

DEVELOPMENT

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Development of Learning Cycle 5E Oriented Learning Tools to Critical Thinking Skills and Creative Thinking

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ABSTRACT

Biology learning can do by exploring the nature and its contents, including living beings an inanimate beings everyday life. In past, students have not active roles process in the classroom. Students are only required to memorize the factual information obtained from the teacher. They should develop their potential broadest in order to understand the processes and concepts that exist. The development potential of students begins by assembling the experience and knowledge that has been previously owned. Biology learning is expected to be implemented by the *Learning Cycle 5E*, so that students are expected to improve the understanding of the experience and prior knowledge. By carrying out an *Learning Cycle 5E*, students will find their own concepts of biology and can develop biology process skills, so as to equip students with skills such as scientists and make them able to solve his problems independently. Students will become more critical in thinking and looking for creative answers to the problems they face in everyday life. By nit dong rote, students are expected to be qualified individual.

Keyword : Development Of Learning Devices, Learning Cycle 5E models, critical dan creative thinking

INTRODUCTION

The ability to think critically and creatively is a basic ability for someone to encourage them to always look at the problems they face critically and to find solutions or answers creatively so that something new is obtained that is useful for later life. (Silver, Harvey L., Strong, R.W. & Perini, 2007) To develop students' creative thinking skills, it is necessary to make efforts to apply a learning model that allows students to explore, problems solving, think critically and creatively and make them independent. One of the learning models that makes students explore is Learning Cycle 5 (Priawasana, Degeng, Utaya, & Kuswandi, 2020).

The 2013 curriculum applies a learning process consisting of five main lessons, namely: observing, asking questions, gathering information, associating, and communicating. Learning in this waste management chapter students can be trained to think about an authentic (real) case and are invited to think critically in order to analyze, provide solutions, and solve problems that exist in a case (Mulyasa, 2013)(BNSP, 2006). Some of the main learning stages in the 2013 curriculum can be achieved by learning critical thinking. (Mulyasa, 2013) stated in the Regulation of the Minister of Education and Culture of the Republic of Indonesia Nomor 81a Tahun 2013 Regarding the implementation of the curriculum that in compiling the KTSP it is necessary to pay attention to important principles, one of which is the ability of the students required, namely, the needs of future competencies.

1 Ability to communicate, think critically, and be creative by considering the values and morals of Pancasila in order to become a democratic and responsible citizen, tolerant in diversity, able to live in a global society, have broad interest in life and readiness to work, intelligence according to their talents/interests, and care about the environment. (Kallick, 2012)

LITERATURE REVIEW

A general teaching approach strategy that applies 16 various material areas and is used to meet learning objectives (Paul Eggen, 2012). Collectively, the design models and processes represented are referred to as learning system development (*instructional systems development, ISD*). *instructional design, ID* 15 used as a general term covering all stages of the ISD process. Model Dick dan Carey combines a diverse set of tools drawn from each of the 13 three major theoretical positions (elements of the behaviorist, cognitivist, and constructivist views) 13 of the last fifty years and constitutes an effective design framework for guiding pedagogical practice across the three basic orientations. (Degeng, 2017; Charles M. Rigeluth, 2017).

The development of this learning system design model is not only obtained from theory and research results, but also practical experience gained in the field (Paul Eggen, 2012). The implementation of this learning design model requires a systematic and thorough process. This is necessary to be able to create a learning system design that can be used optimally in overcoming learning problems.

One of the higher-order thinking processes used in the formation of the science conceptual system is critical and creative thinking, 4 there are three terms related to thinking skills which are actually quite different, namely high 22-order thinking *complex thinking*, and *critical thinking* (D. W. Johnson & Johnson, 2002; Ülger, 2016). Higher order thinking is a cognitive operation that is much needed in thinking processes that occur in short-term memory, if it is associated with Bloom's taxonomy, higher order thinking includes evaluation, synthesis, and analysis. Complex thinking is a cognitive process that involves many stages 17 parts. Critical thinking is one type of convergent thinking, namely heading to one point. The opposite of critical thinking is creative thinking, which is a type of divergent thinking that spreads from a point (King, Goodson, & Faranak, 1998; Nugraha, Suyitno, & Susilaningsih, 2017; Paul Eggen, 2012). Thinking skills can be divided into critical thinking and creative thinking. These two types of thinking are also known as higher order thinking skills (Kallick, 2012). Critical thinking is a mental process that is well organized and plays a role in the decisionmaking process to solve problems by analyzing and interpreting data in scientific inquiry activities, while creative thinking is a thinking process that produces original or original, constructive ideas, and emphasizes intuitive and rational aspects. (Paul Eggen, 2012).

The general understanding of critical thinking is actually a reflection of what was initiated by John Dewey since 1916 as scientific inquiry and is a way to build knowledge. Thinking uses symbolic processes that state real objects, events and uses symbolic statements to discover the basic principles of objects and events. (Arends, 2015). In the thinking process, there is an event of analyzing, criticizing, and reaching conclusions based on the intervention or careful consideration used by students to answer. r respond to a problem. This means that students are able to systematically evaluate the quality of one's own reasons as well as others. (Kallick, 2012) that practicing critical thinking needs to be done repeatedly while providing suggestions and improvements to students' critical thinking outcomes. Fundamental thinking is the ability of students to construct facts into a whole concept. Critical thinking is the ability and tendency to make and judge conclusions based on evidence (Kallick, 2012) the ability to test, relate, evaluate aspects related to the problem, collect and organize information, validate and analyze information, remember and associate previously learned information, find rational answers, draw valid conclusions and produce products (ideas, ideas, thoughts, creations, etc.) that are interesting and useful.

METHODS

This research is a development research, using the R & D development model (*Research and Development*). This research method is used to produce certain products and test the effectiveness of these products.

Procedure for developing

The stages in the procedure for developing this research are as follows:

Potential and Problems

At this stage, the potential and problems are analyzed and then described, also equipped with supporting research data. The potential in this study is in accordance with the Graduate Competency Standards and Content Standards, the learning principles used by students find out (copy of the Attachment of the Minister of Education and Culture Nomor 65 Tahun 2013 tentang Standar Proses)(Mulyasa, 2013). Based on this, students must build their own knowledge in accordance with constructivist theories, one of which is owned by the Learning Cycle 5E learning model. The research targets are high school students of Class X who are around 15 to 17 years old, according to Piaget, children at this age in the formal operational phase. The main abilities at this stage are abstract thinking and being able to solve problems. So at this stage students are able to think abstractly, thinking skills can develop so that they can solve problems through higher-order thinking activities.

The problem in this study is that practicum activities are rarely carried out in learning because of time constraints to achieve learning targets, even though learning that involves students actively, especially in mental activities is one of the factors that can help develop critical and creative thinking skills .

Data Collection

The initial step of data collection is to conduct a literature study on curriculum, learning, as well as the characteristics and concepts of the material.

KI and KD Analisis analysis

Curriculum analysis aims to analyze the core competencies and basic competencies selected in the development of Learning Cycle 5E-oriented learning tools for waste management materials. (1) Formulation of learning indicators and objectives
Based on the curriculum analysis that has been carried out, the indicators that must be achieved by students in learning activities using waste management learning tools will be formulated. (2) Analisis Konsep. Concept analysis is carried out by identifying the main concepts taught and systematically arranging them in the form of concept maps.

(3) Analisis Tugas, Task analysis is used to analyze the steps needed to achieve the indicators in accordance with the studies contained in the core competencies and basic competencies in the 2013 curriculum and some critical and creative thinking skills that are trained on students. Task analysis in learning is set on tasks that will be given according to activities during learning that take place at each meeting.

Product design

At this stage, the design of the learning device is carried out which includes three main parts, namely: (1) Biginning part, The initial part of the learning device consists of the cover, cover image, the identity of the study group, and the identity of the compiler of the learning device. (2) Contents Section, The content section consists of Learning Cycle 5E learning activities and the skills that are trained on students include interpretation, analysis, explanation, conclusion, and evaluation. (3) Final Part, The final part consists of a bibliography containing literature used as a reference in writing learning tools.

Validasi Desain Produk

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The product design validation stage is carried out to assess the validity of the learning device product designs that have been developed. Validation is carried out using a learning device validation sheet based on the criteria for good quality learning tools including: didactic requirements, construction requirements, technical requirements, and conformity with the function of learning devices.

Product Design Revision

The product design revision stage is carried out to improve the design of the learning devices that have been made.

Product Trial

Product trials are carried out after the product is declared valid with several revisions. The learning device was tested on the class X IPA SMAN 1 Jenggawa Jember which amounted to 37 heterogeneous people. This trial was carried out for 3 face-to-face meetings, each meeting was allocated 2 x 45 minutes. In the trial process, the researcher acts as a teacher by using a product that has been validated by experts. This trial aims to determine the practicality and effectiveness of learning tools.

Product Design Revision

Learning tools are improved based on input from students and observers based on the results of trials so that a final draft of learning tools is produced.

Description of Research Results

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The data that has been collected is analyzed and then from the results of the analysis can be identified and described the effectiveness and practicality of the learning tools.

Method of collecting data

To obtain research data, several data collection methods were used, including:
Observasi, This observation technique is carried out to collect data related to behavior, in this study data on the implementation of learning, student activities, and obstacles that arise during teaching and learning activities. Questionnaire, Questionnaires were given to students after they finished learning activities. The technique of giving questionnaires is in the form of a written questionnaire test, validity sheets carried out by experts, student response questionnaires are used to obtain information about teaching materials, practicum activities, textbooks, and worksheets. Tes, Giving this test is used to obtain information about student learning completeness on the subject of waste management.

Data analysis

Data analysis was carried out by researchers and in collaboration with supervisors to increase the validity and reliability of this study.

Readability analysis of student worksheets and books

The readability analysis of student worksheets and books was carried out in a qualitative descriptive manner by asking students to provide corrections regarding the readability of student worksheets and books. The results of student corrections are then presented based on students' positive and negative responses in filling out the LKS readability questionnaire and student books..

Analysis of Learning Results⁵⁴

Data analysis was carried out after the researchers obtained all the data needed to determine the completeness of the learning objectives, individual mastery, and classical completeness.

Analysis of Student Activity Observations²⁷

Student activities are all activities carried out by students during the Teaching and Learning Activities (KBM). Data from observations of student activities were analyzed using descriptive statistical analysis.

Student Response Questionnaire Analysis

The data obtained based on questionnaires about student responses to learning activities were analyzed in a quantitative descriptive way, namely calculating the percentage of the statements given.

RESULTS AND DISCUSSION

Learning Device Development Results

The development of Biology learning tools for SMA Learning Cycle 5E was made and then validated by experts.

Learning Implementation Plan²³

The Learning Implementation Plan (RPP) is a guide to the steps of learning activities carried out by the teacher in the classroom. The calculation results obtained an average reliability coefficient of the RPP of 86%. According to (Borich, 1994) this instrument is categorized as good and can be used for activities in learning because it has a reliability coefficient 0.75 (75%)⁴³

Student Textbooks

The student textbook developed in this study is a student textbook for waste recycling materials. The student's book was developed with the hope of helping students to learn the material on the subject being developed and teachers more easily teaching the subject matter with Learning Cycle 5E. The textbook in this study is a student handbook that is used as reading material and as a student learning guide both in the learning process in class and in independent study. The results of the calculation of the reliability of student textbooks showed a high level of reliability, namely 78%. This shows that student textbooks can be used in the learning process because according to (Borich, 1994) the instrument is said to be good (reliable) if it has a reliability coefficient 0.75 (75%)⁴⁶

Student Activity Sheet

Student Activity Sheets were developed with the hope of clarifying observations or experiments in student textbooks, besides the LKS that had been developed were expected to provide convenience for teachers in applying Learning Cycle 5E learning to students. The student activity sheet is a guide sheet for students to carry out observation or practicum activities in teaching and learning activities, in the development it produces 3 Student Activity Sheets namely Student Activity Sheets 1 waste as waste, Student Activity Sheets 2 waste recycling technology, Student Activity Sheets 3 utilization of waste recycling for life.¹¹

Student Activity Sheets 1 Regarding waste as waste, it is necessary to have a clear explanation about the type of waste and how to process it so that students always apply an attitude of caring for the environment when they see piles of garbage around them piling up, the pictures are more clarified and

given information so that students ³⁷ are easily understand how to assemble, the work instructions are further clarified in grammar so that ²⁴ students can more easily understand the commands contained in the instructions, the editor of the analysis questions uses a language style that is easy to understand and adapts to the level of development of high school children, and bibliography is written in each LKS. The results of the calculation of the reliability of the Student Activity Sheet instrument are 82%. Menurut (Borich, 1994), instrumen Student Activity Sheets ini dikategorikan baik (reliabel) dan dapat dipergunakan untuk kegiatan pembelajaran karena memiliki koefisien reliabilitas $\geq 0,75(75\%)$.

The attractiveness aspect of the book content is 89.18%, the attractiveness of the book appearance is 78.37%, the difficulty of explanation is 83.78% stating that there is no difficult explanation, and about the ease of understanding illustrations/pictures by 97.2%.

Results Test developed based on Learning Objectives (TP). The learning outcomes test developed consisted of a product test consisting of 10 multiple choice questions and 3 essay questions. The reliability coefficient value of the instrument exceeds 75%, thus this instrument is included in the category of a good instrument (Borich, 1994).

Student responses to the learning process, to caring for the environment, and to the media used

Student response questionnaires are used ⁵⁶ to determine student responses to learning with Learning Cycle 5E and the device by which students are asked to fill out a questionnaire, filling out this questionnaire, no observation is needed, because it only asks for opinions and comments from students about the learning process and learning tools. The reliability coefficient value of the instrument exceeds 75%, thus this instrument is included in the category of a good instrument. The average sensitivity value of the items is 0.30 which means that the item has a good sensitivity value and ¹³ is sensitive to measuring the learning effect. Students' cognitive abilities were measured using the Learning Outcome Test in the form of multiple choice questions and descriptions consisting of 13 questions. The cognitive abilities can be known from:

Completeness Indicator, The achievement of indicators is analyzed after ⁸ the learning process is carried out, to measure the completeness of the learning indicators, the criteria for learning completeness that have been determined by the Ministry of National Education are used, which ranges from 0%-100%, ideally the criteria for each indicator are $>75\%$ (Depdiknas, 2006). ⁷ Classical completeness is the completeness of the whole class. A class is said to be classically complete if in that class there are 85% of students who have completed their studies (Mulyasa, 2013). Based on the summary of the results of individual and classical mastery analysis in Table 4.17 which shows that the percentage of classical mastery of students reaches 94% and is categorized as complete in studying the ⁷ subject of waste recycling.

Individual and Classical Completeness, Individual completeness of students' correct answers is 75%, and a class is said to have completed its learning (classical completeness) if in that class there are 85% of students who have completed learning.

Hasil belajar kinerja, Assessment of student performance is given at the end of the meeting which is used to determine the ability of students' performance in sorting organic and inorganic waste (performance assessment 1), making compost (performance assessment 2), list the benefits of recycling the waste contained in the article (performance assessment 3), and make inorganic waste products (performance assessment 4), all groups are said to have completed their studies, because they are included in the very satisfactory level, this has met the school's minimum learning completeness standard, which is 75% of the score obtained from the performance assessment. This shows that students are able to sort out organic/inorganic waste, do composting, are able to record the benefits of recycling waste correctly in articles., create value-added products from inorganic waste. Assessment of performance

results is carried out by asking for work results for each meeting (plans and implementation of making recycled products made from organic and inorganic waste).

20 DISCUSSION

Learning Implementation Plan is a plan that describes learning procedures and management to achieve a basic competency set out in the content standards described in the syllabus. The lesson plans developed in this study were to achieve basic competencies, namely making waste recycling products on the subject of waste recycling which were described into five indicators that had been tested at SMAN 1 Jenggawa Jember. Learning Implementation Plan developed with Learning Cycle 5E, in the development of this tool, because Learning Cycle 5E can make it easier for teachers to teach about the subject of waste recycling and students in learning can explore their knowledge and everyday experiences about the surrounding environment. The learning tools and Learning Implementation Plan assessment sheets used are reliable. Aspects of writing a learning implementation plan which consists of paying attention to students' prior knowledge and prerequisite knowledge, planning a learning process that is more student centered than teacher center, planning the process of learning concepts and theories starting from the concrete to the abstract, emphasizing student activities to work together in creating learning better, planning the learning process in a democratic and interactive setting, and planning feedback for self-assessment.

The developed student book is said to have met the criteria for conformity with Learning Cycle 5E if the book met the criteria for all aspects assessed including connecting science with the surrounding environment connecting science with technology, connecting science with the state of the surrounding community. Based on the students' responses, they find it easy to understand the material presented in this book because the language used is easy to understand so this can motivate students to learn. (Sari, Duygu, Şen, & Kirindi, 2020) The presentation of the material in the developed student books is coherent, starting from easy material to difficult material. Besides that, the presentation in this book also varies so that it can motivate students to learn the features presented in the developed book are also liked by students. Attractive layout with interesting colorful rules. The student book is equipped with several additional box features, namely bio info, bio lab, and summary. (Degeng, 2017; C. Reigeluth, Merrill, Wilson, & Spiller, 1980; Seifert et al., 2008)

The development of this LKS resulted in three LKS, among others, LKS 1 on waste as waste which aims to find out how the types of waste are classified, organic and inorganic waste is grouped as well as environmental care attitudes and their positive and negative impacts, LKS 2 on waste recycling technology, p. This study aims to find out how to process organic waste in a simple way, LKS 3 on the use of waste recycling for life to know how to utilize inorganic waste into goods that have high use-value..

The relevant learning theories for mutual-oriented worksheets are behaviorism learning theory and constructivism learning theory. (Tatsi & Zafar, 2013) Constructivism learning theory states that students must be able to build their own knowledge based on what they already know, therefore students themselves must be proactive in seeking and discovering that knowledge and experiencing the learning process by themselves (E. B. Johnson, 2002; Charles M. Reigeluth, 2017). Behaviorism learning theory emphasizes human behavior, namely viewing individuals as reactive beings who respond to the environment, experience and maintenance that will shape their behavior. The challenges and demands of the future in the era of globalization are to create competitive, skilled, honest, hard-working and independent human resources. LKS is expected to train, guide, and equip students to think critically, work hard and be independent. LKS is expected to train students to be more concerned about the environment and the surrounding community and reduce students' dependence on teachers.

Student analysis is a study of student characteristics in accordance with the development design. These characteristics include students' cognitive abilities, students' backgrounds, and students' cognitive development. In addition, tests related to students' abilities in formulating problems, formulating hypotheses and determining research variables were also carried out. Analysis of environmental demands on Biology learning. Analysis of environmental demands on Biology learning is a study of community (environmental) expectations of Biology learning for high school students. These challenges and demands must be faced and resolved by producing a competitive young generation, namely having a young generation that is active, creative, skilled, independent, and confident..(Ullynuha, Prayitno, & Ariyanto, 2015)

The legibility of student worksheets and student books, both in content and in attractive appearance for students, is hoped that these books can arouse students' enthusiasm for learning, in accordance with student development and are at a high level of readability. The Learning Outcome Test (THB) or assessment sheet is used to measure the achievement of a basic competency, namely making recycled waste products. These basic competencies are broken down into 5 indicators, then further elaborated into 21 Learning Objectives (TP), from each goal one question is formulated, namely from 21 objectives, 10 questions are in the form of multiple choice and 3 are in the form of descriptions. (Ramdiah & Duran Corebima, 2014; Wuryanto, 2016)

The results of the implementation in the field showed that there were several questions, both on multiple-choice questions and in descriptions, students had difficulty in answering, this was because apart from they did not understand terms in Biology and students also had difficulty understanding some questions. The results of the summarized RPP observations show that the implementation of learning with Learning Cycle 5E in general has a reliability level of 86%, this indicates that the RPP on the subject of waste recycling with Learning Cycle 5E is well implemented, and the instrument for implementing the RPP used can be categorized as reliable.

Observation of teaching and learning activities in the preliminary stage is the first phase in the learning cycle (engagement), where the teacher presents phenomena and asks questions about the phenomena that have been given, in this case the teacher actively motivates students to focus on teaching and learning activities, which can be seen from the observations on the enthusiasm of teachers and students in the classroom. The core activity stage contains four phases of the learning cycle model, namely: the exploration phase, the explanation phase, the elaboration phase and the evaluation phase. The exploration phase begins by forming heterogeneous student study groups, distributing worksheets to each group of 3 students each and assigning and guiding students to carry out practicum in accordance with the worksheets, then answer the questions in it. The average results of observations on the implementation of overall learning carried out by observers in this phase are included in the very good criteria in each class, this phase the teacher needs to pay more attention in guiding students to do practicum, especially in filling in the observation data. This is because some students still seem confused about the activity.

If the teacher does not immediately provide scaffolding to students it will cause a tendency to carry out activities outside of learning, therefore, teachers need to guide students when they begin to reconstruct their explanations for these activities (Jonasson & Reigeluth, 1999). Through the guidance given by the teacher to students, students can reach the zone of proximal development (ZPD). (Slavin, 2014) tasks in the zone of proximal development are something a child still cannot do alone but can really do with the help of a more competent peer or adult.

Fase *explanation*, the teacher distributes student books and guides the discussion of the results of the practicum that has been carried out through group discussions and class discussions, in this case the teacher tries to develop student explanations by presenting multimedia and connecting these

explanations with experiences that have been obtained by students in the engagement phase and exploration phase. Teachers have a variety of techniques and strategies at their disposal to elicit and develop student explanations, usually using verbal explanations, but there are many other strategies, such as videos, films and educational courses (Schools for, & Failure, 2010). Through explanations from the teacher, the teacher can guide students towards a deeper understanding, which is an important part of this phase. In the elaboration phase, the teacher distributes advanced worksheets, then assigns students to carry out advanced practicum using advanced worksheets and answer questions in the worksheets. Fase *evaluation*, The teacher gives practice questions to students in the student book. Based on the class atmosphere during the KBM runs according to the expected learning objectives, as well as the syntax that is carried out is in accordance with the learning model used. In addition, during KBM tends to be student-centered. This is because the learning cycle model is a student-centered learning model, where the phases in the learning are organized in such a way that students can master the competencies that must be achieved by playing an active role.

Meeting 1 most of the students still seemed confused about this activity (exploration phase), therefore the teacher needed to pay more attention in guiding students in these activities and emphasize to students to remain honest in carrying out practicum in accordance with work procedures and fill in the observation table according to the data. observation result. Character behavior of students in carrying out practicum and filling in observation tables for the next meeting in each class has shown an increase in most students, although there are some students who do not experience changes, but there are no students who experience a decrease in the behavioral aspect of honest character. In this case students have been able to carry out their duties independently and the teacher continues to provide guidance to students if needed.

These social skills began to appear in the engagement phase activities when students were asked for their opinions on the problems given by the teacher, then continued in the exploration phase, explanation phase and elaboration phase, where students studied in groups to do practicum and answer questions contained in the LKS, which then provide an explanation of the answer given. students discuss with each other to contribute opinions/ideas and other friends become good listeners. (Slavin, 2014) The interaction that occurs allows students to think to complement each other and become a common understanding, hear conversations well and can learn how other people have succeeded in solving problems.(Evans, Richardson, & Waring, 2013; ROFIQ, 2014)

The teacher becomes a facilitator in student discussions and provides guidance if the student needs guidance. The social skills of students in contributing opinions/ideas and being a good listener at the next meeting in each class improve the majority of students,(Insyasiska, Zubaidah, Susilo, Biologi, & Malang, 2015) although there are some students who do not experience changes, but there are no students who experience a decrease in the aspect of social skills, The learning cycle model is a learning model that requires students to be active in the classroom to achieve the expected learning objectives. There was a significant increase in students' understanding of concepts for each class because students were given treatment using the 5E learning cycle model, the 5E learning cycle model used in this study is a learning model that makes students active and provides direct experience in learning the competencies required. want to achieve. This model consists of five learning phases which include: engagement phase, exploration phase, explanation phase, elaboration phase, and evaluation phase.

The engagement phase makes a connection between students' past and current learning experiences, by first revealing students' conceptions through questions from phenomena found in everyday life according to the concepts to be studied, in this phase an assimilation process occurs where students use existing cognitive structures to respond to new information it receives, so as to reduce cognitive imbalances that occur and be actively motivated in learning, after doing the engagement phase,

students then explore ideas through the exploration phase. This phase builds on the student experience to introduce and discuss concepts with the help of student worksheets. In student worksheets students are facilitated to complete practical activities that help them use prior knowledge to generate new ideas and explore questions that arise so as to start the balancing process. In this case, not all new concepts can be assimilated into the schemas that have been owned by students which in the end the accommodation process occurs. The balance process is needed to regulate the balance between the assimilation and accommodation processes, so that students can integrate the new concepts they receive with existing cognitive structures (schemas). This is in line with Piaget's thinking which states that knowledge is not static, but continues to grow and change constantly as long as students construct new experiences that force them to build and modify previous knowledge (Arends, 2015).

In the exploration phase, students are formed into heterogeneous groups that can help students actively build their own concepts by interacting with their social environment, both with guidance from teachers and collaboration with their peers in one group in carrying out practicum according to the worksheets provided. This is in line with the thinking of Vygotsky who believes that social interaction with other people spurs the construction of new ideas and enhances the intellectual development of students (Langford, 2005), Bruner also emphasized the importance of helping students to understand the structure or key ideas of a discipline, the need for active student involvement in the learning process, and the belief that true learning occurs through personal discovery. (Arends, 2015). The two thoughts above are supported by the average response results obtained in each class that students are very happy with the learning atmosphere in the form of study groups and they also strongly agree that group work can help them understand the material.

The explanation phase encourages students to explain the understanding of concepts that have been obtained in the engagement phase and the explanation phase with their sentences, asking for evidence and clarification of their explanations and leading to discussion activities. Through this phase, students can find terms from the concepts that have been studied, to guide students towards a deeper understanding of concepts, the teacher distributes student books and displays multimedia and provides brief explanations to students on the phenomena they observe in this phase. fase exploration. (Mulyasa, 2013) explanations from the teacher or curriculum can guide them towards a deeper understanding, which is an important part of this phase, thus it is hoped that it can reduce conceptual errors that occur and students can gain a complete understanding of the concept. The use of student books and multimedia can also help students who have not yet reached the stage of formal thinking in understanding abstract concepts and processes that previously could only be imagined. The average response results in each class were obtained that students strongly agreed that the student books and multimedia provided helped them understand the material being taught.

The elaboration phase facilitates the transfer of concepts for the same but new situations with the help of follow-up worksheets. Students carry out advanced practicum in accordance with the advanced LKS provided to develop a deeper and broader understanding of concepts. Through group discussions and cooperative learning situations can provide opportunities for students to express their understanding of the material being studied. This phase provides opportunities for students to be involved in new situations and problems that require the transfer of identical explanations, thus learning becomes more meaningful because students are expected to be able to relate new situations and problems to existing cognitive structures.

This is in line with Ausabel's thinking which states that meaning can emerge from new material only if the material is related to the cognitive structure of previous learning. (Arends, 2015) the last phase of the learning cycle model is evaluation which is an opportunity for teachers to assess students' conceptual understanding. Students are asked to do the exercises in the student book to find out the understanding

of concepts for waste material. Through learning phases using the 5E learning cycle model, students can play an active role in exploring and enriching their understanding of the concepts they learn.. The average good and very good student response to learning using the learning cycle model in each class is because the learning cycle model can generate student interest in the material to be studied through the engagement phase, where the teacher is expected to make the learning atmosphere less tense so that students become enthusiastic and their curiosity increases, besides that the teacher is also expected to be able to convince students that the material they are learning is important and useful for them. It is important to convince students about the importance of the attractiveness of the material to be presented, to show (if possible) how the knowledge that will be obtained will be useful for students (Jonassen & Reigeluth, 1999).

(Schools et al., 2010) The learning cycle model can also maintain student curiosity through the exploration phase and elaboration phase, in which the teacher divides students into several heterogeneous groups and gives worksheets to each group which contains tasks that are used to guide students in finding the concepts being studied and provide hands-on experience to students. (Slavin, 2014) found that providing students with hands-on experiences in natural science activities greatly increased their learning from books on related topics and provided more motivation.

The use of interesting presentations in the learning cycle model can be done in the explanation phase to provide guidance to students towards a deeper understanding of concepts through the provision of student books and the use of multimedia in explaining abstract concepts. (Slavin, 2014) Intrinsic motivation to learn something will increase through the use of interesting materials, as well as different types of presentation. The evaluation phase is used by the teacher to assess students' conceptual understanding, in this case, students are expected to be able to determine the level of success of the learning they carry out. (Kallick, 2012) One of the fundamental principles of motivation is that people work harder for the goals they set for themselves than for the goals someone else has set for them. Viewed from the student dimension, the application of the learning cycle model provides the following advantages: 1) Increases learning motivation because students are actively involved in the learning process, 2) Helps develop students' scientific attitudes and, 3) learning becomes more meaningful. (Kallick, 2012),

Students conduct simple experiments related to the material that has been studied at the first meeting students carry out simple experiments classifying types of organic and inorganic waste, according to the sub-chapters discussed, namely waste as waste, at this stage the teacher plays more roles because students are doing the experiment for the first time, and the condition of the students were not familiar with the simple tools used in the experiment, to facilitate and manage the time, before conducting the experiment the teacher first demonstrated the procedures or ways to use the simple tools to be used in the experiment, in addition to the second meeting the students conducted a simple experiment that is about simple technology in making compost, according to the Textbook and Student Activity Sheet.

The second meeting the students already understand and recognize the tools and materials used in the practicum, so the teacher is only limited to guiding the practicum process to completion and the third meeting the students make products from inorganic waste into items of high use value, but even though the condition of the students is more understanding, the teacher is still dominant in guiding students, after the practicum process is carried out, to train students in expressing ideas and opinions, the teacher continues learning by presenting the results of observations, due to time constraints, the teacher only provides opportunities for one group, by carrying out Learning Cycle 5E learning in a sequential manner. automatically students will get used to always being able to think critically about the problems of each object of observation / activity experienced in everyday life, because they are trained to think critically,

they will also be trained to do creative experiments to get answers that vary from the questions they get, that's why Learning Cycle 5E is widely recommended to be implemented in science learning.

The student's critical thinking ability test is an evaluation tool to measure how much students' critical thinking skills are in solving problems related to the respiratory system material in humans, to be able to measure critical thinking skills, questions are designed based on critical thinking indicators adapted from. Critical thinking indicators used include formulating problems, providing arguments, and concluding by induction, deciding and implementing and evaluating, (E. B. Johnson, 2002) general, the achievement of critical thinking skills cannot be separated from their ability to work in cooperative groups, in this study students were given the opportunity to complete tasks independently before sharing with friends in their group.

Learning Cycle 5E which is carried out in cooperative groups, students are invited and involved in mental (cognitive) and physical (psychomotor) activities. The activities carried out cooperatively, in addition to encouraging students to do a lot of cognitive activities, are also encouraged to be able to work together with one another, during collaboration, complex interactions occur, for example in terms of exchanging ideas, conveying arguments, and cooperating in conducting investigations. This series of activities will affect the development of learning outcomes in the form of critical thinking skills, understanding biological concepts, and collaboration skills (Slavin, 2014), but to practice this ability requires a longer time and requires careful planning. The results of the study indicate that to train students' critical thinking skills, it is not enough just to meet several times, but it takes time to get used to and gain students' critical attitudes. research which states that it takes two to three years for students to be able to integrate their ideas and apply critical thinking to new things (Charles M. Reigeluth, 2017).

8 CONCLUSIONS

Based on the results of the analysis and discussion, it can be concluded that the Biology learning device with Learning Cycle 5E, the waste recycling material for class X SMA produced is effectively used in learning in terms of the implementation of learning tools, dominant student activities are active in learning, student worksheets, student books, evaluation instruments, and most of the student responses gave a positive response so that the results of the learning tools were effective in improving student learning outcomes.

Based on the results of the study, the researchers gave the following suggestions: Considering that research is only conducted on waste recycling materials, the effectiveness of Biology science learning tools with Learning Cycle 5E to improve learning outcomes cannot be concluded from this study alone, but further research needs to be carried out and disseminated by other researchers who are similar in other study materials that have the same characteristics.

The use of learning tools with Learning Cycle 5E which was developed in the method of implementation and assessment of learning when in class takes a long time, so good will is needed from the teachers who will apply it Learning Cycle 5E can make students more active and motivated, teachers must be able to complete teaching aids/learning media and carry out practical activities in addition to elaborating through theory, teachers should give more attention and guidance to students in the exploration phase and elaboration phase, so that the time required for both phases can be utilized effectively. This is because in both phases it takes a longer time for students to do practicum according to the worksheets and actively build concepts independently. As well as developing a deeper and broader understanding of concepts in the same but new situation (elaboration phase).

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