]. The module as a teaching material has some advantages, such as applies independent or self-directed learning [12] and can be used to train and measure specific skills.

The module applies a constructive learning process that presents topics for investigation activities, accommodates an active, recursive and sustainable learning process, and provides feedback for students to reflect on their learning outcome and learning process [13]. Therefore, it trains students to reason, analyze, evaluate and provide solutions to a problem [14]. The problem-based learning module provides problems as a stimulus that raised from real events in students' life. The real event that closely related to digestive physiology topics is the excessive junk-food consumption level, which is one of a high-fat diet. Excessive junk-food consumption could cause a high lipid level or hyperlipidemia that triggers various diseases such as hyper cholesterol, diabetes, and obesity [15]. Prevention of hyperlipidemia without side effects can be done by utilizing natural ingredients with the ability to decrease lipid levels in the blood, one of it is utilizing Allium sativum extract which contains organosulfur compounds with lipid-lowering agent [16]. The potential of Allium sativum in reducing lipid levels can be proved through laboratory research by injecting Allium sativum

extract into hyperlipidemic mice. The results of this laboratory research are used as a base to make a stimulus or problems in a problem-based learning module and contextualize the material in the form of phenomenon presentation.

The whole systematics of the learning process that is student-centered, self-regulated, and constructive to improve students' critical thinking skills and cognitive learning outcome is composed in the form of a module. Based on the elaboration of analysis and problem background research is proposed to develop a module based on problem-based learning according to a research result on Allium sativum's potency in reducing lipid level in hyperlipidemic mice to improve students' critical thinking skill and cognitive learning outcome that is valid, efficient, and effective.

Materials and Methods

Research subject

The research participants for validity and practicality tests were FMIPA lecturers of Universitas Negeri Malang. The research for the readability test, product trial test and implementation test were students of the Biology Department of Universitas Negeri Malang. The research was conducted from April to December 2018 at the Biology Department Universitas Negeri Malang.

Research procedure

Analyze. Analysis activities were conducted to look for research background and development to be done.

Design. Design activities were conducted by compiling the achievement of Animal and Human Physiology course and KKNI achievement, content to be developed, and critical thinking skills to be trained and improved; making storyboard; and design product feasibility test instruments.

Develop. This was a stage to develop the product/ module content which was consisted of laboratory research to test Allium sativum's potency in reducing lipid level in hyperlipidemic mice and developed it into a PBL module to improve critical thinking skill and cognitive learning outcome and perform a module feasibility test.

Implement. The product implementation test was performed on students of the Biology Department of the Universitas Negeri Malang using non-equivalent control group design with pretest and posttest. The implementation test design table is presented in Table 1.

Table 1. Non-equivalent control group design

Subject	Pretest	Treatment	Posttest
Control class	O1	X1	O2
Experimental class	O1	X2	O2

Evaluate. This stage is to evaluate the result of the developing module for improving students' critical thinking skills and cognitive learning outcomes. The criteria and technique to conduct evaluation are described in Table 2.

Table 2. Criteria and Technique of Product Evaluation

Type of Data	Evaluation Technique	Conclusion	
		Criteria	Description
Critical thinking skills	Value = $\frac{\text{score}}{\text{Max score}} x100$	91 – 100	Excellent
		75 – 90	Good
		65 – 74	Fair
		54 – 64	Low
Cognitive learning outcome improvement	N-gain score $g = \frac{Sf - Si}{100 - Si}$	g ≥ 0.7	High-g
		0.7 > g ≥ 0.3	Medium-g
		g < 0.3	Low-g

Result

Analyze

The result of the analysis activity was the need to improve students' critical thinking skills and cognitive learning outcomes. The background was that the result of students' initial critical thinking and cognitive learning outcome test was low (more than 50% students received a score of 54-64; Low).

Design

Mapping the linkage between achievement in Animal and Human Physiology course and KKNI achievement with content and critical thinking skills aspect to be improved were essential to developing content in the module. The mapping is presented in Table 3. In addition, the stage also produced the product's storyboard, and product feasibility test instruments consisted of validity test, practicality test and module readability test sheets.

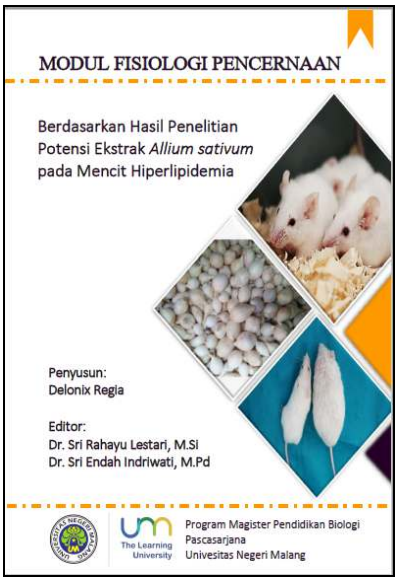
Table 3. Content Design of Problem-Based Learning Module to Improve Critical Thinking Skills and Cognitive Learning Outcome

PBL Syntax	Educator Activity	Module Content	Critical Thinking Skills Aspect	Cognitive Achievement
Orient students to the problem	Present learning objectives, motivate students' involvement in the learning process	Objectives, learning indicators, content & phenomenon	Analyzing information; data, ideas or concepts	C3
Organize students to study	Guide students to determine problem-solving assignment	Student activity instruction		
Assist independent and group investigation	Assist students in gathering information, conduct investigation, and look for solution	Student worksheet containing questions that train critical thinking skills	Applying procedures, formulas, principles or theme	C4
Develop and present artefact and exhibit	Assist students to present artefact/solution as well as inform the result		Presenting multiple solutions, position or perspectives	C5
			Drawing well-supported conclusions	C3
Analyze & evaluate the problem-solving process	Guide students to monitor and reflect their learning process result	Reflection on students' critical thinking activity on phenomenon presentation.	Synthesizing ideas into a coherent whole	C4

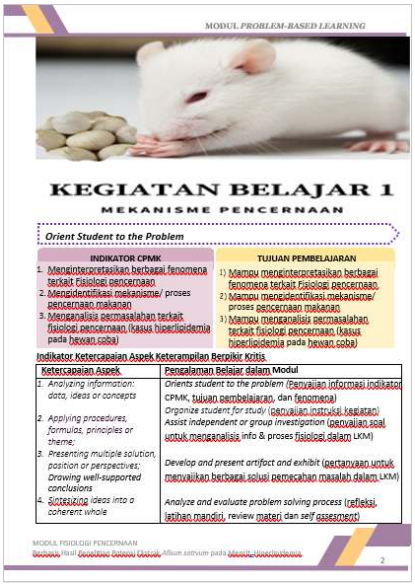
Develop

The result of this stage was a laboratory research result on Allium sativum's potency in reducing lipid level of hyperlipidemic mice that later used as a basis of content development, especially in part of phenomenon and content in PBL-based module to improve students' critical thinking and

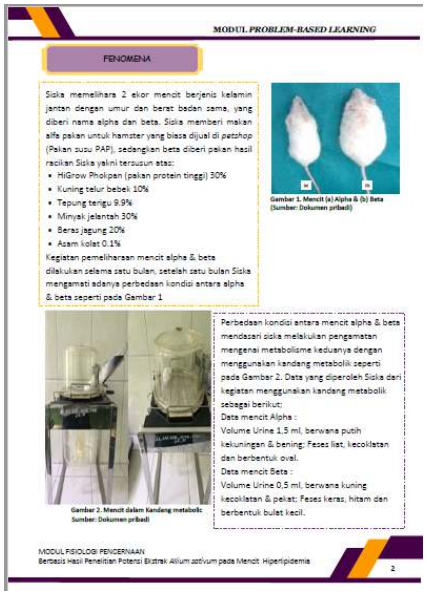
critical learning outcome. The module was compiled based on mapping grid, and the storyboard made. Product/module display according to the result of development is illustrated in Figure 1.



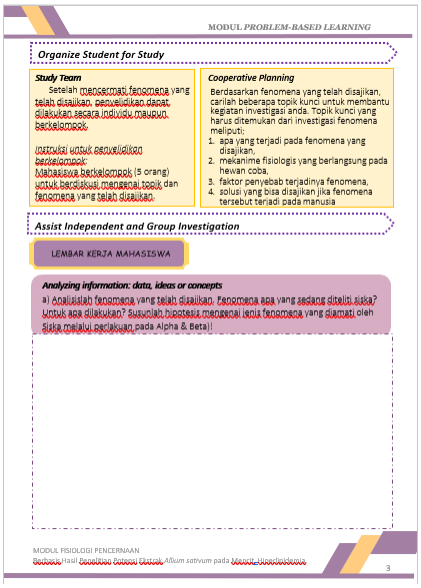
(a). Module cover page



(b). The initial part of learning activity



(c). Phenomenon page from laboratory research result



(d). Student working sheet

FIGURE 1. Product Development Result

The develop stage was also a stage where product/module feasibility test was performed. The result is described in the following tables.

Table 4. Result of product validity test (content)

No	Indicator	Average(%)	Criteria
1	The suitability of the module title with the content	100	Very valid
2	The suitability of the module introduction body	100	Very valid
3	The suitability of the module core part	100	Very valid
4	The suitability of the module closure part	100	Very valid
5	The suitability of the content	85	Valid
6	The suitability of the module content with PBL syntax & critical thinking skill aspect	100	Very valid
7	The suitability & consistency of words selection	75	Valid
8	The suitability of font layout, & illustration selection	100	Very valid

Table 5. Result of product validity test (module)

No	Indicator	Average (%)	Criteria
1	Self-instruction	91.6	Very valid
2	Stand alone	87.5	Very valid
3	Adaptive	87.5	Very valid
4	User-friendly	83.3	Valid
5	Module graphic	75	Valid

Table 6. Result of product practicality test

No	Aspect	Average (%)	Criteria
1	The suitability of the title with the module content	100	Very practical
2	The suitability of the content with the course objectives and achievement	100	Very practical
3	The suitability of the content with Animal and Human Physiology science	100	Very practical
4	Language	100	Very practical
5	Graphic	75	Practical

Table 7. Result of a product readability test

No	Indicator	Average (%)	Criteria
1	Title attractiveness	82.50	Very practical
2	The clarity of instruction for using the module	92.50	Very practical
3	Content readability	82.50	Very practical
4	Clarity of language selection	85	Very practical
5	Display attractiveness	97.50	Very practical

Implement

The implementation stage data consisted of students' critical thinking skill and cognitive learning outcome scores. The average critical thinking skill score is elaborated in Table 8.

Table 8. The average score of critical thinking skill

No	Aspect	Average of Initial Score	Average Score of Class Control	Average Score of Experimental Class
1	Analyzing information; data; ideas or concept	2	2.6	3.6
2	Applying procedures, formulas, principles or theme	2.3	2.4	2.5
3	Presenting multiple solution; position or perspective	2	3.3	3.8
4	Drawing well-supported conclusions	2.3	2.2	2.7
5	Synthesizing ideas into a coherent whole	2.3	2.6	3.7
	Total Score	10.9	13.1	16.3

Note:
Initial score: score before product implementation
Control Class: a class where the developed module is not used in the lecture
Experimental class: a class where the developed module is used in the lecture
The maximum score of Analyzing information, data, ideas or concepts aspect = 4
The maximum score Applying procedures, formulas, principles or theme aspect = 3
The maximum score of Presenting multiple solutions, position or perspectives aspect = 5
The maximum score of Drawing well-supported conclusions aspect = 3
The maximum score of Synthesizing ideas into a coherent whole aspect = 4

The result of students' cognitive learning was obtained from pretest and posttest scores in the experimental and control classes. The average pretest and posttest score in the experimental and control classes is indicated in Table 9.

Table 9. Average of pretest & posttest score

No	Class	Average Pretest	Average Posttest	Differences
1	Control Class	46.51	77.78	31.27
2	Experimental Class	48.72	87.12	38.40

Evaluate

The average score of each critical thinking skill aspect in the experiment class indicated a higher score than the control class. In addition, the experimental class showed higher percentage of increase in score for each

aspect obtained before and after the implementation of product. Table 10 describes the increase in score of critical thinking skill aspect.

Table 10. Percentage of increase in score for critical thinking skill aspect

No	Aspect	Control Class	Experimental Class	Difference
1	Analyzing information; data; ideas or concept	An increase of 23.08%	An increase of 44.44%	21.37%
2	Applying procedures, formulas, principles or theme	An increase of 4.17%	An increase of 8.00%	3.83%
3	Presenting multiple solutions; positions or perspectives	An increase of 39.39%	An increase of 47.37%	7.97%
4	Drawing well-supported conclusions	A decrease of 4.55%	An increase of 14.81%	19.36%
5	Synthesizing ideas into a coherent whole	An increase of 11.54%	An increase of 37.84%	26.30%

Students' cognitive learning outcome was evaluated in terms of its increased level using N-Gain score analysis between pretest and posttest. The increase in the cognitive learning outcome in the experimental class indicated students' average gain score of g= 0.75. If g ≥ 0.7 it suggested that there was a high significance between pretest and posttest in the experimental class (high-g). Whereas, average gain score obtained by students in the control class was g= 0.57, where if 0.7 > g ≥ 0.3. This results means that the class control indicated a medium significance between pretest and posttest scores. this data also supported by independent sample t-test analysis results that the p value is 0,000 which is < 0,05. This results shows that there is a statistically significant or significant difference in the probability of 0.05 between the average results of control class and experimental class. It indicates that the increase in learning outcome in the experimental class was higher than in the control class.

Discussion

The product produced from the research and development was a problem-based learning module according to a research result on Allium sativum's potency in reducing lipid level in hyperlipidemic mice to improve students' critical thinking skill and cognitive learning outcome that is valid, practical, and effective. Revision is required for the improvement and perfection of the developed product based on suggestion, comment and supplement from validators, field practitioners, and students' response. Revision done to the

module was related to the topic of content suitability with the scientific field, language and module graphic. The suitability of content was vital in compiling a module as a teaching material since the module applied constructive learning [17] and assisted students in developing self-understanding.

The module applied a constructive, student-centred, and self-directed learning process. The large active role and contribution of students in the learning process would motivate students to find and develop their own concept (self-discovered) through experiences and things learned; thus, the understanding gained by students would be more in-depth and attach and not easily forgotten [18]. One of factors influencing the active role in using the module as a teaching material was the attraction and convenience in using the module accommodated by interesting graphic thus supported maximum use. The fact is that learning process is started from new science grasp by the five senses as empirical data and then cognitively processed in brain into an understanding. The base is that understanding will occur when learners or students could develop a meaningful connection between verbal representative and visual [19].

The result of the module implementation test indicated that problem-based learning module according to a research result on Allium sativum's potency in hyperlipidemic mice proven to improve students' critical thinking skill and cognitive learning outcome. The result suggested that students' essential thinking skill can be enhanced using a module based on problem-based learning syntax according to problems raised from the research result since it facilitated constructive and interactive learning process as well as self-reflection by students [20].

The increase in students' critical thinking skill through the use of the module was closely related to the role of problem-based learning syntax containing in the module. The syntax was useful as guidance or order in mapping students activities and encouraging students to directly involved in the learning process as well as shape their own understanding [20,21], analyze the situation, think systematically and various problem-solving possibilities, and able to find the best solution [22]. The syntax could also train students' skill in analyzing, solving problem, and synthesizing problem-solving result [23].

The problem-based learning module that was according to a research result on Allium sativum' potency in reducing lipid level in hyperlipidemic mice proven to improve students' critical thinking skill as well as a cognitive learning outcome. The syntax in the module that was systematically compiled could help students' way of thinking and increase students'

cognitive learning outcome [24]. It was due to the increase in cognitive learning outcome was also related to the increase in students' critical thinking skills [25]. Moreover, the students with learning experience using problem-based learning according to a research result on Allium sativum's potency in hyperlipidemia mice obtained feedback from the thinking activities and was able to monitor critical thinking and the righteous of its learning process; therefore the established students' understanding was stronger and correct [26].

Summary

To sum up all, the module that developed with problem-based learning module syntax according to a research result on Allium sativum' potency in reducing lipid level in hyperlipidemic mice are proven to improve students' critical thinking skill as well as a cognitive learning outcome. Therefore, it can be used to improve students' critical thinking skill as well as cognitive learning outcome.

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The Development of Problem Solving Module Based on Research at the Level of Advanced Glycation End Products (AGEs) of Hyperlipidemic Mice Model to Improve Student Critical Thinking Skills

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Abstract: Problem-solving modules based on research results is one of the teaching materials that can help students to learn more deeply and train and improve their higher-order thinking skills. The purpose of this study was to produce problem-solving based modules based on the results of research on advanced glycation end products (AGE) mice model of hyperlipidemi to improve of student's critical thinking skills. The development of the model of ADDIE and product validity was measured based on a validity test by media experts, material experts, and field practioners. Data were analyzed using anacova and Quade's rank analysis of covariance. The results showed that the average critical thinking skills in experiment class were higher than control class in each aspect of critical thinking skills. The average value of gain score in experiment class is higher than that of in control class (0.73; high-g > 0.49; medium-g). ANACOVA results (P= 0.000) also prove that this difference is really caused by the treatment. Based on the result can be concluded that a problem-solving module based on research can use to improve undergraduate student's critical thinking skills in the University of Muhammadiyah Malang.

Introduction

Curriculum for the college is a competency-based curriculum and learning outcomes that must be adapted to the Indonesian National Qualification Framework (KKNI), which has a qualification level with nationally agreed learning outcomes (0). It is stated in the Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 49/2014 that college graduates must be able to apply their field of expertise field in problem-

solving and help students achieve the specified competence (1). To achieve these KKNI demands, student's need to be equipped with 21st century life skills. Life skills of the 21st century are important and according to the SN Dikti one of the skills that needs to be developed is critical thinking.

In globalization era, college graduates must have critical thinking skill. Current globalization era make it easy for each individual to obtain information, receiving information as well as conveying that information to other individuals even though far away2. Therefore, students must be able to analyze every information obtained and critical thinking could guide students making decisions and solving the problem appropriately. Critical thinking skill is one of things that need to be considered in producing an individuals that can fulfill global demands 3. Efforts to achieve competence according to KKNI and 21st century skills could be applied in Anatomy of Human Physiology course biology education University of Muhammadiyah Malang.

Facts in field indicate that in Anatomy of Human Physiology course of Biology Education of University of Muhammadiyah Malang shows that students' critical thinking skills is low. It is obtained from student worksheet in Digestive System material that in aspect of analyze is 40,62, use data to develop critical thinking is 33,12, apply is 30,62, synthesize is 28,75, evaluate is 25,52. The low students' critical thinking skills could be related to the difficulty in learning experienced by the students. About 91.2% experienced difficulty in following the lecture in Anatomy of Human Physiology course in Digestive System subject. The reasons include less interactive learning process, difficulty in applying the subject to the daily life, and less availability of relevant learning sources. Therefore, a learning source that able to facilitate the learning is a necessity. Further study on learning process of Anatomy of Human Physiology course found that the learning has not equipped with a more contextual teaching materials. It still refers to text books and reference sources provided by the lecturer.

The low students' critical thinking skills lead to the necessity of teaching materials that are contextual and can increase student independence to practice critical thinking skills, one of the teaching materials that is suitable and according to students' needs is a module 4. Animal physiology modules based on research can improve students' competency and critical thinking skills. In addition, it can be used as teaching material for animal physiology courses in college 5. Development module based on research is one of action that could expand the content applicatively 6. Therefore, a relevant research can be used as learning material in college so that the research can be beneficial.

Modules will trigger the learning process to become contextual by providing current information and improving critical thinking skills 7. The advantage of using modules is that it can motivate students through supplemental materials that are applicable and prepared with information for the conferred material 8. Module selection based on research is according to constructivism learning theory. Through constructivism learning, the student can understand the concept well 9. In the constructivism theory, learners must construct their knowledge by themselves according to their prior knowledge and experiences so that the new knowledge can be obtained 10. Learning models that can develop critical thinking skills based on constructivism is problem-solving that can improve student cognitive during learning.

Problem-solving is a method that can be used to improve critical thinking skills in problem-based learning that prioritizes student strategies in solving problems 11. The presence of a problem could encourage students to be able to solve problems quickly. Problem-solving involves identify, explore solution alternatives, implement alternatives or solution chosen, and bring a result called conclusion 12. Critical thinking skills can be identified through the provision of problems that are expected to be the basis for the development of modules related to the anatomy of the human physiology course. Description of students' critical thinking skills obtained from various questions compiled according to Polya problem solving syntax.

Materials and Methods

Research Design and Sample

The development research used an ADDIE development model consisted of 5 stages: Analysis, Design, Development, Implement, and Evaluation 13. The analyze stage was conducted by distributing a questionnaire on teaching material need analysis to one responsible lecturer and students who have taken anatomy of human physiology course that consisted of 35 Biology education students at the University of Muhammadiyah Malang. The Design stage was carried out by listing all components in the development of modules in the form of materials about advanced glycation end products, composing product designs, and composing product assessment instruments. The Development stage was performed to produce a products in accordance with the design, conduct a formative revisions after validation by media experts, material experts, validation of field practitioners with a minimum educational background of S2 and having experience in their

fields. Then, a trial was conducted a small-scale to 20 undergraduate students of biology education comparised 20 students to perform a readability test thus practicality data of the digestive system module that had been developed would be obtained. Further, effectiveness test was carried out to 35 students in experimental class and control class for two meetings from problem solving-based module in the developed digestive system subject. Quantitative data were validation result and quantitative data were in form of suggestion and comment from validators. The critical thinking skills test uses the rubric of critical thinking skills adapted by Greenstein (2012) on a scale of 1-4. Data were analyzed descriptively using ANCOVA to identify the increase in overall critical thinking through pretest and posttest scores.

Results

The product resulted was in form of problem solving module based on research at the level of advanced glycation end products (AGEs) of hyperlipidemia mice model to improve critical thinking skills. The problem solving-based module consisted of three learning activities, namely the organs and physiology digestive system, absroption of food substances, and metabolism digestive system. The module is also equipped with cover, foreword, glossary, table of content, introduction, learning activities, references, and biography.

The effectiveness test of problem solving-based module on students' critical thinking was done through a pseudo experiment. The test was conducted to find out the differences between students who applied the module on digestive system subject and students who used conventional learning. Data on the pseudo experiment research result were in the form of pretest and posttest score of critical thinking. The summary of students' pretest and posttest result is shown in Table 1.

Table 1. Average of an increase in pretest and posttest score of critical thinking skills

No	Variable	Class	Average of Pretest	Average of Posttest	Increase (%)
1	Critical thinking skill	Control	43.28	84.85.	68.75%
		Experiment	50.28	70.00	61.72%

Nonparametric analysis selected was Quade's rank analysis of covariance. Based on the analysis result, calculated F-value was 70.394 with p-value 0.000 ($p < 0.05$). Therefore, the problem solving-based module had an

influence on students' critical thinking since the average of the experiment class was higher than the control class. The hypothesis testing result concluded that there was "a difference". Thus, it can be inferred that students' critical thinking in the experiment class was significantly higher than the control class

Discussion

A module is a printed teaching material related to a learning unit that is detail 14,15, stand-alone and consists of a series of learning activities used to assist students to achieve learning objectives 15. Problem solving-based module according to a research result was compiled as an additional learning media in Anatomy of Human Physiology course at the University of Muhammadiyah Malang.The test result indicated that there were differences in the average score of critical thinking skills between students in the experimental class and control class. The average critical thinking score in each aspect experienced an increase in every learning activity. It suggested that the application of problem solving-based module could improve students' critical thinking skills 16,17.

Students' critical thinking skills have improved because students read and pay attention to every hint and step in the module 17,18. Moreover, the phenomenon presented was general problems occurred in daily life so that students were easy to understand 18. Problems that exist in daily life can be used as student learning material in solving problems 19. Therefore, students are required to have critical thinking skills to make the right decision in every problem that they solved. Someone who has critical thinking skills has a tendency to behave critically (for example: having high curiosity) 20 and has analytical, concluding and evaluative skills 21–23.

The application of module based on problem-solving according to a research was able to improve students' critical thinking skills. It was due to the module that provided various examples and explanation related to the research that make students to read repeatedly. In the control class, there was only an explanation about the research but no module. The developed module based on problem solving in the digestive system subject integrated critical thinking skill aspects consisted of use data to develop critical insight, analyze, apply, synthesize, evaluate 24 visualized through phenomenon, student worksheets, material review, independent exercise, and self-assessment in content of the module 18,25,26. The activities presented in the module are organized in a structured way to support students' thinking processes through problem-solving activities, and conceptual questions 27, case samples, and laboratory practice so that students became more active

in learning 16,28 and able to develop ideas about the material being studied more thoroughly27. Exercises aimed to make students actively learned and in the end, can understand the content discussed in the learning activity 8.

Learning activities consisted of cases, laboratory practice, and observation that could help students to understand the phenomenon and facts in the digestive system related to daily life; therefore, it assisted students' critical thinking16. The cases in student learning activities related to facts and daily life can help in applying solving problems experienced by students.29, can help evaluate every solution chosen, and encourage critical thinking to overcome and solve problems 30. Laboratory practice contained in the student worksheet helped students to be more active in solving problems, analyzing problems, and finding their own concept according to previous experiences 19. Evaluation activity was performed through self-assessment to find out self-weaknesses and designed to overcome the weaknesses using self-thinking 21.

Summary

According to the result, it can be concluded that problem solving-based modules, according to a research result on hyperlipidemia-model mice could improve students' critical thinking skills indicated by differences in critical thinking skills between students in the experimental class and control class.

Acknowledgments

Thanks to the grant of this research with No. 1.3.46/UN32.14/LT/2018.

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The Analysis of Student's Mathematical Representation Errors in Solving Mathematical Problem-Solving Problems and Giving Scaffolding

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Abstract. One of the very important thing in solving mathematical problem-solving problems is mathematical representation, where through mathematical representation, a mathematical problem can be clearly described. Mathematical representation errors often occur in solving mathematical problem-solving problems. This research aims to describe the types of errors in mathematical representation of students. Furthermore, the types of scaffolding is carried out to overcome mathematical representation errors. This research was conducted in grade VIIIe Laboratory Junior High School State University of Malang. The used instrument consisted of a preliminary test and problem-solving test. In this study, scaffolding is given when students make mistakes or encounter difficulties while solving the Problem-Solving Test. The results of the study are analyzed so that it can provide an overview of student's mistakes so that the cause of the errors can be known and how to provide the right scaffolding. From this research, three mathematical representations were made by all subjects and they did not do all phases in some problem.

Introduction

Representation is a picture of something that can be understood by others. Goldin [1] states, a representation is a configuration of signs, characters, icons, or objects that can explain, or "represent" something else. Whereas Hwang [2] defines representation as the process of modeling concrete things in the real world into abstract concepts or symbols. Furthermore, Goldin [3] explains mathematical representations are visible or real productions such as diagrams, number lines, graphs, mathematical expressions, formulas, and equations, which embody mathematical ideas or relationships. Students can develop and deepen their understanding of mathematical concepts and relationships as they create, compare, and use various representations [4].

Representation is needed in solving mathematical problems. Astin and Bharata [5] describe the ability of mathematical representation: (1) Visual (diagrams, graphs, or tables, images), (2) Equations or mathematical models, and (3) Words or written text. Furthermore, Montague [6] states that successful problem solving is not possible without first representing the problem correctly. One characteristic difference between successful and unsuccessful problem solvers is the number and types of representations they bring to the problem [7]. So in solving mathematical problems, students need the ability of representation that can represent the problems.

Carson [8] states that a problem is a situation that confronts individuals or group of individuals, which requires resolution, and which individuals do not see a clear way or process to get a solution. While problem solving is an effort to find a way out of a difficulty to achieve a goal that is not directly achievable [9]. Problem solving in this study refers to problem solving according to Polya [9]: understanding problems, devising a plan, carrying out the plan, and looking back. The Polya step was chosen because it can help students in the problem solving process (Lesh and Zawojewski in Reys [10].

Based on observation at grade VIIId in Laboratory Junior High School State University of Malang on April 10, 2019, the results showed that of the 27 students given the preliminary test, only 1 student could complete the test. Whereas the other 26 students cannot solve the problems and make many mistakes such as: writing wrong information that is known, error calculating operation, and incorrectly representing inequality. Lannin et al [11] explain that 'mistakes from students, the teacher can know the extent of students' understanding of the material and be a reference for providing assistance. Galler and Yovanoff [12] state that error analysis focuses on weaknesses and helps teachers classify students' mistakes.

Slavin [13] states that the term scaffolding has the meaning of providing assistance/support to children during the initial stages of learning and then eliminating it. In order to provide guidance according to the right level of guidance, there are several levels of scaffolding. Anghileri [14] states that there are three levels of scaffolding practices: (1) environmental provisions, (2) explaining, reviewing and restructuring, (3) developing conceptual thinking. From the explanation above, it is important to analyze students' mathematical representation errors. So the researcher wants to analyze the mathematical representation errors of students and give scaffolding when students solving mathematical problem-solving.

Methods

The approach of this research was a qualitative approach. The study was conducted on April 11, 2019 at the Laboratory Junior High School State University of Malang. This research was conducted to find out and examine the mathematical representation errors made by subjects in solving mathematical problem-solving problems. A total of 27 students of grade VIII have taken the initial test. The researcher and mathematics teacher in the class choose one student from each type of representation error. So that three students (S1, S2, S3) assigned as research subjects were given problem-solving test and given scaffolding if they made a mistake or encountered difficulties while working on it. Furthermore, the subjects were interviewed to find out the cause of mathematical representation in solving problems.

Mathematical representation errors that examined in this study are adapted from previous research by Susilo [15] which is described based on the types of representations: (1) visual representation errors, (2) symbolic representation errors, and (3) Verbal representation errors. Indicators of mathematical representation errors in solving problems in this study can be seen in Table 1.

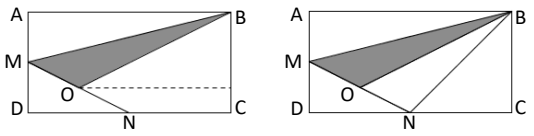
TABLE 1 . Mathematical Representation Errors that May Occur in the Problem Solving Process

	Representation	Error Description
Understanding Problem	Visual	Presenting an incorrect picture from information in the problem
	Verbal	The words presented are not appropriate based on the information
	Symbolic	Incorrectly using mathematical symbols or notations to present information
Devising a plan	Visual	Incorrect in making problem solving strategies in the form of images
	Verbal	Incorrect in making problem solving strategies in the form of words
	Symbolic	Incorrectly using mathematical symbols to make mathematical models
Carrying out the plan	Visual	The picture made wrong in solving the problem
	Verbal	The words used are wrong in solving problems
	Symbolic	Incorrectly manipulating mathematical expressions to solve problems
Looking back	Visual	Incorrect drawing conclusions in the form of images
	Verbal	Incorrectly concludes the answer obtained
	Symbolic	Incorrect checking the solution that has been obtained

Results

S1 Student's Work, Representation Errors in Solving Problem-Solving Problems, and Scaffolding Given.

In the understanding problem phase, S1 understands the problem but does not write it in the answer. In the devising a plan phase, S1 makes a plan by drawing an ABCD rectangle first as an initial strategy. The work of S1 can be seen as follows:



~~b) Determine the area of AMB, MBN, NOB, NBC triangle then subtract the ABCD recatangle~~

b) Find the length and area of the rectangle then besides BMO

FIGURE 1. S1 student's work on problem a and b

S1 student failed to carrying out the plan phase, that is, cannot make point O because there is no MN segmen on the ABCD rectangle. Scaffolding is given to S1 by asking students to tell what is known from the problem. Researcher also provide scaffolding in the form of parallel modeling. S1 did not do the looking back phase because S1 is sure of the answer and only makes 1 possible BMO triangle in the ABCD rectangle.

In problem b, S1 cannot do understand the problem phase. S1 thinks that calculating the area of a triangle must know how long the sides are. So S1 writes "find the length and area of the rectangle". Then S1 also cannot do the devising a plan phase because it is not wonted to problem with verbal forms like this. Then in carrying out the plan phase, S1 also write the phrase "then besides the BMO angle is removed". Besides that S1 did not does looking back phase because S1 did not know of any other way to answer problem b. Scaffolding given to S1 can be seen in the following dialog.

R : How to find area of BMO? (probing question)
S1 : (silent)
R : For example, there is a triangle like this (inside a rectangle). Then there is shading outside. To find the area of this shading, the area of the rectangle subtract the area of the triangle, right? (parallel modeling)
S1 : Yes, sir
R : Then, for example there is a rectangle, there is a triangle shaded inside. You can subtract the area of a rectangle to the area of this, this, and this triangle. Can this method be used problem b? (parallel modeling)

S1 : Yes
R : What triangles are subtract? (prompting question)
S1 : DMN. What shape of this one, sir?
R : So in a geometric plane, you can make an additional line. For example, we may draw an additional line here. So there are triangles and trapezoid. In this problem, additional lines may be made. (parallel modeling)
S1 : like this sir? (making BN segment)
R : Yes. Then how to find the area of BMO? (prompting question)
S1 : The area of ABCD subtract with the area of AMB, MBN, NOB, NCB triangle
(R : Researcher as interviewer)

In problem c, S1 do understand the problem phase by writing down information that is known, but not writing what was asked. S1 mistakenly writes information that is "area" which is actually "width". Researcher provide scaffolding in the form of probing questions by asking S1 to mention information on the problem. In the devising a plan phase, S1 has difficulty determining the formula for inequality. S1 write "determine the circumference first" to determine area. So the researcher gave a probing question, which was asking whether it was necessary to determine circumference and ask what information was known from the problem. The S1's work can be seen in Figure 2.

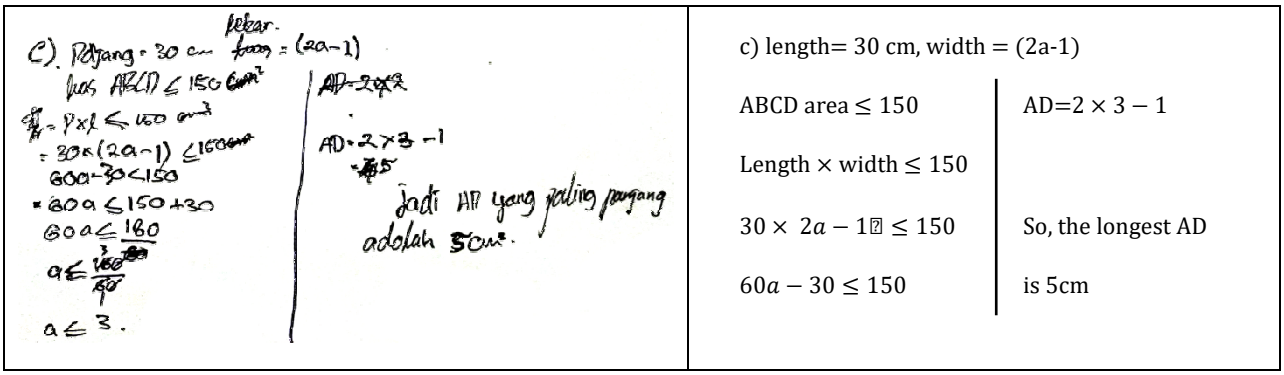


FIGURE 2. S1 student's work on problem c

In the carrying out the plan phase, S1 writes the unit when the solving the inequality and writes the "=" sign at the beginning in several row of inequality. Then the researcher explains that there is no "=" sign in the inequality. In addition S1 also forgot to write the sign "≤" on each line. So the researcher remind that the "≤" sign must be written.

S2 Student's Work, Representation Errors in Solving Problem-Solving Problems, and Scaffolding Given.

In solve problem a, S2 student immediately takes carrying out the plan phase without doing devising a plan phase. First, S2 misplaced the sequence of points from the ABCD rectangle, in the order A-B-D-C. So the scaffolding given to S2 is probing questions and parallel modeling. S2 cannot create BMO triangles because making ABCD rectangles incorrectly. Through a parallel modeling about how to naming points on a rectangle, S2 can make ABCD rectangles correctly. Then to assist S2 in making BMO triangles, the researcher gave a parallel modeling by assuming a point P was in the middle of the JK line segment. With both parallel modeling, S2 succeeded in making a visual representation of BMO triangle. The results of the S2's work can be seen in Figure 3.

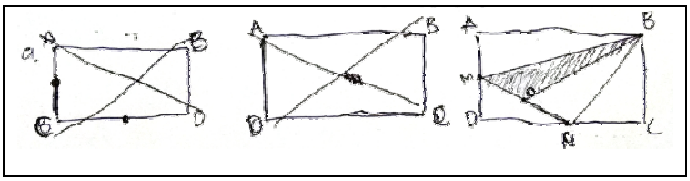


FIGURE 3. S2 student's work on problem a

In solving problem b, S2 does not understand the information in the problem. This is the same as what happened to S1. S2 made a verbal representation error by writing "to get the area of BMO needed only BMO/triangle may also be cut" which was identified as devising a plan phase. Then the researcher gave a parallel modeling, which is to find the area of shading outside an scalene triangle inside a rectangle. Through scaffolding, S2 gets an idea to solve problem b in the carrying out the plan phase. The S2's work on problem b can be seen in Figure 4

b) To determine area of BMO only needed BMO/the triangle can also be cut
b) subtract the area of rectangle by area of AMB, MDN, NBO, BNC triangle

FIGURE 4. S2 student's work on problem b

Then in the carrying out the plan phase, the researcher gave a probing question, apparently S2 did not understand how to solve the problem b. So the researcher gives another parallel modeling which explains that an the area of an irregular polygons can be determine by giving a guide line that divides the polygon into several regular polygons.

S2 made a lot of mistakes in solving on problem c. In the understanding problem phase, S2 understands the information in the problem but does not write it down. In the devising plan phase, S2 makes a mistake by writing "area 150", where it does not match the information in the problem. So the researcher gave scaffolding in the form of reviewing to ascertain whether the S2 understood the information in the problem or not. With a probing and promptiong question, S2 can make inequality correctly. The S2's work on problem c can be seen in Figure 5.

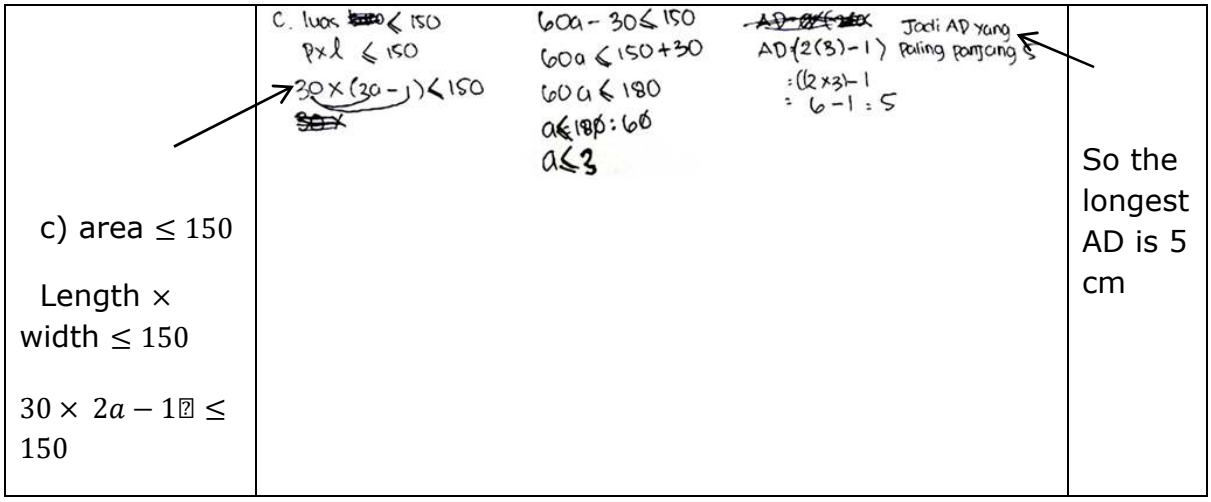


FIGURE 5. S2's work on problem c

On carrying out the plan phase, S2 makes a mistake in doing multiplication operations with distributive properties. To multiply 30 × (2a-1), S2 writes 30x. Therefore the researcher gave a scaffolding in the form of probing and prompting question. The parallel modeling, probing question, and prompting question lead S2 so that can overcome the difficulties when solving problem c in the carrying out the plan phase. S2 doing a looking back phase by writing conclusions from the answers that have been made.

S3 Student's Work, Representation Errors in Solving Problem-Solving Problems, and Scaffolding Given.

In solving problem a, S3 student understands the question asked but does not write it down in the answer. S3 did not does devising a plan phase and immediately drew to does carrying out the plan phase. At this stage, S3 incorrectly determines the order of points A, B, C, and D. The researcher gives scaffolding in the form of an probing question about the order of

naming the points on the rectangle. After being given an probing question, S3 hasn't realized his mistake. Then the researcher gives a parallel modeling, that is the sequence of naming points on a regular pentagon. The results of S3 work on problem a and b can be seen in Figure 6.

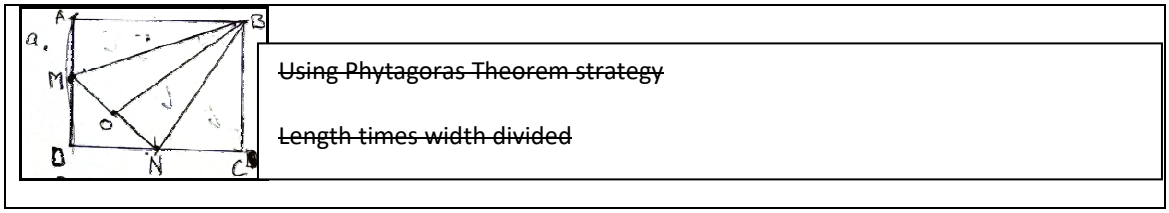
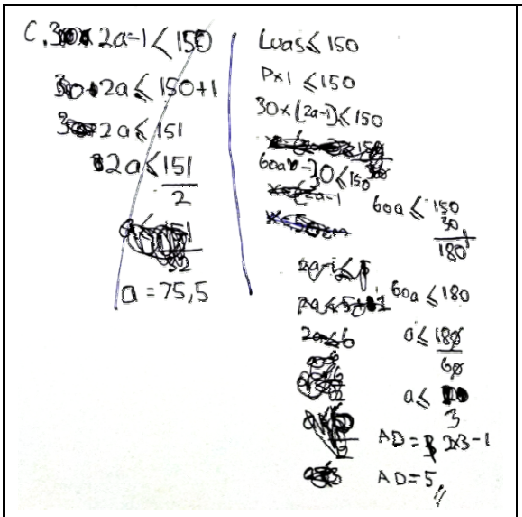


FIGURE 6. S3's work on problem a and b

In solving problem b, S3 says the same thing as S1 and S2. They are not wonted with verbal questions as in this research, so they cannot understand the problem, devising a plans, carry out the plans, and looking back. Initially S3 wrote the answer "using the Pythagorean theorem strategy" which was identified as devising a plan phase. However, the sentence is crossed out and write the sentence "length times width divided by two". Then the researcher gives an probing question to S3's answer, but S3 cannot answer and cannot continue the answer. Then the researcher gave S3 scaffolding in the form of a parallel modeling which is help to find the area of shading outside the triangle inside a rectangle.

With prompting questions, the researcher directs parallel modeling to carrying out the plan phase for the problem b. Next, the researcher gives a similar example of how to determine the area of an irregular polygon. Then, the researcher saw that S3 was wrong in writing down the area of triangle which was subtracted from the area of the ABCD rectangle in order to get the area of the BMO triangle. Just like S1 and S2, looking back phase is not done by S3. Meanwhile, the results of the S3's work on problem c can be seen in Figure 7.



c) ~~$2a - 1 \leq 150$~~ area ≤ 150

~~$2a \leq 150 + 1$~~ length×width≤ 150

~~$2a \leq 151$~~ $30 \times (2a - 1) \leq 150$

~~$a \leq 151 \div 2$~~ $60a - 30 \leq 150$

~~$a = 75{,}5$~~ $60a \leq 180$

$a < 180 \div 60$

FIGURE 7. S3's work on problem c

In solving problem c, S3 understands information and problems but does not write them down in the answers. In the devising a plan phase, S3 has a plan to solve the problem by finding the a, but S3 making inequality incorrectly. In the carrying out the plan phase, S3 is wrong because it doesn't use bracket "$()$" for "$2a - 1$" and writes "$<$" to represent the sentence "no more than".

Errors that occur in the beginning also cause errors in the next step which is dividing 151 by 2. By giving probing and prompting questions, researcher help S3 correct the mistakes. Then, S3 considers the multiplication sign as a variable. So that researcher provides prompting question that help S3 resolve inequality. S3 also did not make a back looking phase because he was sure of the answer.

Discussion

Visual Representation Errors and Scaffolding

In making a visual representation, three subjects make mistakes when answering problem a. The subject was wrong in making a sequence of naming the ABCD rectangular vertices. This error was made by S2 and S3. Therefore, researcher provide scaffolding in the form of a parallel modeling. Scaffolding in the form of a parallel modeling given by researcher in helping S2 and S3 is about naming the vertices on a polygon. Researcher provide examples in naming vertices on the pentagon, then directing the subject to

his work. Of all subjects given this kind of scaffolding, the subject succeed to correct his mistake.

Another error made by the subject when solving problem a is that the subject cannot make point O because there is no MN line segment. This error was made by S1 and S2, where researcher gave scaffolding in the form of a parallel modeling. The researcher gives an example of a point that is in the middle of a line segment. And this parallel modeling direct the subject to solving the problems. This is similar with Herlina [16] research which is explained most subject made visual represrentation errror from the data.

Verbal Representation Errors and Scaffolding

Mistakes that occur when solving problem b made by all subjects because the subject is not wonted to the verbal representations problem. This is parallel with research by Herlina [16] which explains that students have difficulty changing data into written words or text. Furthermore Herlina [16] states students are not accustomed to translating into verbal form because it is rarely given by the teacher during daily learning. In addition, there are subjects whose answers lead to one of the solutions that have been compiled by the researcher, but the subject cannot continue the answer.

To help the subject write a strategy in determining the area of the BMO triangle in problem b, the researcher gives a parallel modeling. In general, parallel modeling are used to make subjects understand to determine the area of BMO triangle. Then the other parallel modeling is used to make the subject understand how to determine the area of an irregular plane. With several probing and prompting questions, the researcher helps the subject solve problem b correctly.

Symbolic Representation Errors and Scaffolding

One of the mistakes made by the subject is writing information incorrectly. This error was made by S1 because they did not read the problem carefully. This is similar with Susilo [15] research which is explained that the subject made a symbolic representation errors because subject was not careful in representing the information that was known. Scaffolding given by researcher is probing question. Another mistake is the operation error to resolve the inequality that was made. This error is made by S1 and S2 which is wrong in operating "$30 \times (2a-1) \leq 150$". Researcher give scaffolding in the form of a parallel modeling. Widodo [17] states that procedural errors (arithmetic operations) carried out by the subject are

caused due to inaccuracy of subject in solving problems. So that, to correct procedural errors in this study, researcher gave the subject scaffolding as in a study conducted by Hapsah [18], where scaffolding was given to subjects who made calculation errors.

Conclusions

Based on the discussion of the results of the study, it can be concluded that the errors of the three mathematical representations were made by all subjects. Visual representation error occurs because the subject is wrong in making the sequence of naming the vertex of the rectangle, or unable to make the midpoint make the subject being unable to make the BMO triangle correctly. Verbal representation errors occur because the subject is not wonted to problems that use verbal representation. Symbolic representation error occurs because the subject does not understand the inequality symbol, incorrect in operation of multiplication with distributive properties, and students incorrectly solving the inequality that was created. Beside that, all subjects did not do all phases in some problem. Subjects who make mistakes at the understanding the problem phase make carrying out the plan phase also wrong. Scaffolding at the reviewing stage is given in the form of probing questions, prompting questions and parallel modeling.

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Determining Promotion Route of Indraprasta University using Greedy Algorithm

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Abstract. Data production of the university are abundant and sometimes causing waste of data. Therefore if we use data wisely, it can be analyzed into something useful. Geographic Information System (GIS) is a system designed to capture, store, manipulate, analyze, manage and present all types of geographical data. Greedy Algorithm is a simple, quick and easy algorithm for optimization; it is an algorithmic model that follows the problem-solving approach of making the locally sourced optimal choice at each stage with the hope of finding a global optimum. We will collect and analyzed the data, which was in line with system requirements. Steps of this research are system requirement analysis, system modeling; database design and user interface design. Aim of this study are to help campus management in making policy regarding the promotion route and to propose system to find an effective promotion route using greedy algorithm.

Introduction

These days, higher study fees makes business of higher education become competitive. Universities have to make the right marketing solution to gain enrollment. The current market strategy of Universitas Indraparasta is visiting schools to provide them with brochures, souvenirs, and to give them a quick presentation about university. Hence, universities need to find the best route of promotion to meet efficiencies.

Computer-based technologies currently penetrate in all aspects of human life and it becomes an overriding preoccupation. One of the most popular system information nowadays is Geographic Information System (GIS). It is design to capture, store, manipulate, analyze, manage and present all types of geographical data [1], [2]. GIS become one of a very useful tools for researcher, manager and decision-maker to solve optimization problems and make policies. There are a lot of data that can be retrieve from university, student's data, lecturer's data, staff's data, etc.

Methods

Greedy Algorithm

Greedy Algorithm is a simple, intuitive algorithm that is used in optimization. It makes an optimal choice at each step as it attempts to find the optimal solution [3], [4]. The greedy algorithm is one of the constructive algorithms that guarantee satisfying one important constraint of the hard constraint [5]. The main principle of greedy algorithm is "Take what you can get now".

Unified Modeling Language

Unified Modeling Language (UML) is a set of tools developed to assist analysts in uncovering the important features of a design project, finally arriving at a set of models that will be used to design, document, and implement the project, whether it is an information system or other software development projects. UML is a recent development based on object-oriented thinking and has gained popularity because many design projects that use databases also use software components such as webpages, intelligent agents and other software objects [6]. There are several types of UML diagram and each one of them has a different purpose, categorized into Behavioral UML diagram and Structural UML diagram. The types are broken down as follows:

TABLE 1. Types of UML Diagram

Behavioral UML Diagram	Structural UML Diagram
Activity Diagram	Class Diagram
Use case Diagram	Object Diagram
Interaction Overview Diagram	Component Diagram
Timing Diagram	Composite Structure Diagram
State Machine Diagram	Deployment Diagram
Communication Diagram	Package Diagram
Sequence Diagram	Profile Diagram

Related Work

In [7], the authors present Greedy Perimeter Stateless Routing (GPSR), a novel routing protocol wireless datagram networks that uses the positions of

routers and a packet's destination to make packet forwarding decisions. There is a developed system of finding nearest hotel using greedy algorithm [8]. This [8] system resulted hotel and route recommendation that provide tourist attraction using greedy algorithm.

Study of Geographic Information System (GIS) [9], The Implementation of GIS using Google Maps API in mapping the freshmen originated school.

Result and Discussion

The proposed system is a web-based geographic information system aiming to support marketing department of Universitas Indraprasta PGRI to find the best promotion route. There are predetermined criteria of sorting first-year students originated distribution academic year; faculty, department, city/regency, gender, group of study and religion. This GIS were developed using UML. The following Fig 1, 2, 3 shows Use case diagram, activity diagram and class diagram of Universitas Indraprasta GIS.

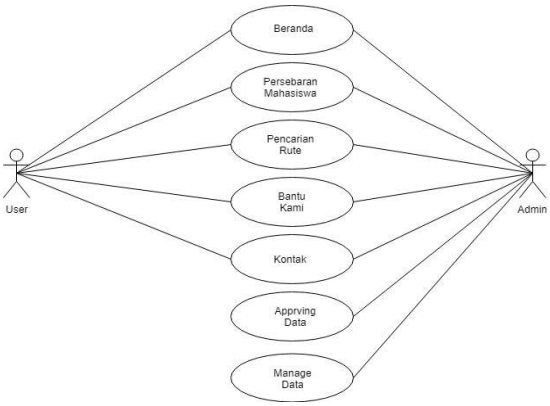

FIGURE 1. Use case diagram of Universitas Indraprasta GIS

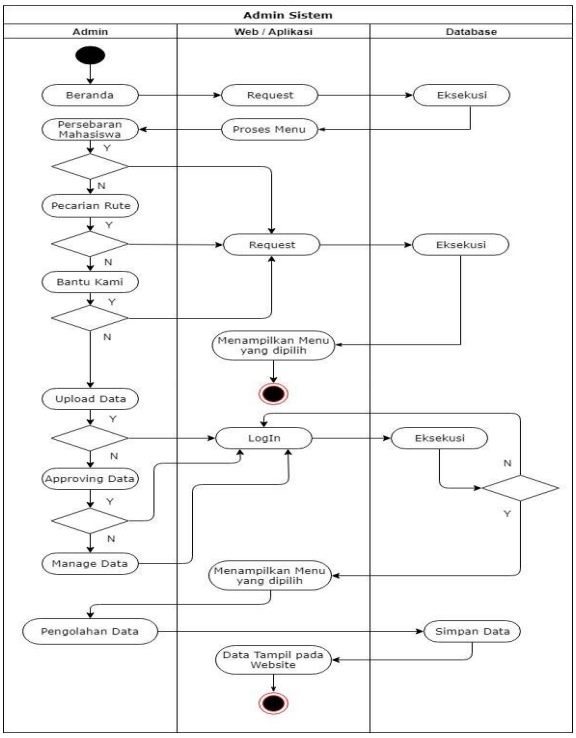

FIGURE 2. Administrator activity diagram of Universitas Indraprasta GIS

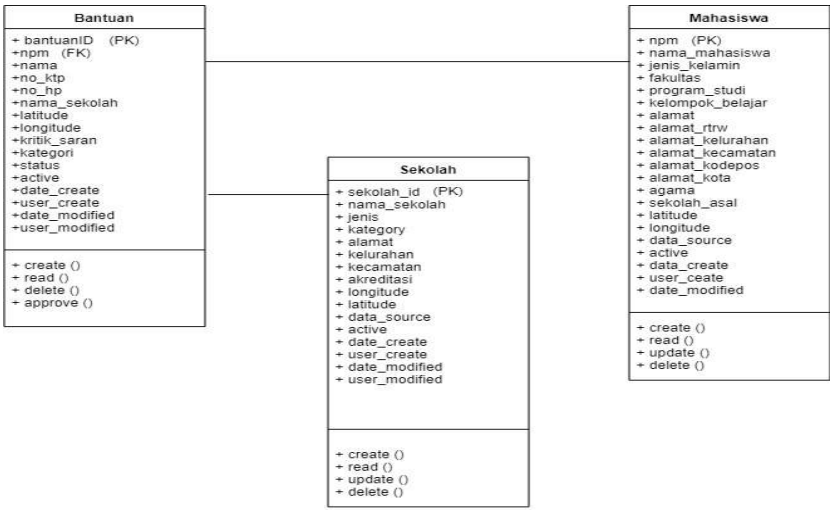

FIGURE 3. Class diagram of Universitas Indraprasta GIS

System Design

Universitas Indraprasta GIS User interface is a web based service, as this system built using CodeIgniter Framework. This system can be accessed via browser i.e. Google chrome, Mozilla Firefox, Opera, etc. Universitas Indraprasta GIS also compatible and can be accessed using mobile devices. Hence, this system can be access anywhere as long there is internet services. Following figure 4 is User Interface of Universitas Indraprasta GIS

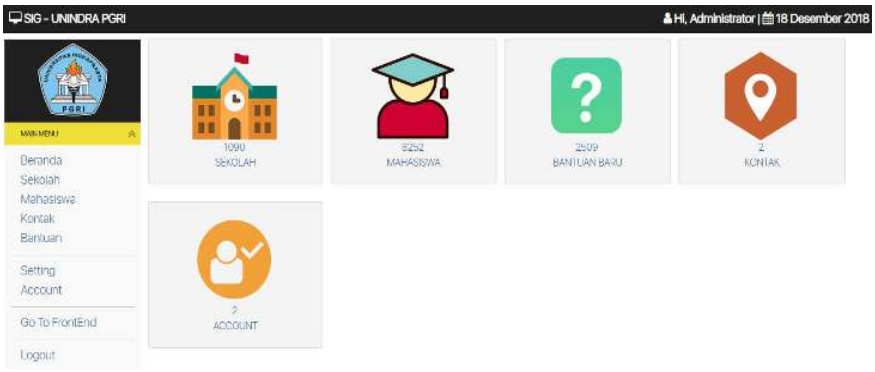

FIGURE 4. User Interface of Universitas Indraprasta GIS

Conclusions

The aim of this study is to build GIS of Universitas Indraprasta that present efficient promotion routes. It also present first-year students originated school to help marketing department in making marketing policies. GIS of Universitas Indraprasta is a web based system using greedy algorithm. It shows that greedy algorithm can be used to find the best promotion routes. And this system work faster using greedy algorithm than Dijkstra algorithm.

For the future work it is suggested to use of another API that support the use of longitude and latitude point to show the exact location.

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Development of Kampung Organik Model Pasca Pilot Project of Zero Waste Zone to Supporting Public Economy and Government Programs of Food Reserved Garden

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Abstract. This study purposed developing kampung organik model pasca pilot project of zero waste zone in supporting public economy and government programs of food reserved garden in Lowokwaru, Malang. Design of research and development using model from Borg and Gall (1983) with stage: First Year (1) research and information collecting, (2) planning, (3) develop preliminary form of product, (4) preliminary field testing, (5) main product revision, (6) main field testing, (7) operational product revision; Second Year: (8) operational field testing, (9) final product revision; and Third Year: (10) dissemination and implementation. Results of this study are (1) the realization of kampung organik model pasca pilot project of zero waste zone in supporting public economy and government program of food reserved garden in Lowokwaru, Malang and (2) the organization of guide book for development of kampung organic model pasca pilot project of zero waste zone in supporting public economy and government program of food reserved garden which has been validated and field trial.

Introduction

Kampung organik is housing area with specific wide where its community have awareness and care in environment. They apply concept of go green with doing organic agriculture, organic fishery, and using renewable energy [1]. It is related with the government programs of food reserved garden which using home-yard as the garden of food plants for filling daily food needs [2]. Home-yard usage is pointed out to fill the foods and nutrient needs for family and promising to increase the household income.

Based on observation in Lowokwaru, people have no fish pond and they do not apply organic fishery. There were some people had applied it, but it unsold well because of repugnant and faces smelled. Finally, that fish pond

was closed by its owner. They generally have not applied urban farming with vertical garden. Though they had planted vegetables but it was not taken care well. For example, tomatoes in their garden suddenly pulled after harvest. No one of them has applied household waste treatment to liquid fertilizer or renewable energy, biogas. Those make source of vegetables, fishes, and energy which are used in daily cook must be bought. So their economy for foods payment is still maximum.

Creation principles for kampung organic model will adopt role of self-supporting group (society organization). Those principles are adapted from previous research which had been done by Al Muhdhar and Susilowati at 2012-2013 about developing pilot project of zero waste zone in Lowokwaru, Malang. Through development model comprehensively, people will assure continuance of the program. Involvement of society organization at previous research is umberella organization of community which is organized along with implementation of national program about community involvement in independent city. It is very urgent because Malang has been chosen as cleanest city in Indonesia.

Based on those problems, objects of research and development were (1) developing media and instructional materials about kampung organic model, (2) applying kampung organic model with media and instructional materials in Malang, and (3) disseminating development of kampung organic model with media and instructional materials.

Methods

Location of kampung organic model is Lowokwaru, Malang. It was chosen because this study continuing previous research entitled pilot project of zero waste zone using 6M based on role of self-supporting group in Malang. Location of previous study was in RW 10, Lowokwaru, Malang. Design of research and development using model from Borg and Gall [3] with stages such as in Table 1.

TABLE 1. Design of research and development

Year	Stages of Research and Development	Activities
First Year (2015)	Research and Information Collecting	Studying about kampung organik and food reserved garden by looking for references and interview experts Observating location which will be developed become kampung organic model
	Planning	Organizing every information from data analysis in stage 1 Preparing draft template of guide book for development of kampung organic model
	Develop Preliminary Form of Product	Arraging first product that is first draft of guide book
	Preliminary Feld Testing	Testing validity fist product to an expert of instructional materials and environmental education (EE), an expert of community involvement, and an expert of stakeholder (leader of environmental cadre of kampung organik and food reserved graden)
	Main Product Revision	Revising first draf of guide book based on suggestion from validity result. So, it will be the next product that is second draft of guide book which will be tested in Lowokwaru
	Main Field Testing	Applying kampung organic model in one of RW in Lowokwaru Analyzing excess and weakness of implementation for arranging revision plan in next development stage
	Operational Product Revision	Revising product that is second draft of guide book so gotten next product (third draft). Third draft will be tested in Malang

Year	Stages of Research and Development	Activities
Second Year (2016)	Operational Field Testing	Applying kampung organic model in Malang pass through formal education and non-formal education Collecting data of successful implementation using observation sheet (checkt list) about all attainment indicators in development of kampung organik Collecting respons data of community using interview guide sheet and questionnaire
	Final Product Revision	Last product is gotten that is guide book about development of kampung organic model
Third Year (on process)	Desimination and Implementation	Testing organic reidential area model in several city at East Java pass through formal education Presenting paper in national or international scientific forum Writing article which will be published in national or international journal Publishing and Distributing final product of guide book about development of kampung organic model

Technique of collecting data, instrument, and analysis data which is used in this study is shown in Table 2.

TABLE 2. Technique of collecting data, instrument, and analysis data

Variables	Indicators	Technique of Collecting Data	Instruments	Technique of Analysis Data
Implementation of Kampung organik	Organic Fishery Urban farming Waste treatment become liquid fertilizer Renewable energy, Biogas	Observation	Checklist and progress description sheet	Quantitative and qualitative
	Exces, weakness, and continuance of the program	Observation	Observation Sheet	Qualitative
Public Economy	Payment level for vegetables needs	Distributing Questionnaire	Questionnaire	Quantitative
Validity of Guide Book	Arrangement Contents completeness about indicators of kampung organik Easy of understanding Conspicuousness of supporting figure	Filling Validity Sheet	Validity Sheet	Quantitative and qualitative

Normalized Gain score analysis [4] is used for knowing treatment effectiveness. Formula of normalized Gain score:

$$< g >= \frac{\%<G>}{\%<G>\max}$$

$$< g >= \frac{(\%<S_f>-\%<S_i>)}{(100\%-\%<S_i>)}$$

Note: <g> is normalized Gain score
Sf is average score of pasca-test
Si is average score of pre-test

Normalized Gain score <g> is method which is suitable for analyzing score of pre-test and pasca-test [5 and 6]. It is also a better indicator to showing treatment effectiveness than score of pre-test and pasca-test itself. Level of normalized Gain score are in 3 categories that are:

g – high : with (<g>) > 0.7
g – medium : with 0.7 ≥ (<g>) ≥ 0.3
g – low : with (<g>) < 0.3

Results and Discussion

First Year (2015): Development of Media and Instructional Materials Supporting Development of Kampung organic model

In order to maximizing socialization and development of kampung organik in Malang, be needed socializing and applying it pass through formal or non-formal education use supporting media or instructional materials. Those developed media or instructional materials have been tested in the schools at Malang. They give positive effects to development of kampung organik in Malang. Development of each media or instructional materials and the results of it trial are shown in Table 3.

TABLE 3. Development media and instructional materials supporting development of kampung organic model in formal way

Media/Instructional Materials	Implementation	Results
Parctical guide book of making biogas from household damp wastes based on group investigatin model	Tenth grade students at 8th State Senior High School of Malang	Final product can be accessed at https://goo.gl/wrMPbB Results of validity test: material is very valid (91.3%), construct is very valid (91.7%), and uniformity with instructional goals is valid Results of practicability test: material is practical (85%), construct is very practical (94%), usage by teacher is very practical (84.6%), and usage by students is practical (84.6%) Results of effectiveness test: test score of the students is advance with <g> in medium category. It is also effective in order to help student's achievement in cognitive, attitude, and skills Results of Respons: practical activity which is done is practical (81.5%), its usage is practical enough (80.4%), very practical in filling student's needs (91%), practical in adding competences and making environmental learning process easier (88.2%), also practical in giving stimulus, activating students and making student's comprehension easier
Experimental guide book of household damp waste compascaing with rotten pinneapple starter	Tenth grade students at 3rd State Islamic School of Malang	Final product can be accsessed at https://goo.gl/XWnAAG Results of validity test: instructional material is valid (93%), material is valid (94%), assessment from field expert to instructional materials is valid (99%), and assessment from students to to instructional materials is very valid (91%)
Practical guide book of	Tenth-grade students at 2nd	Final product can be accsessed at https://goo.gl/s1cC63

Media/Instructional Materials	Implementation	Results
compascaing with rotten carrot extracts starter	State Senior High School of Malang	Results of validity test: material is valid (88.7%) and instructional materials is very valid (94.4%) Results of effectiveness test: usage by teacher is very practical (94.4%) and usage by students is practical (86.1%) Results of effectiveness test: <g> in medium category that is 0.5
Instructional equipment with project-based learning (PjBL) for supporting food reserved garden program	Tenth-grade students at 1st State Senior High School of Singosari	Final product can be accsessed at https://goo.gl/9p2R27 Results of validity test: all developed instructional equipments have been assessed very valid by 3 experts Results of effectiveness test: developed products are assessed very practical Results of effectiveness test: improvement of learning outcomes are 2.4 based on test scores, about 81.1 % students give positive respons and average of their activity scores are 91.2 %
Module of food reserved garden programs based on project	Fourth-grade students at Moh. Hatta Islamic Elementary School of Malang	Final product can be accsessed at https://goo.gl/l0OUgU Results of validity test: validity scores for module which are gotten from experts of media and material can be rated valid whereas validity scores from education practitioner is valid enough Results of effectiveness test: improving knowledge, environmental awareness, and scientific process skills of the students
Module of food reserved garden programs with problem based learning (PBL)	Seventh grade students at 18th State Junior High School of Malang	Final product can be accsessed at https://goo.gl/I32Jko Results of validity test: modules completeness is very valid (90.5%), material is very valid (94.06%), and module quality is very valid (96%) Results of effectiveness test: module is very practical (89.9 %) Results of effectiveness test: average of pasca-test scores in experimental class is higher than in regular class and control class
Comics of food reserved garden programs	Fourth grade students at Moh. Hatta Islamic Elementary School of Malang	Final product can be accsessed at https://goo.gl/Vv6DtG Results of validity test: media completeness is valid enough (82.3%), material is very valid (87.2%), and media quality is valid enough (81.3%) Results of effectiveness test: average of pasca-test scores in experimental class is higher than in regular class and control class. Based on t-test, cognitive (sig 0.00 ≤ 0.05), process skills and social attitude (sig 0.04 ≤ 0.05) of the students before and after learning generally show improvement in each aspect

Media/Instructional Materials	Implementation	Results
Interactive instructional materials of home-yard management with vertical garden	Tenth grade students at 8th State Senior High School of Malang	Final product can be accsessed at https://goo.gl/EG1bV3 Results of validity test: design is very valid (92.75%) and material is very valid (92.5%) Results of practicability test: material and operasion are very practical (≥ 90%)

Development of each media or instructional materials and testing results are described in Table 4.

TABLE 4. Development of media and instructional materials supporting development of kampung organic model in non-formal ways

Media/Instructional Materials	Implementation	Results
Video supporting implementation of food reserving garden program	Malang Society	Final product can be accsessed at https://goo.gl/RvFvys. Results of validity test: instruments are very valid (85.4%), material is valid (84.64%), media is very valid (87.5%)
Booklet supporting implementation of food reserving garden program	Malang Society	Final product can be accsessed at https://goo.gl/nHKFO4. Results of validity test: booklet structure is very valid (90.5%) and booklet material is valid enough (76.1%)

Those developed media or instructional materials which are form of printed or digital have been tested in Malang. Media or instructional materials generally can be a human, material, or fenomena [5], books, perinted module, programmed texts, computer, presentation slide, movie, video, etc. [6] which are used for extend information in order to reach goals such as knowledge, skills, or attitude [7 and 8]. Many previous research which focus on development of environmental cares attitude at young generation pass trough various experience, media, and program [9, 10, and 11]

Second Year (2016): Applying Model of Kampung Organik is Supported by Media and Instructional Materials in Malang

Final Characteristic of Organic Residential Area: Organic Fishery

One of aspects in kampung organik is organic fishery which is given example to one people using portable pond from set bag like in Figure 1.

FIGURE 1. Installation of pond for organic fishery

The existance of pond which is managed by people themselves, can completely skip their fear of consumed fishes. Nowdays, they consuming fishes from their organic fishery. It makes them sure about quality of fishes they consumed.

Final Characteristic of Organic Residential Area: Urban Farming with Vertical Garden

Community begin aware and habitually to implementing urban farming after socialization and implementation of kampung organic especially about organic agriculture with vertical garden. It has positive results for community such as product of food plants and making house scenery be green and fresh. They also can easier to get foods and paring down vegetables payment. A few of them have been succesfull harvest crop of urban farming periodical. Beside for consumed in household, vegetables are also given to their neighbor because it is plenitude or more than enough for their needs. Aspect of urban farming which is done by community is shown in Figure 2.

FIGURE 2. organic residential area: (a) using harvest corp of beans for comsumtion by household, (b) one of vegetables which is taken care and harvested periodically, and (c) vegetables which backing with pergola as street decoration

Guidance activity and monitoring are done by researchers together with community periodically for finding community problems about plants treatment so that they experience process of raising seedlings, treatment until harvest. Other than vegetables cultivation in organis residential area is also planted another food plants such as plants of small fragnats, lime, rambutan, longan, guava, mango, star fruit, etc. Planting activity is done by towny collaboratively start from painting trace tires pot until planting process like in Figure 3.

FIGURE 3. Planting activity of fruit plant: (a) painting trace tires pot, (b) process of rising seedlings, (c) moving rised fruit seed into trace tires pot, and (d) placement pot and fruit plant in strategic places

Final Characteristic of Organic Residential Area: Utilization of Renewable Energy, Biogas from Household Waste Treatment

One of programs of kampung organik is household waste treatment become renewable energy, biogas. This program can make environment free from waste and help society getting their needs for cooking. In order to that program can be implemented well, collaboration and participation of inter-communal in community is needed, included school participation. It is very important because school is one of educational medium towards environtment. Implementation of this program in the schools can be assigned as alternative learing at environmental education (EE). One of schools that is location for developing prototipe of biogas digester is 8th State Senior High School of Malang.

Production of biogas uses damp waste or oganic waste from rotten vegetables or fruits which is formed in about 2 months [12 and 13]. Practically, biogas is implemented by community using compascaer barrel with easy technique and possible done by them in household scale like shown in Figure 4.

FIGURE 4. Making renewable energy biogas in houshold scale

Final Characteristic: Community Payment for Vegetables Needs in Location of Kampung organik

Food reserved garden up till now has given many benefits for community, especially for people who implementing the programs and their environment. For community, these activities give daily food-supply and the realized food diversification at their household. For environment, these can make situation become more fresh and pleasant. It is also can change community paradigm about possibility using norrow area for planting or agriculture activities. With this, community proves that norrow area can be planted or using for agriculture activities by techniques of urban farming, one of them is vertical culture. It is a technique of planting with cultivating media which are organized vertically. Vertical culture can be inmplemented in norrow area, especially in the urban area like shown in Figure 5.

FIGURE 5. Harvest vegetables: (a) cleaning/cutting branch, (b) selecting beans, (c) beans is ready to cooked, and (d) waste of leaves and twigs put into compascaer

Implementation of food reserved graden and kampung organik has worked well so that it can cut down cost for daily consumed vegetables. Abundant harvest exceeds household needs, so part of it is given to other people so do the other citizen. There were people who successfully harvest vegetables such as cale, spinach, etc. also give each other because of excess crop. It proves that community who using environmental green yard will benefit the fulfillment of food and nutrition needs, diversification of food based on local resources, the preservation of food crops for future, and increase in income that will ultimately improve the welfare of the community [14].

Based on final characteristics in location of kampung organik and public expenditure for daily food needs show that there were positive changes are quite good such as more beautiful, clean, functional, and productive. Monthly expenditure on food needs is also reduced by the availability of food supplies obtained by citizen from organic residential area. The implementation of this program also in fact can increase the quality and quantity of food consumed by citizens, so food issues that often occur in urban areas [15, 16, 17, and 18] can be minimalized.

Third Year (on Process): Disseminating of Kampung organik is Supported by Media and Instructional Materials

Dissemination plan of development results as sequential in order to implemented in another town or city in Indonesia in way: (1) adopting kampung organic model in several cities in Indonesia pass through formal and non-formal education, (2) presenting paper on national or international scientific forum, (3) writing article for published in international journal, (4) using media or instructional materials for supporting formal education ways in several city in Indonesia, (5) using media or instructional materials for supporting non-formal education ways in in several city in Indonesia, (6) publishing, distributing, and adopting the final product that is guide book for development of kampung organic model with ISBN.

Articles and paper of this research and development which have been published in national or international conferences and journal are listed in Table 5.

TABLE 5. Articles which are published in national or international conference and journal about research and development of kampung organic model

Name	Tittle of the Article	Information of Publication
Lely Mardiyanti (minithesis)	Implementation of food reserved garden principle about renewable energy in household scale as environmental education at 8th State Senior High School of Malang Environmental Education: Making Renewable Energy to Supporting the Sustainability Program of Foods and Energy for Household in Malang, Indonesia Development of Practical Guide Book of Making Renewable Energy Biogas as Supplement for Environmental Education to Tenth Grade Students of Natural Science in order to Supporting Food Reserved Garden Program	Conference: 3rd National Conference of Biology, IPA, and Learning in State University of Malang at October 15, 2016 Journal : Faculty of Mathematics and Natural Science, State University of Malang (Status: Accepted) Journal : Applied Environmental Education & Communication, index by Scopus (Status: After reviewing and revision process) Jurnal : Journal of Pascagraduated Program, State University of Malang (Status: Accepted)
Zerlinda Mara Ditta (minithesis)	Development of experimental guide book of damp household waste compascaing with starter of rotten pineapple extract at material of environmental change and waste recycle for tenth grade students at 3rd State Islamic School of Malang	Journal : Faculty of Mathematics and Natural Science, State University of Malang (Status: Accepted)
Nanda Hilda Khikmawati (minithesis)	Development of Interctive instructional materials about vertical garden for advancing cognitive, attitude, and skills of tenth grade students at 8th State High School of Malang to supporting food reserved garden program	Journal : Faculty of Mathematics and Natural Science, State University of Malang (Status: Accepted)
Imam Fikry Fanani	Development of instructional equipments	Journal : Faculty of Mathematics and Natural Science,

Name	Tittle of the Article	Information of Publication
(minithesis)	based on project based learning (PjBL) to food reserved garden program tenth grade students at 1st State High School of Singosari	State University of Malang (Status: Accepted)
Vindri Catur Putri Wulandari (Thesis)	Role playing based learning alloyed group Investigation supported by comics of food reserved garden program to developing cognitive and social attitude	Jurnal : Journal of Pascagraduated Program, State University of Malang (Status: Accepted)
	Development of comics as instructional media of food reserved garden program	Conference : National Conference of Biology Leaning and Science Technology in Muhammadiyah University of Solo at May 21, 2016
Bonny Timutiasari (Thesis)	Project based learning supported by module of food reserved garden program to advancing environmental awareness and scientific process skills of Students in Moh. Hatta Islamic Elementary School of Malang	Jurnal : Journal of Pascagraduated Program, State University of Malang (Status: Accepted)
	Development of module about food reserved garden program for Moh. Hatta Islamic Elementary School of Malang	Conference : National Conference of Biology Leaning and Science Technology in Muhammadiyah University of Solo at May 21, 2016
Ferdiana (Tesis)	Development of Booklet about food reserved garden program and its influence towards community environmental knowledge in Malang	Jurnal : Journal of Pascagraduated Program, State University of Malang (Status: Accepted)
	Implementation of food reserved garden program and its influence towards environmental knowledge and awareness in Bareng, Malang	Conference : National Conference of Biology Leaning and Science Technology in Muhammadiyah University of Solo at May 21, 2016
Mardiana (Thesis)	The effect of module about food reserved garden supported by problem based learning towards students cognitive and	Jurnal : Journal of Pascagraduated Program, State University of Malang (Status: Accepted)

Name	Tittle of the Article	Information of Publication
	environmental awareness in 18th State Junior High School of Malang	
	Development of Modul about food reserved garden program based on problem based learning	Conference : National Conference of Biology Leaning and Science Technology in Muhammadiyah University of Solo at May 21, 2016
	for students of Junior High School in Malang	Conference : 2nd National Conference of Biology, Learning, and Environtmental interdisciplinary perspective in Muhammadiyah University of Malang at March 26, 2016
	Problem based learning as effort to advancing students cognitive and environmental awareness	
Benny Satria Wahyudi (Thesis)	Development of Video about food reserved garden program and its influence towards community motivation in Malang	Jurnal : Journal of Pascagraduated Program, State University of Malang (Status: Accepted)
	Analysis of community comprehension about food reserved garden program in Malang	Conference: National Conference of Biology Leaning and Science Technology in Muhammadiyah University of Solo at May 21, 2016
	The Development Of Sustainable Reserve Food Garden Program's Video In Malang City	Conference: The 1st International Basic Science Conference 2016 (The 1st IBSC 2016) in Universitas Jember at September 26-27, 2016

Dissemination of organic residential rea model is needed in order to realized an area and stable society condition toward their consumed foods. Dissemination is done in several ways. That publication will be references or guidance to advance knowledge, interest, skills of community in implementation organic residential are model. As explained by previous research that is knowledge, interest, skill, and attitude of people can influence their participation in environment [19, 20, 21, 22, 23, and 24].

Conclusion and Suggestion

Based on reseach and development, inferential several things.

1. It has been successfully developed some media and instructional materials supporting development of kampung organik which is successfully implemented pass through formal and non-formal education.

2. It has been known final characteristics of kampung organik about organic fishery.
3. It has been known final characteristics of kampung organik about urban farming with vertical garden
4. It has been known final characteristics of kampung organik about utilization of rewable energy of biogas from household waste treatment.
5. It has been known final characteristics of community payment level for vegetables needs in location of kampung organik
6. It has been created articles about kampung organik and food reserved garden which have been publicated at national or international conference and journals.

Good and going concern coordination between researchers and target is necessary. So that program will go on well [25]. Inplementation programs of organic resindential area and food reserved garden need more be optimized, so its benefits can be felt by more people. In addition, competent people is needed in order to each program of kampung organik and food reserved garden which are started is really implemented well.

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The Development Of Integrated Hooke's Law of Learning Media for Concept Attainment And Skill Problem-solving in Competency Analysis of Material Elasticity

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Abstract. The Students in learning material elasticity competencies still face obstacles in measuring length increments appropriately. In order to the problem to be resolved, an integrated Hooke's law learning kit was developed. The best performance indicator kit for the integrated Hooke's law experiment was valid, practical and effective. The results of the research on the development of integrated Hooke learning media obtained 3.8 validity, 95 % practicality, effectiveness N-gain concept of 0.77 with the completeness of 89.7%. It was concluded that the integrated Hooke's law learning media was valid, students did not experience difficulties during operation, were effective in improving mastery of concepts and problem-solving skills.

Introduction

Education is a learning activity that can make students active and able to develop the potential of students themselves. Education is an activity that seeks to improve the quality of Human Resources (HR) [1]. Education is very important for society because education can play a role in developing the talents of each individual [2]. So that education can never be separated from life.

Education in Indonesia has experienced curriculum changes several times. At present, the curriculum in Indonesia is the 2013 curriculum. The 2013 curriculum has four aspects of assessment namely cognitive aspects, aspects of skills, aspects of attitude and behavioral aspects that use a scientific approach. Where the scientific approach consists of observing, asking questions, seeking information, associating, and communicating, the scientific approach can make learning more centered on students (Student Center) so that students not only memorize but can find concepts independently [3]. With the 2013 curriculum, it can help physics learning activities in the delivery of physics concepts with student-centered learning activities.

The results of the study [4] state that learning with practical activities that use real media can help students in understanding the concepts that have been learned. In addition to the results of research from Rahil there is research from [1] stating that by using real media students can

experience directly in finding a concept. Based on the description, the learning activities, especially in learning physics, require real media so that students can easily understand concepts and can find concepts independently.

Hooke's legal elasticity is one of physics. The principle that is in the elasticity of the Hooke's law is very closely related to daily life, one of which is spring bed, spring and so forth. In the material elasticity Hooke'slaw involves practical activities during learning because it is in accordance with the basic competence of physics 4.6 which explains that processing and analyzing the results of experiments on Hooke' law [2]. With the existence of these practicum activities, many schools have not carried out these activities because the media of practicum tools is too complicated so that teachers still rarely do practicum activities so that they still use conventional methods [5].

Based on the description above, the authors developed an integrated Hooke's law kit. Where the media to be developed can make it easier for students to do practical activities as well as data retrieval to do an analysis of experimental activities. It also makes it easier for teachers to explain to students the concepts and principles of Hooke's law material where students are directly involved in practicum activities. So the authors develop a learning media titled "Development of Learning Media Integrated Hooke Law Kit For Understanding Concepts and Skills in Problem Solving in Competence Analyzing Material Elasticity".

Method

In this study using the ADDIE development model which has five stages, namely the analysis phase, the design phase, the development stage, the implementation phase and the evaluation phase. In this study [2], a limited trial was conducted to students of class X-IPA 4 of SMA Negeri 7 Malang.

Data collection techniques were done (1) the method of validation and testing of teaching aids, (2) the method of testing and (3) the method of student questionnaire responses. Data analysis techniques consisted of three steps, namely, (1) The validity test of kits conducted by lecturers and teachers.(2) Analysis test to determine the effectiveness of the kit developed in learning activities and skills analysis. (3) student responses analysis to determine student responses after participating in learning.

Results and Discussion

The assessment conducted on the development of this media is reviewed from the indicators of validity, practicality, and effectiveness for the explanation as follows:

Media Validity

The results of the validation associated with prototype validation are all components of the validity and prototype indicators of the Right Media Use Hooke Law Kit that is designed valid / does not need to be revised, showing that the prototype of the Right Media Use Hooke Law Kit that is designed is relevant (fulfills content validity) and consistent (meet the construct validity) with an average value of 3.8 greater than 3.0 in the valid criteria / no need for revision. In addition to the media validity, the Student Activity Sheet (LKS) validity was obtained, the data obtained (1) the validity of the LKS construction obtained an average of 3.6 valid, (2) the results of the validity of the contents of the worksheet obtained an average of 3.90 valid, (3) the results of the LKS key validity obtained an average value of 3.92 valid.

The validity of Hooke's Law Kit in learning physics towards increasing mastery of concepts is shown in the following tables.

Table 3.1 Results of Appropriate Media Prototype Validation for Hooke Law Kit

No.	Validity Component	SI	Validator score			N	Validity
			V1	V2	V3		
1.	Compliance with the curriculum	4	15	16	15	3,8	Valid
2.	Accuracy	4	15	15	16	3,8	Valid
3.	Technical quality	6	22	22	22	3,7	Valid
4.	Simplicity	5	19	18	19	3,7	Valid
Average						3,8	Valid

Information
SI = Number of indicators V3 = Validator score 3
V1 = Validator score 1 N = Average value
V2 = Validator score 2

Practicality of Media

After validation and revision according to the advice given by experts and limited trials, the next step is to find out the practicality of the media being developed. The practicality of the media is done by spreading the questionnaire responses of students. The results of the analysis of the distribution of student questionnaire responses by 95%. With indicators (1) The use of appropriate media hooke law kits requires sufficient time to retrieve data, (2) it helps to get data with the right media for hooke law kits, (3) feel happy using the right media of hooke law kit kits, (4) dangerous or not appropriate media hooke law kits, (5) whether having difficulties when using appropriate media hooke law kits, (6) whether the ability of appropriate media hooke law kits is adequate, (7) do you feel

difficulties in the media layout hooke law kits are effective, (8) whether hooke law kits are easily damaged during use, (9) do they often make mistakes when using hooke law kits, (10) after using hooke law kits are, do you feel happy to follow physics learning. The practicality of Hooke's Law Kit in learning physics for increasing mastery of concepts is shown in the following tables.

Table 3.2 Practicality of Appropriate Media Kit of Hooke Law Kit Based on Response of Class X IPA 4 Students of SMA N 7 Malang

No.	IPA 4	
	N	N(%)
1	19	95
2	19	95
3	17	85
4	19	95
5	20	100
6	20	100
7	18	90
8	19	95
9	17	85
10	19	95
11	20	100
12	18	90
13	19	95
14	20	100
15	20	100
16	17	85
17	19	95
18	19	95

No.	IPA 4	
	N	N(%)
19	19	95
20	18	90
21	20	100
22	17	85
23	20	100
24	20	100
25	20	100
26	20	100
27	20	100
28	18	90
29	19	95
30	20	100
31	-	-
32	-	-
NR	19,0	95,0

Information:
N = acquisition value
N (%) = Value of acquisition in percent
NR = Average acquisition value in percent

The Effectiveness of Appropriate Media Prototypes Designed in Learning

The Effectiveness of Appropriate Media Prototypes designed to improve students' Mastery of the Concept of the problem was tested by comparing the posttest scores and the pretest scores obtained. The Effectiveness of Appropriate Media Prototypes designed to improve Mastery of the Concept of students' problems was also tested by looking at the average normalized gain score shown by the difference in the gain score between the pretest and posttest. The increase is indicated by the average normalized gain score, the normalized gain score, that is, the

actual gain score divided by the maximum possible actual gain score, formulated as follows.

$$\langle g \rangle = \frac{\%\langle gain \rangle}{\%\langle gain \rangle_{\max}} = \frac{\%\langle data\ post \rangle - \%\langle data\ pre \rangle}{100 - \%\langle data\ pre \rangle} \quad [6]$$

Learning using Appropriate Media Prototype on the subject of Elasticity and Hooke's Law in the Trial Class obtained an average value of 81 and 90% completeness in the very good category while in the Comparison Class obtained an average rating of 74 and a 66% completeness in the unfavorable category. Thus, after the pretest and posttest tests on the Elasticity and Hooke's Law obtained an average value of N-gain of 0.77 with the completeness of 89.7%. The effectiveness of Hooke's Law Kit in learning physics for improving mastery of concepts is shown in the following tables.

Table 3.3 Results of Enhancing the Mastery of the Concept of Trial and Comparative Classes in the Subjects of Elasticity and Hooke's Law

No.	PHK	NHK	g	<g>
1.	13	80	67	0,77
2.	25	80	55	0,73
3.	13	87	74	0,85
4.	13	80	67	0,77
5.	25	67	42	0,56
6.	25	80	55	0,73
7.	25	87	62	0,83
8.	25	80	55	0,73
9.	25	93	68	0,91
10.	13	80	67	0,77
11.	0	80	80	0,80
12.	25	80	55	0,73
13.	25	80	55	0,73
14.	13	80	67	0,77
15.	25	87	62	0,83
16.	13	67	54	0,62
17.	13	80	67	0,77
18.	13	80	67	0,77
19.	13	80	67	0,77
20.	25	93	68	0,91
21.	13	73	60	0,69
22.	13	80	67	0,77
23.	13	87	74	0,85
24.	13	87	74	0,85
25.	25	80	55	0,73
26.	38	87	49	0,79
27.	13	80	67	0,77
28.	25	80	55	0,73
29.	25	80	55	0,73
Average		81	62	0,77
Completeness(%)				89,66

Information:
Layoffs = pretest value of the subject matter of Elasticity and Hooke's Law
NHK = posttest value of the subject matter of Elasticity and Hooke's Law
<g> = Gain score is normalized in concept mastery

Conclusion

"Kit of Hooke law" is valid = 3.8 validity; "Kit of Hooke law" is practice = 95 % practicality; "Kit of Hooke law" is effective = N-gain concept of 0.77 with completeness of 89.7 %.

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Collegiality as a Key for Improving Students Success in Lesson Study Practices

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Abstract. Collegiality plays an important role in the profession of educators, especially teachers. Some schools have not yet try to maintain the quality of learning and even improve their learning at school with responsibilities among peers. This study illustrates the development of collegiality among teachers, especially improvisation and increasing teacher confidence. Some schools in Malang City, East Java, Indonesia have implemented Lesson study to improve the quality of their colleagues, improvise in learning. This qualitative research illustrates the development of collegiality between teachers, improvisation and teacher self-confidence, especially in learning. Data from fourteen teachers and principals were collected using questionnaires, interviews and observations of classroom learning. The results of this study, that some schools fail to implement Lesson Study continuously because collegiality beliefs and practices still low. But on the other hand there are schools that have successfully applied collegiality in increasing student learning. Only a few studies focus on aspects of the responsibilities of colleagues in developing teacher professionalism. Most studies still focus on pedagogical competencies as teaching skills while still ignoring the role of the learning community. Thus, developing the quality of collegial learning in schools is very important to support a shared learning atmosphere

Introduction

Indonesian government awards teacher professionalism with teacher certification to improve teacher professional competence. Strengthening the quality of teacher professionalism will be important as a focus of state development. According to Fahmi et al., Al. (2011) in 2006, Indonesia began implementing a national teacher certification program with the aim of certifying 2.3 million teachers in 2015 with a budget of US $ 460 million. This large cost shows that there is no quantitative study to evaluate the impact of the program on student achievement. The assessment of teacher professionalism includes work ethic, discipline, the ability to accept criticism and advice, the ability to communicate, and the ability to cooperate.

Basically, the process of collaboration to improve the quality of professionalism of teachers has not been specifically regulated in Indonesian. Through a number of programs and development activities, Lesson Study was chosen by the city government of Malang as an effort

to develop collaboration between teachers to achieve an increase in the quality of learning. The efforts to develop the teacher profession that are commonly carried out by public and private schools are through the TeacherWorking Group or Kelompok Kerja Guru (KKG), Teacher's Forum Field of Study or Musyawarah Guru Mata Pelajaran (MGMP) and so on. These activity was initially according to Goverment Regulation No.38 in 1994. It has object to encourage teachers to improve their knowledge and skills in planning, implementing, and evaluating teaching learning activities. Teachers also share problems in daily teaching practice and solve the problems according to the characteristics of subjects, it also provide teachers with the opportunity to share information and experiences tobuild collaboration with other institutions to create conducive, effective, and joyful learning.

This research seeks to describe the role of the teacher community in improving teacher professionalism through its best practices, known as collegiality. Through Lesson Study activities several schools in Indonesia have succeeded in increasing teacher collaboration in improving the quality of learning. However, with the increasingly tight schedule of teaching activities, the completeness of teaching administration, or school agenda schedules full the workload of teachers. It makes collaboration activities between teachers are difficult to be established. This also happened in several schools abroad from the results of the research report. 1,2,4,5.

Lesson study developed currently in Indonesia is named LSLC (Lesson Study for Learning Community). LSLC is a collaborative activity of Lesson Study activists from education practitioners, teachers, lecturers, and school leaders and related institutions who collaborate on improving learning. In the collaborative process, there are similar needs between higher education institutions and schools. According to Nurwidodo et., al., (2018) through collaborative activities of schools and colleges, both face the same opponents the problem of quality of learning. The problem of the quality of learning in Indonesia according to Nurwidodo et., al., (2018) is a matter of culture to develop a network and dependency between teachers, also with higher education institutions, and the community. The results of the application of MGMP and KKG in several schools in West Java according to data from Supriatna (2004) have not been significant. The majority of MGMP activities are mostly in big cities or sub-districts, whereas in rural areas there are very few MGMP activities which are quite intensive. This is still in line with Nurwidodo that in forming a network of cooperation between teachers, schools and education practitioners hold similar importance.

The results of this preliminary observation indicate that some schools have succeeded in increasing collegiality through collaboration in Lesson Study, but there are some schools that have not succeeded. This failure is due to the dependence between teachers to collaborate yet to be seen, and there is no habit of nurture collaborative activities in their schools.

The main focus of this research is to see how the collaboration that occurs in schools with teachers or several teams of teachers who carry out Lesson Study in an effort to develop learning and professionalism. Some schools have succeeded in increasing collegiality through collaboration in lesson study, but there are some schools that have done lesson study but the practices in lesson study have not become a habit of collaborative activities in their schools. The main focus of this research is to see how the collaboration that occurs in a school with a teacher or several teams of teachers who carry out Lesson Study as an effort to develop learning and professionalism.

Method

This study uses descriptive quantitative and qualitative data research and involves five schools as subjects. The schools are (one private elementary school) Saleh Children's Elementary School, two public elementary schools (SDN Kauman 1, SDN Purwodadi 1), one private SMP (MTs Muhammadiyah 1), one UM private high school laboratory) in Malang City. Data obtained from fourteen people consisted of teachers and school leaders from the elementary school, junior high school and senior high school level. This descriptive study consisted of quantitative data from questionnaires and qualitative data from observation and interview data. Data collection uses purposive sampling method, which is determined by schools that have conducted Lesson Study activities. The questionnaire instrument used answer choices on a scale of measurement from 1-7, selected responses from 1 (one) (strongly disagree) to 7 (seven) (strongly agree), which was questions item adapted from Shah (2011).

The results of the questionnaire were confirmed by direct interviews with research subjects. The collegial aspects identified are aspects of trust and support among peers, how observation learning activities, learning planning and evaluation of student learning activities, discussion of ideas and skills, peer learning, sharing of resources, and curriculum development. The response options range from 1 (strongly disagree) to 7 (Strongly agree), showing how true each statement is about it. Next, to see how teachers' practices in developing collegiality are explored through direct interviews. The interview guide instrument was used to identify collegiality activities by direct interviews with teachers and principals. The results of the interview are written on the interview sheet without editing and improving the data and used as supporting data.results

The limitation of this research is the limited number of respondents so that further studies are needed on the greater number of respondents. Tables 1.1 through Table 1.7 contain the results of a survey of teachers with several collegiality factors measured that is demonstrating mutual support and trust, observing one another teaching, sharing ideas and

expertise, teaching each other, developing curriculum together, and sharing resources. In the high score obtained the aspect of teacher collegiality is very good, while the medium and low scores indicate the aspect of teacher collegiality is still low. Data obtained on the collegiality aspect of teachers in Malang, East Java is still very low on the desire to hide the mistakes of students (Table 1.1), feel free to share student problems with other teachers (Table 1.4), and are still hesitant to ask other teachers for help provide input on learning instructions. While the medium result is that the teacher has not sufficiently appreciated the professionalism of other teacher's colleagues (Table 1.1), the teacher is still not comfortable being observed by other colleagues (Table 1.2), and still does not want to argue collectively about learning (Tables 1.3 and 1.4).

Table 1.1 Colegiality Aspect Questionnaire Results

	Factors of collegiality **Demonstrating mutual support and trust**	**Average score**	**Description**
1	Teachers provide strong social support for colleagues.	6,63	High
2	Professional interactions among teachers are cooperative and supportive.	6,75	High
3	There is a feeling of trust and confidence among staff members	6,38	High
4	I can count on most of my colleagues to help me out anywhere, anytime even though it may not be part of their official assignment.	5,25	High
5*	Teachers in this school hide their failures and mistakes	2,88	Low
6	Teachers consider their colleagues as their friends.	5,75	High
7*	Teachers in this school do not respect the professional competence of their colleagues.	4,38	Medium

Note: scores 1.00-3.00 (low category); 3.01-5.00 (medium category); 5.01-7.00 (high)), (*) negative response

Table 1.2 Colegiality Aspect Questionnaire Results

	Factors of collegiality **Observing one another teaching**	**Average Scores**	**Description**
8	We invite other teachers to observe our teaching.	5,00	Medium
9*	Teachers in this school mind being observed by their colleagues while teaching	4,50	Medium
10	We regularly observe one another teaching as a part of sharing and improving instructional strategies.	5,63	High
11	Most of the teachers in this school are receptive to the presence of other professionals in their classrooms.	5,63	High
12	I believe it to be beneficial for my teaching to be open with colleagues about my successes and challenges.	6,71	High
13	Feedback received by the colleagues is considered and responded to appropriately	6,00	High

Note: scores 1.00-3.00 (low category); 3.01-5.00 (medium category); 5.01-7.00 (high)), (*) negative response

Table 1.3 Colegiality Aspect Questionnaire Results

	Factors of collegiality Observing one another teaching	Average Scores	Description
14	Cooperation and collaboration exists across departments.	6,00	High
15	We jointly plan and prepare teaching strategies and procedures.	5,75	High
16	Majority of the teachers participate actively in meetings.	5,00	High
17	We make collective agreements to test an idea or new approach in teaching.	4,75	Medium
18	We jointly accredit new programs and practices.	5,75	Medium
19	My colleagues and I collectively analyze our teaching practice.	5,00	Medium
20*	Teachers do not praise or criticize each others teaching.	3,63	Medium

Note: scores 1.00-3.00 (low category); 3.01-5.00 (medium category); 5.01-7.00 (high)), (*) negative response

Table 1.4 Colegiality Aspect Questionnaire Results

	Factors of collegiality Sharing ideas and expertise	Average Scores	Description
21	We often argue over educational theories, philosophies, or approaches.	4,88	Medium
22	Teachers encourage each other to contribute ideas and suggestions.	6,75	High
23	We often ask each other about classroom management ideas and suggestions.	6,38	High
24	Teachers in this school do not feel comfortable about discussing their students' problems.	2,00	Low
25	Teachers in this school often ask for suggestions to specific discipline problems.	5,63	High
26	We discuss frequently about school improvement strategies.	5,50	High

Note: scores 1.00-3.00 (low category); 3.01-5.00 (medium category); 5.01-7.00 (high)), (*) negative response

Tabel 1.5 Colegiality Aspect Questionnaire Results

	Factors of collegiality Teaching each other	Average Scores	Description
27	We often teach each other informally.	5,88	High
28	Teachers in this school enjoy teaching in teams.	5,88	High
29	We feel part of a learning community which values shared responsibility for ongoing learning.	5,88	High
30	Teachers give demonstrations on how to use new models or strategies	5,63	High
31	Teachers in this school like to share what they have learned or want to learn	6,25	High

Note: scores 1.00-3.00 (low category); 3.01-5.00 (medium category); 5.01-7.00 (high)), (*) negative response

Tabel 1.6 Colegiality Aspect Questionnaire Results

	Factors of collegiality Developing curriculum together	Averages scores	Description
32	Most teachers in this school contribute actively to making decisions about curriculum	5,25	High
33	I find time to work with my colleagues on curriculum during a regular work day	5,13	High
34	Teachers in this school jointly prepare their lesson plans.	5,13	High
35*	Teachers in this school feel hesitant in asking for help on specific instructional problems.	3,00	Low

Note: scores 1.00-3.00 (low category); 3.01-5.00 (medium category); 5.01-7.00 (high)), (*) negative response

Tabel 1.7 Colegiality Aspect Questionnaire Results

	Factors of collegiality Sharing resources	Averages scores	Description
36	My colleagues and I share materials related to my subject teaching.	5,88	High
37	Teachers in this school often lend and borrow materials like worksheet and lesson plans.	5,38	High
38	We often share journal articles and educational books.	4,63	Medium

Note: scores 1.00-3.00 (low category); 3.01-5.00 (medium category); 5.01-7.00 (high)), (*) negative response

Some of the schools we observed were still doing Lesson study as a teacher collaboration activity, but most of the school teachers were doing lesson studies with communities outside the school or known as the lesson study club. These results indicate that the Lesson Study was successfully implemented in small schools in Malang. However, some schools that have conducted study studies have not contributed to the collegiality of teachers. This is like the results of our interview as follows:

Statement by school leader A about applying Lesson Study in his school: " Lesson study is very good for the development of the learning process, more students learn with the challenges given by the teacher. This is a new thing that did not exist before. However, only 1-2 teachers currently still open their classes for several periods. "

Opinion leaders A school on the development of lesson study in school: " The stages of lesson study are plan, do, and see very well to construct students' thinking skills. That is the most recent where teachers are avoided to provide knowledge or information directly. At first we felt impatient seeing students who did not know the answers , and the teacher did not just give an answer. But finally we understand that the process of finding knowledge by students themselves is also important, so learning becomes more meaningful for students. "

Opinion school leaders A of the problems of implementation of Lesson Study in school : " Lesson studies are currently conducted by 1-2 teachers only, so it is not a lesson study if only 1-2 teachers open classes. But there are lesson study communities from other schools or other practitioners who come during plan, do and see activities. ... we could not do lesson study because of time constraints, the schedule of the teachers who certainly could not have to come to the stage of the plan, then observation on the do, and reflection "

The data for the implementation of lesson studies conducted by schools ranges from only 3-5 times a year. This is a small amount to give significant effect to increase teacher collegiality. Thus, imply with the low openness of the teacher to the learning undertaken as a desire to be peer observed (Table 1.2), together collectively commenting on learning (Table 1.3) only occurs a few times. The results of the study report (Akiba, 2018) the period time for the implementation of Lesson studies from a minimum of 118 days and about 2 hours to 23 hours will influences teacher collegiality or teacher learning outcomes.

In table 1.1 the elaboration of teacher collegiality factors in the aspects of mutual support and trust with a high category is peer support, cooperative interaction, collaboration trust with colleagues. This shows that teachers in Indonesia have the basic capital to collaborate, the existence of trust with peers, support for friends and the desire to collaborate. But in the aspect of the failure of the learning process to be very covered and feared by the teachers. Though failure is one of the stages of achieving learning success. Some lesson study practices that are continuously successful are in the aspect of teacher openness due to the lack of learning they do. 6,7,12. This has not been entrenched in the collaboration of teachers..12, 13, 14.

The most influential thing for the sustainability of lesson study in a school lies in the high collegiality of teachers, especially in the learning process. Research results (Akiba, 2018; Opfer & Pedder, 2011; Akiba, 2017) that teachers really need a conflict of knowledge, dissonance, in order to change their beliefs about teaching and student learning and require a discussion that might might even enforce existing traditional views about teaching and student learning. While this is the opposite of the conditions of teachers in Malang with the low desire of teachers to ask their peers to see class learning (Table 1.6) and the low desire to collectively or together, discuss, argue about teaching instructions and students' thinking processes (Table 1.3). 17,18.

Another factor that still disturbs the collegiality of teachers and needs to be improved is the appreciation of expertise or professionalism. This aspect is related to the increase in the level of professionalism of teachers both structurally and academic aspects which are still reportedly low. 10,11,13 The relationship between teacher disclosure factors which is still low is related to the recognition of teacher professionalism. Fellow teachers have not honored in the form of appreciation, the desire to study with more outstanding peers, as well as exchanging learning innovations and sharing their students' problems as shown in Table 1.4. These results indicate that teachers are also not accustomed to criticizing each other in Table 1.3. In this table, the majority of teachers have shared ideas and expertise factors, with a discussion of learning techniques and methods and being able to share learning resources and classroom management and school management efforts in the Table. 1.5. The basic strength of collaboration is already possessed by most teachers but it has not yet become a form of collegiality in the aspect of improving learning.

In Table 1.2 on the aspect of Observing one another teaching , the results appear to conflict with the discussion of the results of this previous study. Most of the teachers stated that they believed that open class activities would bring benefits to student learning, the teachers also accepted and appreciated the presence of professionals who gave advice to their classes. However, some teachers still object if they have to be observed (medium category). Thus, teachers already understand the

benefits of lesson study activities. However, efforts to develop learning with peers in one school proved to be still limited. The results in table 1.2 are the responses of teachers who have done lesson study with LS technique methods that are already good, but in interpreting the efforts to develop pedagogic and professionalism teachers have not become the main focus of collegiality.

Discussion

Previous lesson study results focus on developing assistance strategies, while in developing countries have fared without developing assistance. This condition is what goes on with the subject of this study. Forming community needed resources such as institutions and utilizing partnerships with schools. The results of Nurwidodo's analysis in creating a Lesson Study community require network management according to mutual needs and mutual benefits. Maeda and Yumiko (2018) in their research on the diffusion process of learning studies in developing countries, Indonesia, present the supporting points of the Lesson Study community in Indonesia. However, the results of previous lesson study studies (Kligyte, 2019; Cajkler et. aAl., 2014; Akiba et. al., 2017) focused on strategies for developing aid while developing countries have fared without developing assistance. Thus, efforts to form collegiality in a school can be a solution in overcoming compelling difficulties.

Missing point found by Maeda (2018) in Indonesia lacks supprot and facilities (according to the results of observations and interviews of researchers as well) "most schools that have conducted Lesson studies, claiming that the school has LS" but the evidence of its sustainability was very minimal of expectations the big one. This research implies that the sustainability of lesson study shows the success of the community. The collegiality aspects have been owned and routinely developed by the lesson study community at UM Lab High School. The pattern used by these schools is a good model for schools in Indonesia even with relatively low financial support. The application that has been applied by the LS community in Lab High School is to maintain collegiality with peers.

Teachers collegiality as the key to creating positive interdependence between teachers (Kligyte, 2019; Maeda et. al., 2018; Cajkler et. al., 2014; Akiba et. al., 2017) so that they can innovate continuously. However, lesson studies that entered Indonesia in the early 1990s according to Nurwidodo's research results (2018) suggests the need for strategies in building a community Lesson Study network. Forming such communities required resources and utilized partnerships with schools. Nurwidodo's analysis results in creating a Lesson Study community that required network management in accordance with shared needs, maintaining cooperation and mutual benefits. Maeda and Yumiko (2018) in their research on the diffusion process of Lesson study as an

educational innovation in developing countries, especially Indonesia, conveyed the missing points in forming a lesson study community.

Practices of the Success of Lesson Study in Improving Student Learning

Some of the success of the implementation of Lesson Study which is continuously also found in schools in Malang, especially UM Laboratory High School. This school intensively implements lesson study activities in an effort to improve student learning and build collegiality. These practices are the teacher's duty to research their class, the teacher open learning plan based on a schedule and there are adjusments for the study team's schedule. Every week teachers at UM Laboratoium High School who do not teach today are used to collaborative activities to open plans, observe classes, and reflect on classes. Furthermore, the model teacher who opens the class is required to write the results of class researchthrough articles in schools.

This effort has been carried out for a several years until now based on interviews with several teachers at UM Laboratory High School. Following are the statements of several teachers who are the subject of our research

"Lesson studies have been around a few years ago, but they are not very significant compared to the current conditions. Previously we also never got to do LS again. However, the introduction and application of the new LS approach that is focused on strategies to teach all students or constructivists finally we start again. ... At first we were the only two who took the initiative to study LS practitioners. With a few knowledge, we made a presentation and sharing with colleagues at our school. Finally, until now LS activities have become a routine agenda for schools. "

Statements of supporting teacher collaboration strategy through Lesson Study in improving student learning in the classroom.

"We rotate every month what subjects will be open class right. For lesson study teams do not have to be from teachers with the same subjects. We develop more strategies or stages of learning that drive constructivism in students. Sometimes we also discuss material concepts. For open class subjects, there are usually several teachers in the same subject. But for the suggestions and planning of the learning steps all teams are involved. Teachers usually test certain strategies to maximize the potential of soft skills of students who are the main target. For example students who have not been actively collaborating with friends, students who rarely participate in discussions, etc ... "

Our observation was that we participated in LS activities at the UM Laboratory High School. We felt that there was such an atmosphere of collegiality. As an observer outside from school who directly see the planning process, teachers openly accept our presence. He also allowed us to take part in the planning stages of Lesson Study activities. The

collegiality seen from the planning stage when the mediator teacher or the opening speech that can develop the critical thinking of the teachers in his team to plan special learning. The response from the planning team teachers, although not their expertise of study, can also add strategic suggestions as well as identifying the intended class. This discussion went smoothly and argued with each other. The teacher directly know the characters most of students at the school and understand the learning situations that commonly occur in those classes

The success of the lesson study practice to increase collegiality was also seen during the reflection process. The model teacher openly expresses his impressions and reflections on the reflection forum. The model teacher also explained in detail the situations in the learning activities that have been carried out. The other teacher as an observer appreciated the model teacher by giving detailed observations in the form of facts from observations of student learning processes. Comments and suggestions provided no longer revolve around how the teacher manages the class and the physical condition of the class but rather comments on how the students' thinking processes are, whether the teacher's efforts are as expected of students or there are other responses. The results of observations and suggestions become improvements for planning activities in different classes with the same topic / material. Thus the existence of joint reflection efforts is used to innovate further learning.

Teachers Collaboration's Practicess

The schools that are the subject of our research also conduct collaborative activities in schools. In particular the practice of collaboration in schools that discuss learning problems in the classroom other than through lesson study , does not exist. This is a characteristic of lesson study which is able to raise student learning problems as an individual who also has the same learning rights. This aspect has not yet become the focus of schools and also stakeholders. However, the practice of collaboration in schools has also been carried out for example in the efforts of curriculum holders in one primary school. School curriculum stewards attempt to synchronize learning outcomes at several different levels from grade 1 to grade 6 in elementary school. Efforts are made through the existence of several field coordinators (Natural Sciences, Social Sciences, Mathematics, etc.) and there are class level coordinators, namely low level class coordinators (Class 1, 2, and 3 Elementary Schools) and top level class coordinators (Grades 4, 5, and 6 elementary).

The practice undertaken is to overcome the achievement gap in each class so that it can guarantee the quality of learning. This collaboration has been carried out and gave good results when compared to the absence of a level coordinator and field coordinator. The task of the level

coordinator and also the field coordinator is to coordinate with class teachers, control the learning achievements of each class level and conduct discussions about changes in the curriculum. With the collaboration between the classroom teacher and the coordinating teacher, it is directly beneficial to the management and quality control of schools. 5,8,9,11,14,15.

The results of interviews with several school leaders who have not successfully carried out lesson study on an ongoing basis stated that they have a main agenda which is of course focused on the vision and mission and excellence of the school. From this statement we conclude that the awareness of improving the quality of schools through both academic and non-academic has been largely carried out and owned by schools in Malang. However, it seems that the approach to the existence of a new method of collaboration, namely Lesson study, still cannot enter into the school program. The schools are now aware of the importance of the uniqueness and uniqueness of the school so that they are not just followers or imitations of practices in other schools. The approach needed by the stakeholders to potential schools certainly requires a separate approach. With the excellence of the school, of course, through the optimization of internal school collaboration, especially in the academic field will provide significant results.

Some academic collaboration practices that have been carried out and standardized by the Education Office such as the Teacher Working Group (KKG) and MGMP (Deliberation of Subject Teachers) have been very well done. However, the school accreditation assessment has not yet reached the assessment of teacher collaboration or has not yet assessed how the school's efforts in improving the professionalism of teachers especially in improving the quality of learning. Thus increasing collegiality of teachers to improve student learning outcomes is very important to be a concern of stakeholders. The best results of the Lesson study practice that is still being done is that the school principal or school stakeholders intensively support the activities of enhancing teacher collaboration to improve their professionalism. 11,12,13,14. The absence of formal support from either the principal or official institution to improve teacher professionalism will cause failure of existing tutoring study practices . 5,8,9,11,14,15.

The lesson study practices that have been understood and practiced by most teachers in Malang are still not comprehensive. Most of them are at the stage of implementing the lesson study stage but have not yet practiced supportive colleagues, especially on learning. The focus of educational research has not yet emerged from the teacher as the main actor in the learning process in his class. So the activity of visiting practitioners or educational experts to improve learning in their classrooms will only be temporary. Thus, awareness is needed in improving the quality of learning that can be pursued through Lesson Study or other collaborative activities owned by the school so that learning does not only belong to the private teacher. The importance of

improving the quality of learning through the professional community as stated in Nurwidodo (20118) is that there are six reasons to improve learning, as an effort to manage continuous professionalism improvement, as an effort for autonomy and discipline, the emergence of awareness from within the teacher to improve the quality of learning and self-discipline, as an effort to improve the learning rights of all students and ensure all students have a learning experience so that they can achieve learning goals, through collaboration with peer teachers so that not only the subject of private class teachers to enhance learning, as an effort to open themselves so as to trigger an increase in the quality of learning, and as an effort to improve learning both visible and measurable and which other expected outcome especially student's character.

Conclusion

The results show that the practice of improving the quality of learning through Lesson study has been successfully carried out by UM Laboratory High School. However, most schools and teachers have not yet interpreted collegiality in the practice of Lesson study. Furthermore, an approach to class-disclosure is needed to raise awareness and needs of schools in improving the quality of learning, fulfilling students' learning rights, improving the quality of education through the character of collaboration not only by students but also by teachers. These aspects are not owned by schools that fail to implement LS in a sustainable manner. The aspects of openness, mutual argument, mutual conflict of knowledge in the discussion, and not hesitate to convey the problem of student learning.

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Identification of Concepts for Class X Students about Viral and Bacteria Topics in Malang and Lamongan

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Abstract: This study aims to identify students' concepts of viral and bacteria topics in class X students in Malang and Lamongan. This type of research is quantitative descriptive research. The study sample consisted of 156 students who were determined by purposive sampling in the X class of SMA in Malang and Lamongan including SMA Islam Malang, SMA Panjura Malang, SMA Surya Buana Malang, MAN 2 Lamongan, SMA Muhammadiyah Babat, dan MA Raudlatul Muta'allimin. The research data collection used an interview sheet and questionnaire with Guttman's scale which contained 60 questions about odd grade X grade biology topics. The results showed that 45.16% of students did not know the concept of the virus and 56.33% of students did not know the concept of bacterial. It is necessary to conduct research related to misconceptions of viral and bacterial topics in Malang and Lamongan by using three tiers. Identification of tier misconceptions is needed because it not only knows students 'conceptual knowledge but can know students' conceptual understanding of the beliefs that students have when answering.

Introduction

Teachers need to have teacher competencies, including pedagogical, personal, social, and professional competencies in teaching. In addition to competency in teaching, teachers must also have a good mastery of learning material [1]. Teachers must have Pedagogical Content Knowledge as an illustration of the ability of a teacher to package certain material so that it is easily accepted by students and the teacher's understanding of what he can do in teaching a specific concept that is easy and difficult for students so students do not experience misconceptions. (PCK) from a teacher is very important to create useful learning for students [2][3].

Students have an initial knowledge about a concept or explanation of a phenomenon through what is seen or heard, but this initial concept or preconception is sometimes not in accordance with scientific explanations [4]. The preconceptions will be a problem if they are still settled in students (resistant) even though they have been given a correct understanding (scientific concept) [5].

The preconceptions are not always wrong but preconceptions also do not always conform to scientific concepts that have been accepted as truth [6]. Ignorance of students originating from preconception errors can lead to misconceptions in the form of false or non-scientific beliefs held by students on certain concepts or phenomena, which may be

caused by their misunderstanding of other subjects or obtained from previous experience [7].

Traditional teaching using teacher lecture methods can also lead to misconceptions for students [7]. This misconception is persistent or persistent for years and is often not affected through learning in the classroom so that it has a negative impact on the learning process of biology [8]. Misconceptions experienced by students are caused by several factors, namely (1) the formation of informal ideas derived from everyday experience, religious culture, peer groups, and other environmental stresses, (2) incomplete or incorrect views developed by students during learning, and (3) concepts that are inappropriate, misleading, or incorrectly conveyed by the teacher or from a book [9].

The concept that students have is very important to be identified in science education because the ignorance of concepts and misconceptions that are not handled properly can disrupt students' thinking in receiving subsequent knowledge [10]. Interviews, concept maps, and multiple choice tests are common tools for identifying student misunderstandings [11]. The teacher needs to identify the concept of students in the classroom so that the teacher can reflect on the conceptual knowledge that students have after the learning process. Many biological concepts are wrong regarding viral and bacterial material.

Knowledge of incompatible concepts in viral material is found in indicators of viral structure, viral replication, and the role of viruses as vaccines [12]. Whereas incompatible conceptual knowledge of bacterial material is found in the indicators of a grouping of Archaebacterial and Eubacterial, reproduction of bacterial cells, the way bacterial obtain nutrients, bacterial endospores, and the role of bacterial in life [13][14]. Based on the amount of conceptual knowledge that is not in accordance with scientific concepts, a preliminary study was conducted entitled "Identification of Concept for Class X Students of Viral and Bacteria Topics in Malang and Lamongan" which aims to identify students' concepts of viral and bacterial material in class X students in Malang and Lamongan .

Research Method

The research method used is descriptive quantitative method. The study population was all students of class X in Malang and Lamongan. The sampling technique used was purposive sampling using a sample of class X students who had gotten viral and bacteria topics in six schools namely SMA Islam Malang, SMA Panjura Malang, SMA Surya Buana Malang, MAN 2 Lamongan, SMA Muhammadiyah Babat, and MA Raudlatul Muta'allimin. The instrument used in the study was an interview sheet with a biology teacher and a Guttman scale questionnaire containing 20 questions about viral and bacteria topics.

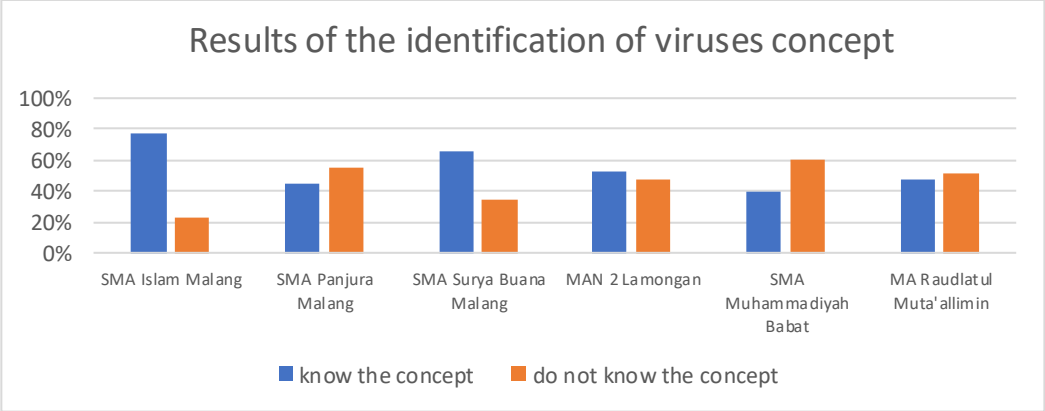
Data analysis is done by making a percentage between students who understand and who do not understand the concept.

Results

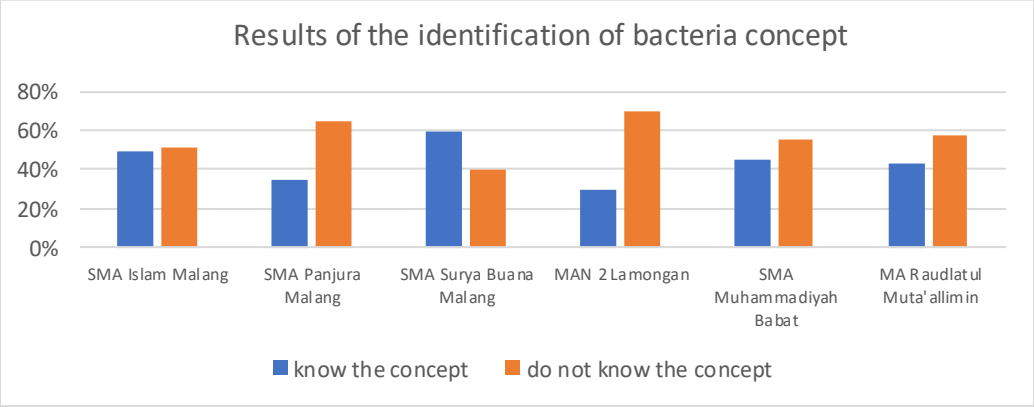
Based on the results of interviews with teachers who taught biology in March 2019 at SMA Islam Malang, SMA Panjura Malang, SMA Surya Buana Malang, MAN 2 Lamongan, SMA Muhammadiyah Babat, and MA Raudlatul Muta'allimin, many misconceptions in class X students in viral and bacteria topics, it is evident from the low test scores, students found it was difficult to understand the characteristics of viral and bacteria due to microscopic forms of viral and bacteria, students cannot apply known traits to determine differences in viral and bacteria, students find it was difficult to explain viral replication, and how to breed bacteria.

The teachers have an opinion on the use of relevant learning resources (not only from one textbook) to reduce student misconceptions or can be used as learning resources that the teacher considers can not cause student misconceptions. Teachers can also use a variety of learning models and methods so students get meaningful learning about viral and bacteria topics. The results of the identification of viral and bacteria topics concepts in 156 class X students in two places namely Malang City and Lamongan Regency with six schools can be seen in Graph 1. and Graph 2.

Graph 1. illustrates that the results of identifying the concept of viral topic in six different schools. There were three schools with the results of students knowing the concept of the virus outnumbered their counterpart, namely SMA Islam Malang, SMA Surya Buana Malang, dan MAN 2 Lamongan. Graph 2. also shows the identification concepts of bacteria topic in the six schools. Suprisingly, in only SMA Surya Buana Malang, students knowing the concept of bacteria outnumbered their counterpart.



Graph 1. Results of Identification Concepts of Viral Topic



Graph 2. Results of Identification Concepts of Bacteria Topic

Discussion

The results of identification of the concepts of viral and bacteria topics in class X students in Malang and Lamongan using the Guttman scale questionnaire show that there were still many students who did not have knowledge of concepts related to viral and bacteria topics. Viral and bacteria topics are an abstract topic so students must learn to focus on the role of reason, mastery of principles, concepts, and generalizations to gain understanding and problem-solving in studying viral and concepts [15]. Students do not have the knowledge related to viral and concepts in the viral structure, viral replication, bacteria structure, and the role of bacteria. Students can lose if they do not know the concept of viral and bacteria because there are many beneficial and harmful roles for viral and bacteria in life.

Teachers use traditional teaching through lectures and students using textbooks as their guide for studying viral and bacteria topics. Students do not know the concept of viral and bacteria even though they have learned because students experience a memorizing learning process, students are passive in class, and students experience learning difficulties [16][17]. Biology subjects are like other science subjects that have a conditional nature. It means that every new concept sometimes requires a prerequisite the previous concept for understanding. Therefore, if there are learning difficulties and/or a misconception in a subjects, it will be carried over to the next subject and/or on to the next level of education [17].

One important factor that influences learning is what students or preconceptions have known before students experience the learning process of viral and bacteria topics [18]. So that learning activities are more meaningful, then new concepts must be associated with existing concepts to improve student retention and make the concept as a memory that students can hold for a long time (long term memory) [19].

Teachers need to invite students to be active and give students the opportunity to develop the ability to understand the concept in the

classroom so that there is a change of concept in students [10]. The change of the concept is defined as a condition where students hold the conception and beliefs that students have where both (conception and belief) conflict with what is being studied so that students decide to change it [20]. The student's concepts changes can occur through two stages, namely assimilation and accommodation. Assimilation means students use existing concepts to deal with new symptoms with a small change in the form of adjustment. The accommodation process asks students to change or change the concept of their old subjects because they are no longer suitable for the new problem [21]. With these two stages in the learning process, students will know more about and understand a concept.

Several factors, both internal and external, can influence students who do not have knowledge of the concepts of viral and bacteria topics such as learning methods that are still used conventionally namely lectures, understanding concepts that are not in accordance with the actual concepts, information received by students incomplete, experience and interest in learning low students, a learning process that only invites students to memorize or passively, and the use of textbooks that use traditional approaches [16][22][23][24].

The results of this concept identification can be followed up in the form of identification of conceptual errors or misconceptions to find out students who know the concepts related to viral and bacteria topics only know the concept or have understood the concepts related to viral and bacteria topics. It needs to be done so that researchers know there is no guessing factor when students answer because there are only two choices on the Guttman scale questionnaire used. One instrument that can be developed to identify misconceptions is diagnostic test three-tier [11]. Three-tier diagnostic tests are considered more accurate in generating alternative concepts of students, students can detect a lack of percentage of knowledge using trust ratings [25]. Identification of misconceptions with three tiers can also be followed by making handouts so students can have knowledge in accordance with the learning objectives to be achieved by the teacher.

Conclusion

Based on the results of identification of the concepts of viral and bacteria topics in class X students in Malang and Lamongan there are still many students who do not have knowledge of concepts related to viral and bacteria topics, so further research is needed regarding identification of concepts errors in viral and bacteria topics in Malang and Lamongan using three tier diagnostic tests and making of teaching topics in the form of handouts to increase the knowledge of students' concepts that are correctly related to viral and bacteria topics.

Suggestion

The development of a three-tier diagnostic instrument can be done first so that it can be used to identify conceptual errors or misconceptions of students with more number of schools (samples).

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Need Analysis of Biology Teaching Material using Macrozoobenthic Diversity as Bioindicator Water Quality of Metro River Module for Junior High School

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Abstract. The purpose of this study determines the needs of Biology Teaching Material using Macrozoobenthic Diversity as Bioindicator Water Quality of Metro River Module for Junior High School. The type of research was a descriptive quantitative of survey method used questionnaires and interview. This research was conducted at SMPN 15 Malang, which is located around the Metro River. The respondents taken by purposive sampling were 58 students of grade VIII and the Science Biology teacher. The findings showed that teachers and students (81,03%) have agreed with teaching material that already exists, but they still needed to apply it by doing the practicum beside learning through notes given by the teacher (50% strongly agreed; 46,6% agreed). From the results of needs, the analysis showed that students needed the biology teaching material using Macrozoobenthic Diversity as Bioindicator Water Quality of Metro River Module (20,7% strongly agreed; 53,4% agreed).

Introduction

Rivers that are important for humans to cross[1], [2] because it is used for various purposes[3]. One of these natural resources is vital for human needs. The water quality must be maintained [1], [4]. But in reality, most of the water used by human activities is discharged into the river which causes a decrease in the river water quality[1], [5], [6].

One of the rivers that become the natural resources of the people of Malang is the Metro River that used by the community around the river as a place to dispose of wastewater from household activities such as bathing, washing, and defecation activities, industry, runoff from agricultural activities and disposal of waste from the market. These activities cause water pollution in the Metro River which will also affect aquatic organisms[7].

Decreased or increased diversity of a species can be considered as a bio-indicator of river pollution [8]–[10]. Bioindicators are biological indicators (organisms) that can show the quality of an environment[9], [11]. One of the biotas that can be used as a bioindicator in determining water quality is macrozoobenthos[8], [11]–[14]. Macrozoobenthos is

more widely used because it can represent the water quality more specifically [14].

The problem of river quality needs to be known by students as the human beings successor who are expected to be able to overcome all problems related to the environment [15], [16]. One of the schools located around the Metro river is SMPN 15 Malang. The students need to know the diversity of macrozoobenthos to identify the quality of polluted rivers and find solutions to overcome these problems. The diversity of macrozoobenthos as a river quality bioindicator can be designed as teaching material for students. Teaching material is a set of learning materials that are arranged systematically to assist teachers in carrying out teaching and learning activities.

Based on the description above, it is necessary to analyze the needs of biology teaching material needed by junior high school students. The aims of this study are to find out about (1) students' condition on the biology learning process, (2) biology teaching material that already exists, (3) students response about biology teaching material, and (4) biology teaching material that students need for the learning process.

Experimental Details

The research employeda descriptive quantitative approach with the survey method. Research participants were 58 students of grade VIII (VIII H and VIII I) taken by purposive sampling and the Science Biology teacher at SMP Negeri 15 Kota Malang on 19 July 2019. Data analysis using quantitative descriptive analysis which is also supported by the results ofinterviews with biology teachers in class VIII.

Result and Discussion

Needs analysis is the process of determining the priority of educational needs[17]. Need analysis is important to be done to develop teaching material for students[18]. Needs analysis is basically a gap (discrepancies) between what is already available and what is expected, and need assessment is the process of gathering information about that gaps and determining priorities of gaps to be resolved [19], that's why the analysis of teaching material needs is very important to determine student learning needs[20]. Students learning condition on biology learning process collected by used Likert scale (4=always/strongly agree; 3=often/agree; 2=rarely/disagree; 1=never/strongly disagree. The results of students learning conditions on the biology learning process are shown in Table 1.

TABLE 1. Students learning condition on the biology learning process

No	Statement	Percentage			
		4	**3**	**2**	**1**
1	Biology is memorizing subject	12,1	55,2	32,8	0
2	Learning process in the class by teacher always links learning the material with daily life	72,4	24,1	3,4	0
3	Learning resource used in learning process are complete	24,1	56,9	19	0
4	The teaching material used is interesting (colored)	27,6	42,4	25,9	5,2
5	The teaching material used is equipped with images that are easy to understand	24,1	67,2	6,9	1,7
6	Explanation of the material contained in teaching materials is complete, so it is easy to answer the questions given by the teacher	31	56,9	12,1	0
7	I like to study Biology using textbooks or modules	32,8	36,2	29,3	1,7
8	I understand the learning material better if teacher use the media (powerpoints, pictures, videos) in front of the class	56,9	34,5	8,6	0
9	There are worksheets / handouts for learning Biology	8,6	25,9	41,4	24,1
10	The teaching materials that I use during learning are always associated with daily life problems, so that helps me understand the learning material for increasing environmental knowledge	46,6	41,4	12,1	0
11	The teaching materials that I use during learning are always associated with daily life problems, so that helps me understand the learning material for increasing environmental worldview	46,6	44,8	8,6	0
12	The teaching materials that I use during learning are always associated with daily life problems, so that helps me understand the learning material for increasing environmental attitude	46,6	41,4	12,1	0

The results of the analysis of the students learning conditions on the biology learning process at SMPN 15 Kota Malang shown the students agreed that Biology is memorizing. The students still think that biology is a memorizing lesson. This is in line with the research conducted by Sadi and Lee [21] that high school students from Taiwanese and Turkish were still learning biology by memorizing. Similar to that, Lin et al.[22], also revealed that a cluster of students with Biology-related majors indeed deemed learning Biology as memorizing simultaneously with understanding. Students conceptions of memorizing might result from their successful experiences because, in Taiwan and the other Asian countries, students have been situated in an educational system with a test[23], [24]. At SMPN 15 Kota Malang learning process in the class by teacher always linked the learning material with daily life and theused learning resource was complete. From the interview, the teacher said that SMPN 15 Kota Malang was the one of Adiwiyata School in Malang so that's why they always link the learning material with students daily life.

The student also agreed that used material teaching was interesting, equipped with images that were easy to understand, and explanation of the material contained in teaching materials was complete so it was easy to answer the questions given by the teacher. Students agree that they like to study Biology using textbooks or modules, but for understanding the learning material better, students need teachers to use the media (powerpoints, pictures, videos) in front of the class. Students strongly agreed that teaching materials they used during learning were always associated with daily life problems, so that helped them to understand the learning material for increasing environmental knowledge, environmental worldview, and environmental attitudes. In line with the research conducted by Cimar [25] revealed that students suggested that teacher should teach byconnecting the Biology topic with daily life, and makebiology learning more interesting.

TABLE 2. Characteristic of biology teaching material

No	Characteristic	Already Exist (%)	Still Needed (%)
1	Contains clearly defined goals	87,9	75,9
2	Contains learning material that is packaged into specific small units to facilitate learning thoroughly	75,9	72,4
3	Provides examples and illustrations that support the clarity of exposure to learning material.	84,5	69
4	Displays practice questions, assignments, etc that allow users to respond and measure the level of mastery of the material.	93	70,7
5	Contextual, that is the presented material is related to the atmosphere or context of the task and environment of the users.	56,9	50
6	Use simple and communicative language.	87,9	84,5
7	There is a summary of learning material.	81	77,6
8	There are assessment instruments that allow users to do the assessment by themselves	40	50
9	There is feedback on the assessment, so users know the level of mastery of the material.	70,7	51,7
10	Available information about references / enrichment / references that support the intended teaching material	86,2	63,8

TABLE 3. Student's response about biology teaching material

No	Question/Statement	Percentage			
		4	**3**	**2**	**1**
1	Can the material presented in existing teaching materials be easily understood?	17,24	81,03	1,72	0
2	Have you ever used the Macrozoobenthic Diversity as Bioindicator Water Quality of Metro River Module based *Problem Based Learning* in this school?	3,4	3,4	22,4	70,4
3	What do you think about this school using the Macrozoobenthic Diversity as Bioindicator Water Quality of Metro River Module based *Problem Based Learning* in this school?	20,7	53,4	5,2	20,7
4	Learning through the notes given by the teacher during learning and applying it by practising, can help you in understanding the material to improve environmental knowledge, environmental insight and environmental attitudes.	50	46,6	3,4	0

It can be seen the characteristics of Biology teaching material analysis in Table 2. The most needed characteristic by students is teaching material that uses simple and communicative language. Teaching materials must contain at least four aspects, and one of which is the language and readability aspects[26]. Language in textbooks sometimes difficult to understand and the discussion in it is too long-winded, so it hard for students to understand the material subject. One of the advantages of the module is using simple language, so that it is easier for students to understand[27]. Beside uses simple and communicative languange, students also need summary of learning material, followed by other characteristics. In other words, students review that the biological teaching material used already contains all the characteristics of teaching material, but they still need it in other teaching materials.

The results of the students' response to biology teaching material analysis shown in Table 3. Students agree that material presented in existing teaching materials be easily understood. But, this school never used the Macrozoobenthic Diversity as Bioindicator Water Quality of Metro River Module based *Problem Based Learning* and they agree to using it. Because, learning through the notes given by the teacher during learning and applying it by practising, can help students in understanding the material to improve environmental knowledge, environmental insight and environmental attitudes. In other words, students still need new material teaching based on problem-based learning because they still need to apply what they learn by doing the practicum. Education should be released from the traditional method, which means the teacher must be more clever in designing teaching materials [28]. This is in line with previous research [25], [29] that Biology teacher must teaching through the use of visual material, and conducting practical experiments. Maras & Akman [30] also prove it in their study, that the use of laboratory and computer-aided instruction fostered learning more than the traditional education method.

TABLE 4. Biology teaching material needs

No	Indicator	Category	Percentage
1	Learning material (subject) *(may choose more than one)*	Classification of Living Things	31
		Energy	46,6
		Life Organizational System	39,7
		Living things and the environment	46,6
		Environmental pollution	72,4
		Weather change	36,2
2	Learning model *(may choose more than one)*	Direct Instruction	36,2
		Cooperative Learning	41,4
		Contextual Learning	55,2
		Problem Based Learning	67,2
		Inquiry Learning	22,4
3	Types of writing (font) *(may choose more than one)*	Times New Roman	34,5
		Calibri	25,9
		Arial	31
		Cambria	17,2
		Maiandra GD	10,3
		Berlin Sans FD	74,1
		Garamond	13,8
4	Types of color (*may choose more than one)*	Black	50
		Blue	79,3
		Green	25,9
		Purple	17,2
		Red	25,9
		Pink	32,8
		Yellow	19
		Grey	10,3

The results of the students' biology teaching material need analysis in Table 4 shown that most students (72%) need biology learning material in subject environmental pollution, and the learning model they need for that subject is Problem Based Learning (PBL) (67,2%). Furthermore, for this teaching material students need the type of writing (font) using Berlin Sans FD (74,1%) with dominant blue color (79,3%). Among the factors determining the quality of teaching material, color is an important one. According to Abadi et al. [31], to increase students' in learning, teaching material should be interesting. Knowing what colors students like will allow illustrators to consider age levels and make teaching materials more interesting [32].

Based on the analysis, students have agreed with the conditions on the biology learning process at school. Teachers have taught them by relating daily problems. This is important because, through environmental education, which introduces environmental problems to students will affect knowledge, insight, and environmental attitudes [33]. The introduction of environmental problems to students, especially those who attend schools in Metro River watersheds needs to be done. This can be applied through a biological learning module on environmental pollution based PBL materials. The strengths of the modules can be used

independently (self-instruction) by students to achieve the specified competencies[34], [35]. The use of modules can provide better planned and independent learning activities[35], [36]. In this learning, students are asked to work on real problems found in everyday life to compile their knowledge, develop independence and self-confidence[37]. Based on real problems experienced by students, PBL modules are expected to improve students' ability to find solutions to these problems[38]. This is consistent with the results of research by Phungsuk, et al.[39], with PBL the students' learning ability increases and students are also able to solve their problem.

Conclusions

Based on the result of the need analysis of biology teaching materials for SMPN 15 Kota Malang, it can be concluded as students already agreed with their learning conditions on the biology learning process and the teaching material that already exists. However, students still need biology teaching material on environmental pollution topics based on problem-based learning because they need to apply what they learn by doing practical work on environmental issues around. Therefore, the researcher will develop biology teaching material using macrozoobenthic diversity as the bioindicator water quality of the metro river module for junior high school.

Acknowledgments

The author would like to thank Head of SMPN 15 Kota Malang for facilitating this research and also thank the teacher and student class VIII SMPN 15 Kota Malang for contributing this research.

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The Effectiveness Of Cooperative Learning Model Type Jigsaw And STAD Based HOTS On Mathematical Problem Solving Abilities

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Abstract. This research was aimed to describe: (1) the effectiveness of cooperative learning model type Jigsaw and STAD based HOTS on mathematical problem solving abilities, (2) comparing the effectiveness of cooperative learning model type Jigsaw and STAD based HOTS on mathematical problem solving abilities. The research design used was quasi-experimental research with a pretest posttest non-equivalent group design. This study used two experimental classes. The research instrument used was a test of mathematical problem solving abilities. The results showed that: (1) Cooperative learning model type Jigsaw and STAD based on HOTS was effective on mathematical problem solving abilities, (2) there was a difference in effectiveness between ccooperative learning model type Jigsaw and STAD based HOTS on mathematical problem solving abilities. and 3) cooperative learning model type Jigsaw based on HOTS is more effective than the STAD type based on HOTS for mathematical problem solving abilities.

Introduction

Improving higher order thinking skills has become one of the priorities in school mathematics learning. Permendikbud Number 21 in the year of 2016 (Content Standards) stated that mathematics is given to all students to equip students with the ability to think logically, analytically, accurately, critically, responsibly, creatively, and have a curiosity and ability to cooperate. Mathematics is the science of logic regarding form, structure, quantity and concepts related to one another (E. Suherman et al. 2001: 18). In learning mathematics, students are required not only to have the ability to think low level (Lower Order Thinking (LOT)), but also the ability to think high level (High Order Thinking (HOT)). According to Anderson in Jailani (2016: 112), in the revised taxonomy, HOTS characteristics are characterized by thoughts that involve analysis, synthetics and creation. W. Winarso (2014: 113) argued that the problem indicators for measuring HOTS capability include non-algorithmic, tend to be complex, have a solution that may be more than one (open ended approach), Requires effort to find structure in disorder.

In Indonesia the ability to think at a high level is still low as evidenced by the Mathematical Score of 397, placing Indonesia at number 45 out of 50 countries. In the field of Science, with a score of 397, Indonesia ranks is 45th out of 48 countries. (TIMSS or Trends in Mathematic and Science Study, 2015). The TIMMS results show that the low level of students high thinking ability in mathematics. The low level of students thinking ability also affects to the low ability of students' mathematical problem solving. The ability to solve mathematical problems can be seen based on student learning outcomes. According to Nana Sudjana in E. Untari (2013: 2), mathematics learning outcomes are abilities possessed after students gain learning experiences.

Based on the data information from mathematics teachers class XI at Boedi Oetomo 3 Maos Vocational School, mathematics student learning outcomes are still low seen from the average value of Mid Term Test (PTS) in the second semester in the Academic Year of 2018/2019 which is 64, while the Minimum Graduation Criteria (KKM) set by the school are 67. So it can be said the average value of students does not reach the expected minimum completeness criteria. In addition, from observations made in the classroom when learning takes place, the low learning outcomes indicate students have learning difficulties. Difficulties of students in learning can be influenced by several factors including the low understanding of students about concepts in mathematics and the learning models used are less varied. One of the things done by teachers to overcome student learning difficulties is to use cooperative learning models. In this study there are two cooperative learning models used, namely the first type of Jigsaw cooperative learning model. According to Aronson in E. Untari (2013: 4) said, Jigsaw type cooperative learning is a type of cooperative learning model that encourages students to be more active. M. Faturrohman (2016: 63) argues, the Jigsaw type cooperative learning model is a cooperative learning model with groups of students consisting of 4-6 heterogeneous students with different sub-materials, collaborating and having respective responsibilities to greet the material to the other group members (home team). Different team members with the same topic meet for discussion (expert team). Then members of the expert team return to the original group to explain to group members the material that has been learned. The second cooperative learning model is a type of Student Teams Achievement Division (STAD) cooperative learning model. According to A. Prabowo and Sunaryo (2015: 3), the STAD learning model is a cooperative learning model that is easy to implement in learning because of the simplicity of the steps.

The problems in this study are: 1). What is the effectiveness of mathematics learning with HOTS-based Jigsaw and STAD type cooperative models for mathematical problem solving skills? 2). Which is more effective between Jigsaw's type of cooperative learning model and HOTS-based STAD on mathematical problem solving skills?

The purpose of this study is to find out: 1). Describe the effectiveness of cooperative learning model type Jigsaw and STAD-based HOTS toward the ability to solve mathematical problems. 2). Comparing the effectiveness between cooperative learning type Jigsaw and STAD -based HOTS on mathematical problem solving skills.

Theoretical BASIS

According to Slavin (2006: 255), "Cooperative learning Instructional approaches in which students work in small mixed ability groups". Arends and Kilcher (2010: 306) also stated that: Cooperative learning is a teaching model or strategy that is characterized by cooperative tasks, goals, and reward structures, and requires students to be actively engaged in discussions, debates, tutoring, and teamwork.

According to Borich (2007: 389), "In the cooperative learning activity called Jigsaw II, you assign students to 4 to 6 member teams to work on an academic task broken into several subtasks, depending on the number of groups. you assign students to teams and then assign a unique responsibility to teach team members". Arends and Kilcher (2010: 316) explained, "This approach to cooperative learning divides up the learning materials so group members can work on particular topics. Students start out in heterogeneous home or base teams consisting of four or five members. Member number of and then move to expert groups. Each expert group learns a different part or aspect of the assigned topic. They read and discuss learning materials provided by the teacher and help each other learn about their assigned topic. They also decide how best to present the material to others when their home teams reconvene. Each member of the team teaches their part to other home team members. Following home team meetings and discussions, students are tested independently on the material.

According to Arends & Kilcher (2010: 317-318), STAD is another approach to cooperative learning. It involves students working together in groups and groups that compete with each other. This approach has been quite thoroughly researched and has been shown to be effective for helping students master declarative knowledge in the form of basic facts and conceptual information. STAD involves organizing students into semi-permanent teams (usually together for about six weeks) and using an improvement point scoring system. Borich (2007: 388) explained that, In Student Team-Achievement Division (STAD), the teacher assigns students to 4- or 5-member learning teams. Each team is as heterogeneous as possible to represent the composition of the entire class (boys / girls, higher performing / lower performing, etc.).

Jati Agung (2018: 2) argues, High Order Thinking Skills (HOTS) is a thought process that requires students to broaden their mindset by manipulating ideas that give students solutions to new challenges or

cases. According to some experts in Jailani (2016: 112), HOTS learning is:

- Liu and Fisher, HOTS are characterized by thoughts that involve analysis, synthesis and evaluation.
- Krulik and Rudnick, critical and creative Thinking.
- Anderson and Krathwohl, HOTS are characterized by involving analysis, synthesis and creation.

Problem solving according to George Polya (in Billstein, et.al (1990: 3), A great discovery solves a great problem but there is a grain of discovery in the solution of any problem. Your problem may be modest; but if it challenges your curiosity and bring into play your inventive facilities, and if you solve it by your own means, you may experience the tension and enjoy the triumph of discovery.In addition, Polya (in Billstein, Libeskind, & Lott, 1990: 3) developed four steps which are the processes that must be carried out for solving the problem, as follows:

- Understanding the problem
- Divising a plan
- Carrying out the plan
- Re-checking all the steps that have be done

Research Methods

This type of research is a quantitative study using quasi-experimental methods (quasi-experimental) which aims to compare the two experimental groups. The design of this study was chosen because the researchers did not do random assignments, but instead used existing groups as experimental groups. This research was conducted at Boedi Oetomo 3 Maos Vocational School which is located at Jalan Raya Penisihan No. 300 Penisihan Maos, Cilacap, Central Java. The implementation of this research includes the learning process and data collection conducted on April, 22 until 26, 2019 semester II in the academic year of 2018/2019 with a total of 60 students. The population in this study were all students of class XI semester II of Boedi Oetomo 3 Maos Vocational School. The sampling technique was carried out by random sampling technique so that two classes were selected, class XI of Light Vehicle Engineering I (TKR I) as the experimental class I and the Light Vehicle Engineering class II (TKR II) as the experimental class II.

In this study the technique used for data collection is the test technique. The test in this study is a matter of pretest and posttest to measure the ability of mathematical problem solving. The test is in the form of essay questions with 5 questions. The data analysis technique used is 1). Descriptive Analysis, the data described are data obtained from measurements on research variables (dependent variables), namely cognitive abilities, and students' social abilities. The data that has been obtained is calculated the average value and then interpreted into the criteria that have been determined and the percentage is

determined. 2). Inferential Statistical Analysis, that is with one sample t-test statistics. This analysis was conducted to determine the effectiveness of cooperative learning type Jigsaw and STAD-based HOTS on the ability to solve mathematical problems.

Results and Discussion

Early Students' Abilities on Mathematical Problem Solving (Pretest)

The data of students' abilities on mathematical problem solving were obtained from pretest scores of experimental class I students (XI TKR1) and experimental class II (XI TKR2) Boedi Oetomo 3 Maos Vocational School.

TABLE 1. Data of Students' Abilities on Mathematical Problem Solving (Pretest)

Parameter	Class	
	Exsperiment I	Exsperiment II
Lowest Value	48	45
The highest score	73	73
Average	61,6	60.3
Standard Deviations	6,3176	7,4794
Variance	39,9126	55,9414
The number of students	30	30

This normality test was conducted to find out whether the data from the early abilities of students' mathematical problem solving experiment class I and experiment II had normal distribution or not. In this study for the normality test used the Chi-Square test formula.

TABLE 2. Normality Test Results Preliminary Ability to Solve Student Math Problems (Pretest)

Class	$X^2_{arithmatic}$	X^2_{table}	Significant Level	Dk	Explanation
Exsperiment I	3,0725	7,8148	0,05	4	Normal distribution
Exsperiment II	3,7568	9,4877	0,05	5	Normal distribution

Based on the above table and calculations that have been done in experimental class I (XI TKR1) with a significant level of 0.05 and degrees of freedom 4, it can be obtained $X^2_{arithmatic} = 3.0725$ dan $X^2_{table} = 7.8148$. So that it can be seen $X^2_{arithmatic} < X^2_{table}$ which means that the experimental class I has the initial ability to solve mathematical problems that are normally distributed. While the calculations that have been done in experimental class II (XI TKR2) with a significant level of 0.05 and degrees of freedom 5, it can be obtained $X^2_{arithmatic} = 3,7568$ dan $X^2_{table} = 9,4877$. So that it can be seen $X^2_{arithmatic} < X^2_{table}$ which means that the

experimental class II has the initial ability to solve mathematical problems that are normally distributed.

Homogeneity test is conducted to find out whether the initial ability data of students' mathematical problem solving experiments class I and II are homogeneous or not. In this study for homogeneity test using the Barlett test formula.

TABLE 3. Homogeneity Test Results on Students Mathematical Problem Solving (Pretest)

$X^2_{arithmatic}$	X^2_{table}	Significant Level	Dk	Explanation
0,8225	3,8415	0,05	1	Homogeneous

Based on the above table and the calculations that have been done in the experimental class I and II with a significance level of 0.05 and degrees of freedom 1, it can be obtained $X^2_{arithmatic}$ = 0,8225 dan $X^2_{table} = 3,8415$. So that it can be seen $X^2_{arithmatic} < X^2_{table}$ which means that the experimental class I and II have the data in initial ability to solve students' homogeneous mathematical problems.

This two-part of hypothesis test was conducted to find out whether there were differences in the data on the initial ability of mathematical problem solving on students of experimental class I and experimental class II. In a two-part of hypothesis test research using two-part t test.

TABEL 4. The Result of the Two Part of hypothesis test Toward the Initial Ability of Students to Solve Mathematical Problems

$t_{arithmatic}$	t_{table}	Significant Level	Dk	Explanation
-0,6899	2,00172	0,05	58	H_0 is excepted

Based on the table above and the calculations that have been done in experimental class I and experiment class II with a significant level of 0.05 and 58 degrees of freedom, it can be obtained $t_{arithmatic} = -0,6899$ dan $t_{table} = 2,00172$. Karena $-t_{table} < t_{arithmatic} < t_{table}$ maka H_0 is accepted, which means there is no difference in the students' initial mathematical problem solving abilities in the experimental class I and experimental class II.

Final Ability to Solve Students' Math Problems (Posstest)

Data on the final ability of mathematical problem solving (posttest) students of experimental class I (XI TKR1) and experimental class II (XI TKR2).

TABEL 5. Data Description of Students' Final Mathematical Problem Solving Ability (Posttest)

Parameter	Class	
	Exsperiment I	Exsperiment II
Lowest Value	65	63
The highest score	87	78
Average	75,5	70
Standard Deviations	5,3546	3,6236
Variance	28,6724	13,1310
The number of students	30	30

This normality test is conducted to find out whether the final ability data of mathematical problem solving (posttest) of experimental class I and experiment class II students is normally distributed or not. In this study for the normality test using the Chi-Square test formula.

TABEL 6. Results of Test for Normality of Students' Final Ability in Solving Mathematical Problems *(Posttest)*

Class	$X^2_{arithmatic}$	X^2_{table}	Significant Level	Dk	Explanation
Exsperiment I	0,2082	7,8147	0,05	3	Normal distribution
Exsperiment II	1,0317	5,9915	0,05	2	Normal distribution

Based on the above table and calculations that have been done in experimental class I (XI TKR1) with a significance level of 0.05 and degrees of freedom 3, it can be obtained $X^2_{arithmatic} = 0{,}2082$ dan $X^2_{table} = 7{,}8147$. So that it can be seen $X^2_{arithmatic} < X^2_{table}$ which means that the experimental class I has normal distributed data. While the calculations that have been done in the experimental class II (XI TKR2) with a significance level of 0.05 and degrees of freedom 2, it can be obtained $X^2_{arithmatic} = 1{,}0317$ dan $X^2_{table} = 5{,}9915$. So that it can be seen $X^2_{arithmatic} < X^2_{table}$ which means that the experimental class II has normally distributed data.

This homogeneity test was conducted to find out whether the final ability data of students' mathematical problem solving (posttest) of the experimental class I and experiment II students was homogeneous or not. In this study for homogeneity test using the Barlett test formula.

TABEL 7. Homogeneity Test Results on The Final Ability of Students Mathematical Problem Solving (Posttest)

$X^2_{arithmatic}$	X^2_{table}	Significant Level	Dk	Explanation
3,3137	3,8415	0,05	1	homogeneous

Based on the table above and the calculations that have been done in the experimental class I and experiment class II with a significant level of 0.05 and degrees of freedom 1, it can be obtained $X^2_{arithmatic} = 3,3137$ dan $X^2_{table} = 3,8415$. So that it can be seen $X^2_{arithmatic} < X^2_{table}$ which means that the experimental class I and experiment class II have homogeneous data.

The Effectiveness of Cooperative Learning Type Jigsaw and STAD based-HOTS on Mathematical Problem Solving Capabilities

This hypothesis test is used to determine whether there is effectiveness in the final ability of mathematical problem solving (posttest) based on the Minimum Completeness Criteria (KKM) of students in experimental class I and experimental class II.

TABLE 8. Hypothesis Test Results Final Capability of Mathematical Problem Solving Based on KKM Value (Posttest)

Class	KKM	The Number of Students	Students Pass	Students Don't Pass	Precent age
Eksperimen I	67	30	28	2	93,3%
Eksperimen II	67	30	25	5	83,3%

Based on the above table and calculations that have been done in Experiment Class I (XI TKR1) with many students 30 and the KKM value of 67, obtained the number of students who completed as many as 28 students and the percentage of 93.3%. So that it can be seen the number of students completed ≥ KKM value of 67 and the percentage > 50 % then H0 is rejected, which means that the experimental class I is effective based on the KKM value. While the calculations that have been done in experimental class II (XI TKR2) with 30 students and 67 KKM scores, obtained the number of students who completed as many as 25 students and a percentage of 83.3%. So it can be seen that students complete ≥ KKM value of 67 and percentage > 50%, then H0 is rejected, which means that the experimental class II is effective based on the KKM value.

This two-part of hypothesis test was conducted to find out whether there were differences in the data of the mathematical problem solving ability (posttest) of the experimental class I students and the experimental class II.

TABLE 9. Hypothesis Test Results of Two Parties Final Ability to Solve Students' Mathematics Problems (Posttest)

$t_{arithmatic}$	t_{table}	Significant Level	Dk	Explanation
-4,8286	-2,0017	0,05	58	H_0 is rejected

Based on the above table and calculations that have been done in the experimental class I and experiment II with a significant level of 0.05 and 58 degrees of freedom, it can be obtained $t_{arithmatic} = -4{,}8286$ dan $t_{table} = -2{,}0017$. Because $t_{arithmatic} > t_{table}$ atau $t_{arithmatic} < -t_{table}$, so H0 is rejected, which means that there are differences in mathematical problem solving abilities in the posttest grade data of students who use Jigsaw learning models based-HOTS with classes that use Student Teams Achievement Division (STAD) learning models based-HOTS.

This one-part of hypothesis test was conducted to find out whether the use of Jigsaw type learning models based on HOTS was more effective than the use of learning models of Student Teams Achievement Division (STAD) based on HOTS on students' mathematical problem solving abilities between experimental class I and experimental class II. This one-part of hypothesis test was conducted to find out whether the use of Jigsaw type learning models based on HOTS was more effective than the use of learning models of Student Teams Achievement Division (STAD) based on HOTS on students' mathematical problem solving abilities between experimental class I and experimental class II.

TABLE 10. One-Part of Hypothesis Test Results Final Ability on Students' Mathematical Problem Solving (Posttest)

$t_{arithmatic}$	t_{table}	Significant Level	Dk	Explanation
-4,82287	-1,671553	0,05	58	H_0 is rejected

Based on the above table and calculations that have been done in the experimental class I and experiment class II with a significant level of 0.05 and 58 degrees of freedom, it can be obtained $t_{arithmatic} = -4{,}82287$ dan $t_{table} = -1{,}671553$. Because $t_{arithmatic} < -t_{table}$, so H0 is rejected, which means that the use of Jigsaw learning models-based HOTS is more effective than the use of Student Teams Achievement Division (STAD) learning methods based HOTS for students' mathematical problem solving abilities.

Conclusion

Based on the results of data analysis and discussion, it can be concluded that: (1) Jigsaw and STAD cooperative learning models based on HOTS are effective in mathematical problem-solving abilities, (2) there is a difference in effectiveness between Jigsaw and STAD cooperative learning models based on HOTS toward the students mathematical problem-solving abilities, and 3) the Jigsaw type cooperative learning model is more effective than the STAD type of mathematical problem-solving skills.

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Games-Educative Space on Development of Flipbook Teaching Materials Based Inquiry Lesson

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Abstract. Physics learning needs to be developed into learning activities that trigger students to be active, independent, and fun. This can be supported by the presence of physics teaching materials accompanied by educational games and appropriate learning models. Inquiry model lesson in accordance with the principles of physics learning "students find out". Games-edu space has many advantages in learning activities by combining play and learn activities to give an exciting impression of learning for students. This research focuses on developing and knowing the feasibility of inquiry lesson based flipbook teaching materials with games-edu space in Hooke's law and elasticity material. This type of research is a 4-D models in which the results of the data obtained from the questionnaire sheet validator and student response. The results of the study indicate that the product is categorized as very valid and suitable for use in physics learning. This research and development proves that the flipbook teaching material can vary the activities of students in learning physics.

Introduction

"Physics is the most basic science and has philosophical implications in life" (Kabil, 2015). This explains the facts which are lessons that are very related to real life and have many uses in life. Physics learning in schools is expected to help students in finding concepts in a fun way. Educators have a role to learn about it, namely looking for ways to make learning physics into a fun learning. One of the things that supports fun learning is fun teaching material. However, teaching materials in the development of learning physics are still limited and focus on the core material. Research by Rahayu et al found 85% of students stated that the teaching materials used were still in the form of textbooks or its containing sentences or paragraphs that were long and difficult to understand, this made students lazy in reading books so learning outcomes after studying were still relatively low (Rahayu et al., 2017). Therefore, it is necessary to develop teaching materials that follow developments and technology. Presentation of teaching materials in digital or electronic format is very in accordance with technological developments that have been mastered by many students. One alternative to electronic teaching materials is flipbook teaching material

where the development of flipbook teaching materials has been studied which can affect students' motivation and learning interests (Pornamasari, 2017). The results of Pornamasari's research found that 73.47% of students stated that flipbook teaching materials were well used in learning.

In accordance with Regulation Of The Minister Of Education And Culture Of The Republic Of Indonesia number 65 of 2013 concerning Standard Process Primary and Secondary Education one of the learning principles used is students find out (Nuh, n.d.). Teaching materials that are appropriate with this are teaching materials that apply the inqury lesson learning model. Based on the research results of (Khan et al., 2011) it was reported that inquiry learning with experimental activities can have a positive impact on the development of students' scientific skills. Inquiry based-learning is increasingly suggested as an efficient approach tahat can increas a students curiosity and motivation (Suárez et al., 2018). The inquiry learning model has several levels. According to Carl J. Wenning the level of inquiry starts from the basic to the highest level consisting of discovery learning, interactive demonstrations, inquiry lessons, inquiry labs, real work applications and hypothetical inquiry (Wenning, 2011). Inquiry lesson-based teaching material is teaching material that contains learning activities that encourage students to analyze, solve problems based on the facts found in order to obtain a more meaningful conceptual understanding and student learning. Syafruddin et al support this with the results of his research using inquiry-based modules, found that the module was effective in improving student learning outcomes, as evidenced by an average learning outcome of 85.00 (Syafruddin et al., 2016).

Inquiry lesson material developed in this research is teaching material on elasticity and spring material. This material is one of the most difficult and challenging physics materials (Azizah et al., 2015). Another matter conveyed by (Hidayati et al., 2016). Based on the results of his research, there were 51.05% of students experiencing misconceptions on the material elasticity and Hooke's law. These problems can arise due to the lack of effective teaching materials used in learning. Based on this, we need teaching materials that support the learning process, especially in students' understanding of the material elasticity and Hooke's law. In accordance with the goals of the educator regarding fun physics learning, the flipbook-based inquiry lesson material can be combined with a fun learning activity that is the existence of educational games (games-edu).

Educational games are learning tools with fun activities that are educated and benefit from improving language skills, think, interact with the environment, develop personalities, draw closer relations between teachers and students. This is supported by (Demirbilek and Tamer, 2010) in his research that games can help students to better understand their knowledge and motivate students to be actively involved and participate in learning. In the experimental results it was found that the

game can be a tool to improve learning and to find out complicated subjects (Ricci et al., 1996). Based on the results of the literature study, it is deemed necessary to conduct research efforts regarding the development of inquiry-based flipbook teaching materials with games-edu space on the material elasticity and Hooke's law.

Methods

This research uses Research and Development (R & D) methods because this research produces an inquiry lesson-based flipbook teaching material with games-edu space on the material elasticity and Hooke's law consisting of teaching materials and student learning materials. The R&D research model used is the 4D development model. Thiagarajan & Sivasailam stated that this development research model has 4 stages, namely: (1) Define; (2) Design; (3) Development; and (4) Disseminate (Thiagarajan et al., 1974).

Consideration of the use of the 4D model because this model is simpler but has several steps arranged in detail and systematically (Thiagarajan et al., 1974). In this research and development method, only 3 stages are carried out out of the 4 stages, which are only up to the development stage. At the defining stage, several analyzes are conducted, including front end analysis with literature studies in related research journals and field studies by observing teaching materials circulating in bookstores and schools as well as discussions with teachers. Furthermore, student analysis is carried out by analyzing student characteristics in physics learning and task analysis, namely identifying student skills based on the analysis of student characteristics. Then the concept analysis is carried out by examining the curriculum, and competencies that aim to determine the type of teaching material. In the last define stage, namely formulating learning objectives as a result or achievement of student learning. It also becomes the basis for designing learning tools.

The second stage is the planning stage (design) where at this stage the teaching material is arranged in accordance with the framework of the results of the analysis in the previous stage. Product design includes syllabus mapping, material preparation, method and media selection, format design and teaching material design and instrument preparation. After two stages of research carried out, the final stage is product development (development). At the development stage two steps are carried out to produce the final form of teaching material. Teaching materials that have been designed will be validated by experts to assess the feasibility of teaching materials. Based on input from suggestions and comments from experts, teaching materials that have been compiled are then revised to make products that are more precise and easier to use. After the product is revised, a readability test is conducted by students to obtain direct input in the form of student responses and

comments on the teaching materials that have been prepared. Product eligibility criteria are obtained through average value analysis. Subjects of the validation study were the lecturer in physics at the State University of Malang and the physics teacher at State Senior High School 7 Malang. The subjects of the readability trial were 20 students of Class X IPA. Data collection instruments used in the form of questionnaire validation of teaching materials and readability test questionnaires. The data analysis technique used in this research and development is the percentage analysis technique. The percentage formula used to analyze the results of the validation questionnaire and legibility test results is as follows.

$$V = \frac{TSe}{TSh} x100\%$$

Information :
V = Validity
TSe = Empirical total score (validation results)
TSh = Expected maximum total score

The product eligibility criteria obtained through the analysis of the average values used are presented in Table 1 below.

TABLE 1. Criteria for Results of Product Feasibility Analysis or Validation

Validity Criteria	Validity Level
85,01 % – 100%	Very Valid (can be used without revision)
70,01 % – 85%	Valid Enough (can be used but needs minor revision)
50,01 % – 70%	Invalid (not recommended because it needs a major revision)
01,00 % – 50%	Invalid (may not be used)

Source : (Sa'dun, 2013)

Results

This research and development resulted in a product in the form of a flipbook based on inquiry lesson with games-edu space on the material elasticity and Hooke's law. Teaching material developed consists of teaching materials for students and for teachers. Teaching material for students is titled Lets Learn: A Study Guide Book. Teaching material for students consists of several parts of learning activities and facilities, including: 1) motivations, 2) observe it, 3) learning objectives, 4) tech & news, 5) information collecting, 6) animations space, 7) sci-link, 8) let's experiment, 9) read corner , 10) sci-gallery, 11) real application, 12) games-edu space, 13) phy-figure, 14) sample questions, 15) final test, 16) quotes, 17) go exercise, 18) self-summary & assessment.

Teacher's teaching material is titled Lets Learn: Teacher's Textbook. Teaching material for teachers consists of several sections, including: 1) motivation for teachers, 2) guide for using the book, 3) syllabus , 4)

competencies, 5) learning strategies and models, 6) learning media, 7) RPP and LKPD, 8) learning activities accompanied by instructional instructions, 9) game-edu game instructions, and 10) learning device document link.

The results of research and development data were obtained from the questionnaire evaluation of teaching material validation by three validators and a readability test questionnaire. The data is in the form of quantitative and qualitative data. Quantitative data in the form of Likert scale data are then analyzed using percentage analysis techniques. For qualitative data in the form of suggestions and comments from the validator as well as suggestions and responses from 20 students of SMAN 7 Malang on the legibility test. The recapitulation of the results of the validation of teaching materials by the validator can be seen in Table 2.

TABLE 2. Recapitulation of Teaching Material Validation Results by Validator

Rated Aspect	Meeting			Average	Percentage (%)	Criteria
	M1	M2	M3			
Content	3,67	3,63	3,71	3,67	91,78	Very Valid
RPP	3,67	3,5	3,79	3,65	91,32	Very Valid
Practicality of Teaching Instructions	3,67	3,67	3,67	3,67	91,67	Very Valid
Rated Aspect	**Section**			**Average**	**Percentage (%)**	**Criteria**
	S1	**S2**	**S3**			
Construct	3,62	3,61	3,69	3,64	91,02	Very Valid
Rated Aspect				**Average**	**Percentage (%)**	**Criteria**
Compliance with Inquiry Lesson				3,66	91,39	Very Valid
Flipbook				3,67	91,67	Very Valid
The average value of the feasibility of teaching materials				3,66	91,47	Very Valid

The results of the validation of flipbook materials based on inquiry lesson with games-edu space developed reached 91.47% with an average value of 3.66. This explains that teaching materials are categorized as very valid and can be used without revision. For the test results readability of teaching materials by students obtained an average percentage of 96%. Based on these results, the readability of flipbook-based teaching materials based on inquiry lessons with games-edu space is categorized as very valid or very suitable for use in learning.

Based on the results of the validation of teaching materials in Table 2 the developed teaching materials have been said to be very valid in the aspects of content, lesson plans, the practicality of instructional instructions, constructs, conformity to the inquiry lesson model, and flipbook media. This shows that teaching materials in the aspect of content can help students achieve competencies and learning goals because they are developed in accordance with curriculum demands, namely considering student needs. For the application of inquiry lesson

models in teaching materials are in accordance with physics learning which refers to a scientific approach. Learning activities have also been arranged coherently and are easily understood by students. as well as the existence of instructional instructions that are delivered practically and clearly. Based on the explanation above, it can be said that teaching materials are very feasible and can be used in learning which certainly can provide good benefits for students and teachers.

Conclusion

The teaching material developed has been arranged based on the inquiry lesson learning model in the presence of games-edu space as a characteristic of teaching material. Teaching materials that have been developed consist of two types, namely teaching materials for students and teaching materials for teachers. After the teaching material is developed, then the evaluation of the teaching material is conducted by an expert validator to find out the validity of several aspects in the teaching material. Based on the evaluation of teaching materials by the validator, teaching materials are categorized as very valid with an average of 91.47%. After conducting the assessment by the validator, readability testing is conducted by students. From the results of the students' readability test, overall teaching material products can be said to be good in terms of the use of teaching materials and clarity of presentation of the content of teaching materials with an average percentage of 96%.

Based on the results of research and development, it can be said that the inquiry lesson-based flipbook material with games-edu space on the material elasticity and Hooke's law can be used in learning which can increase student motivation and attention and can also improve understanding of concepts through learning activities in accordance with curriculum demands this time. Some suggestions for the next teaching material research are the development of teaching materials in the form of andorid and the distribution of teaching materials can be done by disseminating teaching materials to schools, bookstores, and online store playstore on smartphones.

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The Epistemic Game of Students during Physics Learning by Integral Learning

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Abstract. Epistemic game is cognition process to solve the problem. The research aimed to determine the epistemic game of students during physics learning through integral learning. This research used embedded design. The subject of this research is 30 students of X MIA SMAN 3 Malang. The heat concept quiz is used in this research instrument. The results of this research show that epistemic game during integral learning application on the first quiz is mapping mathematics to meaning, physical mechanism game, recursive plug and chug, dan transliteration to mathematics. On the second quiz, students use mapping meaning to mathematics, mapping mathematics to meaning, physical mechanism game, dan transliteration to mathematics. Students solve the third quiz with mapping mathematics to meaning, physical mechanism game dan transliteration to mathematics.

Introduction

Education is one of the important factors of state authority. A good education will utter the competent students in their department. It is shown that improved conditions and rapid science expansion expect the competent students of their department. Physics is one of the science departments to be applied in all of the application department. Today, physics still has to be believed in the horrible department by students. The student understanding of the physics concept, especially the heat concept, is still low. It is shown that the previous researches still show a misconception of heat concept. Angell, et al. (Ornek, et.all, 2008: 30) said that the student perception of physics was difficult because the student had to compete with the different representations like an experiment, formula and calculation, graph with the conceptual explanation at the same time. A big part of students can not relate what studied to how knowledge will be exploited or used (Setyorini, et.all, 2011: 52).

The learning implementation is designed specially like inquiry-based activity to can overcome the student's concept incomprehension (Nottis, 2010: 8). The incomprehension of relating heat to temperature concept is found in engineering education, while the incomprehension of heat transfer concept is found after the student completed the assignment being given by the teacher. According to Baser (2006: 72), the teacher can use the student's incomprehension representation in making a new phenomenon sense to design learning for a student. The

incomprehension can be decreased by the implementation of an accurately learning approach. The learning strategy have to be designed like the student's way to have a conviction that the scientific concept is more useful than the alternative concept. The language using decreases to be understood by the student, causing to occur the concept incomprehension. It agrees on the research result of Halim, et.all. (2012: 128) said that the understanding increase of student's concept about heat energy would be better if the learning instruction use daily language compare with using the second language.

The student's incomprehension of heat concept is showed by Alwan's research result (2011: 604). The students are still confused with heat and temperature concept and can't explain heat and temperature difference. The students can't still approximate the final temperature of different temperature of two sample mixture, however the student understand the mixtured temperature being not higher than before two sample to be mixtured. The previous research said that the student could not give a reason to supporting the student's right answer. Alwan found in his research that the student could use formula and solve theoretical as well as mathematical problem, however the student don't understand the equation based concept and relate to experience.

The physics concept understanding need advanced thinking ability. Agree with Sarwi & Liliasari (2009: 91), physics concept understanding need thinking and reasoning to solve physics problem. The critical thinking ability is needed students to learn about physics phenomenon of nature by a physics concept based analysis. The developing learning method should facilitate actively thinking activity so that learning becomes efective. The previous research result shown that the student's concept understanding is still low because of the students's difficulty of their solving problem. The Subagyo et.all. research (2009: 46) said that concept understanding is still low by deeveloping of process ability and scientific attitude. Agree with Mariati (2012: 159), the student's concept understanding of interpretation aspect is still lower than another aspect because the given problem is not specific. The students will more easily build knowledge explore ideas related to concepts, deepen the concept so that ideas can be developed by problem solving process.

Physics concept understanding can not be separated from the student's cognitive process. Intrepetation of cognitive process that the students use in solving the problem to be called epistemic game. Tuminaro's reasearch result (2007) acquaint the new structure to analyze the thinking of student's problem solving. The developing of new structure is called epistemic game. Epistemic game is equal to problem solving structure. The students can become better and more efficient problem solver by increasing of understanding of knowledge and reasoning be begun to develop the efectively and efficiently circles of learning and interference by acquainting the accurate source and epistemic game (Tuminaro, 2007).

The active learning of interference can build the pleasant learning process for teacher and student and cause the student to can increase the concept understanding of cognitive process (Duron, et.all, 2006: 160). Integral learning is developed by Atkin by using the basis of whole brain model. The good learning of increasing of thinking ability should stimulate all of brain potency and integrate thinking patterns (Atkin, 2000). Agree on Hermmann's clarification, there is to relate to the thinking pattern of integral learning concept. Integral learning is learning to integrate achievement type agree on internal brain characteristics of every learning. Integral lerning focus stimulate student of learning circles that support and challenge student (attract student's attention). Integral learning implementation do not pay attention the student's thinking type, however teacher clarify the important achievement of each knowing type. The learning is become by more efective immendiacy when the processing of whole brain is accurately done inside it. The important point of integral learning is the student's powerful learning to be become when teacher stimulate and integrate all of knowing type by knowing to the power of four.

Methods

The research used embedded design. This research instrument is heat concept quiz. It is given during the physics learning of integral learning to determine epistemic game of students during the giving of concept.

Integral learning implementation consists of 6 steps. The first step is experiental knowledge to be used on the learning activity where the teacher demonstrated on the tropic of connection with heat and its temperature and form, Black principle, coduction, convection and radiation heat transfer, teacher play the bonfire video. The experiental knowledge step aimed to submit the problem of topic concept. The next steps are understanding, imagination, information and clarification. The understanding step, the students make a team for experiment preparations begin with the reading of worksheet. The student begin with setting tools and then doing experiment on the imagination step. The topic of connection with heat and its temperature and form, the student make the graph of relate temperature and time on the imagination step. Specifically for the topic of Black principle, the student drafted the experiment procedure before setting tool on the imagination step and the topic of convection heat transfer, the student make the current pattern of convection heat transfer. After doing experiment, the student notes hypotheses, experiment result and then doing team discussion to solve the problem of worksheet. The worksheet consists of concept application sheet containing the phenomenon that occur in circles and laboratory activation sheet. The concept of application sheet is given at the first until the third meeting reveal the phenomenon of cryotherapy, the waste of electric steam power plant at Paiton,

hypothermia. The next step is the student to presenting the team discussion result (the information and clarification step). The student presenting discussion result be choiced by lottery in order that every student at class has the same chance of presenting of discussion result, while the student of other team respond and teacher is facilitator and gives directive. The closed activity of learning, the student solve the problem be discussed together in front of class (the action step). The students are given quiz, besides solving the exercises at the first, second and fifth meeting on the action step. The students's quiz data are qualitative data will be analyzed descriptively qualitative so that obtained epistemic game data during learning implementation.

The quiz is given for students on the action step during learning implementation. The heat concept quiz is held three times. The first quiz is given on the learning by the topic of connection with heat and its temperature and form. The second quiz is given on the learning by the topic of Black principle. The third quiz is given on the learning by the topic of convection, conduction and radiation heat transfer.

The data of this research are qualitative and quantitative data. The quantitative data of this research are the quiz result data of student's concept understanding. The qualitative data are obtained from epistemic game data of quiz result. This data analysis refered to sequential data analysis. It consists of prepare and organize the data for analysis, code the data, represent findings, intrepent the findings and validate the accuracy of the findings.

Results

Integral learning process of this research cover the concept of connection with heat and its tempererature and form, Black principle, and heat transfer. Based on the result of quiz analysis (during learning implementation) show that the first case (the first question), the 6,67% of students use physical mechanism game on the first quiz, the 66,67% of students of the second quiz, and the 3,33% of students of the third quiz, while used transliteration to mathematics by the 93,33% students of the first quiz, the 23,33% student of the second quiz, and the 93,33% of student of the third quiz. The second case (the second question), the student use mapping meaning to mathematics to be the 0% student of the first and the third quiz, the 90% students of the second quiz, while use mapping mathematics to meaning to be the 16,67% students of the first quiz, the 6,67% students of the second quiz, and the 0% student of the third quiz. The physical mechanism game of epistemic game is used by the 0% student of the first and the second quiz, the 33,33% students of the third quiz. Recursive plug and chug is used to solve the problem by the 80% students of the first quiz and the 0% student of the second and the third quiz. Transliteration to mathematics is used to solve the second case problem by the 0% student of the first and the second quiz,

and the 53,33% students of the third quiz. The percentage of epistemic game during learning are presented in the Table 1.

TABLE 1. The Percentage of Epistemic Game during Learning

Question	Epistemic Games	Quiz 1	Quiz 2	Quiz 3
1	Mapping Meaning to mathematics	-	-	-
	Mapping Mathematics to Meaning	-	-	-
	Physical Mechanism Game	6,67%	66,67%	3,33%
	Pictorial Analysis	-	-	-
	Recursive Plug and Chug	-	-	-
	Transliteration to Mathematics	93,33%	23,33%	93,33%
2	Mapping Meaning to Mathematics	0%	90%	0%
	Mapping Mathematics to Meaning	16,67%	6,67%	0%
	Physical Mechanism Game	0%	0%	33,33%
	Pictorial Analysis	-	-	-
	Recursive Plug and Chug	80%	0%	0%
	Transliteration to Mathematics	0%	0%	53,33%

TABLE 2. The Mean Percentage of Epistemic Game during Learning

Epistemic Games	Quiz 1	Quiz 2	Quiz 3
Mapping Meaning to Mathematics	0%	45%	0%
Mapping Mathematics to Meaning	8,33%	3,33%	16,66%
Physical Mechanism Game	3,33%	33,33%	18,33%
Pictorial Analysis	-	-	-
Recursive Plug and Chug	40%	0%	0%
Transliteration to Mathematics	46,66%	11,66%	73,33%

Based on Table 1, epistemic game to solve the problem of the first quiz during integral learning implementation pada kuis 1 (the topic of connection with heat and its temperature and form) is used by student by mapping mathematics to meaning, physical mechanism game, recursive plug and chug, and transliteration to mathematics. Mapping meaning to mathematics, mapping mathematics to meaning, physical mechanism game, and transliteration to mathematics are used the student to solve the second quiz problem (the topic of Black principle). The student solve the third quiz problem (the topic of heat transfer) by mapping mathematics to meaning, physical mechanism game and transliteration to mathematics.

Discussion

The results of this research can explain that during the integral learning, the student experience the change of epistemic game. It agrees on the results of Teodorescu's research (2013) show that efforts clarify the physics problem and question in accordance with the cognitive process of problem solving still growing.

The results of this research show that the student use some game of epistemic game. Agree on the results of Tuminaro's research (2007), the cognitive model of epistemic game can increase the students's

understanding. Epistemic game is cognition process to solve the problem.

Mapping mathematic to meaning implementation during integral learning implementation is not developed very well yet. It agrees with Tuminaro (2007), the students develop the conceptual story of the physics equation of game mapping mathematics to meaning. The students begin with a physics equation and develop the conceptual story. Tuminaro identifying the four of its game step that is (1) identifying the concept target; (2) finding the equation related target concept to another concept; (3) telling story to use to relating to concepts; (4) evaluating the story.

Transliteration to mathematics is used in this research more. It is caused by this game to use the working example to resulting in the solution without the conceptual understanding development. Tuminaro identifying the four of this game step that is (1) identifying the target measurement; (2) finding the solution pattern related to the current problem situation; (3) mapping the measurement of current problem situation of solution pattern; (4) evaluating mapping.

The result of the research shows that integral learning implementation can change or develop the students' epistemic game. Epistemic game related to the students's thinking way themselves. Atkin (2008) said that an individual will develop methods to know an expressiveness of their thinking pattern. Integral learning is the learning integrates the result type of ability agree on the internal brain characteristic of every learning (Atkin, 2008: 8), that is (1) understanding definition, concept, or theory; (2) procedural ability and understanding the process skill; (3) meant to ability and application every day; (4) developing the idea of picture, model, or design form.

The student's incomprehension of the heat concept is shown by Alwan's research result (2011: 604). The student is still confusing with the heat and the temperature concept can't explain heat and temperature difference. Its research said that the student couldn't give the solution to support the right answer of a student. Alwan discovers that the students can use the formulation and solve the theoretical problem as well as mathematical problems, but they can't understand the concept of the base equation and related to experience.

Summary

The research conclusions are the epistemic game for problem-solving during integral learning implementation on the topic of connection with heat and its temperature and form is done by mapping mathematics to meaning, physical mechanism game, recursive plug and chug and transliteration to mathematics. Mapping meaning to mathematics, mapping mathematics to meaning, physical mechanism game, and transliteration to mathematics are done by the students for problem-

solving on the topic of Black principle. The students solve the problem on the topic of heat transfer by mapping mathematics to meaning, physical mechanism game and transliteration to mathematics.

Acknowledgments

The author would like to thank the Faculty of Engineering of University of Nusantara PGRI Kediri, The State University of Malang, and the participating teachers and students of SMAN 3 Malang for making this research possible.

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