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Development of Learning Cycle-Based Science Learning Devices to Improve Elementary School Students' Creative Thinking Ability

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Abstract: The educational goals listed above have not been optimally achieved. Schools in Indonesia generally tend to train students in terms of receiving knowledge, memory, and reasoning or logical thinking so that little portion is given to train creative thinking skills. This research is development research that develops learning tools including lesson plans, worksheets, student textbooks, and assessment instruments. This research consists of two stages of implementation, namely the stage of developing learning tools and the stage of testing the devices that have been developed. Science learning tools based on the 5E Learning Cycle to train creative thinking skills that have been developed are declared valid and can be used in science learning activities in elementary schools.

Keyword: Cycle-Based Science; Development; Improve; Learning Devices.

Introduction

Human Resources are an important asset of a country. Quality Human Resources is one of the factors that determine the future of the nation and state. From time to time, the government always tries to improve the quality of Indonesia's human resources, one of which is through education. Through quality education, human resources will be produced that are ready and able to compete in facing the challenges of the 21st Century. A generation that is creative and has strong character is a generation that is able to compete in the era of global competition (Husamah and Yanur, 2013). The Ministry of Education and Culture also emphasizes that the aim of education is currently more focused on preparing students to become creative individuals.

The educational goals listed above have not been optimally achieved. Schools in Indonesia generally tend to train students in terms of receiving knowledge, memory, and reasoning or logical thinking so that little portion is given to train creative thinking skills (Munandar, 2009). In line with this opinion, the results of an international survey of 15-year-old students conducted by the Program for International Student Assessment (PISA) in 2012 showed that Indonesian students' thinking skills in science were still low. Indonesia is only ranked 64th out of 65 participants with a score of 382 with an average score of all participants reaching 500. PISA classifies participants' test results into several levels, namely Level 1 to Level 6. Internationally, Level 2 is considered a basic proficiency level on a scale PISA. Students who fail to reach Level 2 are considered to have not acquired sufficient skills and knowledge to be able to participate in the 21st century workforce (Thomson et al., 2013). This survey also shows the fact that 66.6% of Indonesian students do not yet have the basic skills required to be able to compete in the 21st Century. One of the 21st Century skills is creative thinking which is currently one the focuses of education in various countries of the world (Piirto, 2011).

Based on the results of initial observations conducted using the creative thinking test that was given to students of SDN Kalilangkap 2 Bumiayu as a sample, it can be seen that 83.3% are in the less creative category, 13.3% are quite creative, and 3.3% are creative. The results of interviews with class teachers, it is known that so far learning that involves students' creative thinking has not run optimally. One reason is the teacher's limited time in developing learning tools that can train students'

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creative thinking skills. So far, teachers have not optimally implemented constructivist learning, so students are less actively involved in the learning process. Teachers assume that student success in learning is determined by learning outcomes in the knowledge aspect only. While other aspects tend to be ignored.

Creative thinking is the ability to provide various possible answers or problem solving based on the information provided and triggering many ideas for a problem, trying to produce a number of possible answers or problem solving (Yamin, 2013). Munandar (1992) wrote down 4 indicators of creative thinking, namely: fluency (fluent thinking), flexibility (flexible thinking), originality (original thinking), and elaboration (detailed thinking).

The ability to think creatively can be trained through teaching and learning strategies that provide many opportunities for students to be actively involved in working and thinking deeply, expressing and testing their ideas, as well as facilitating students with various learning resources that can arouse their curiosity (Qarareh, 2012).

One learning model that is in accordance with a scientific approach and can train students' thinking skills and encourage students to be active, interactive, and have a positive attitude during learning is the 5E Learning Cycle model. This model has a structure that provides activities to improve students' learning abilities and creativity and combines what is learned with phenomena that exist in everyday life (Risdiana et al., 2014). The 5E Learning Cycle model consists of five phases, namely Engagement (attracting students' attention), Exploration (exploring), Explanation (providing explanations), Elaboration (expanding concepts), Evaluation (conducting evaluations) (Bybee et al., 2016). Activities in these stages have the potential to help students develop 21st Century skills (Bybee, 2009), these skills include creative thinking. Students who are trained to think creatively tend to be better able to master a particular concept well, in accordance with Piaget's statement (Slavin, 2011) that learning can be interpreted as a creative act in forming concepts through thinking about the objects and events they experience. In line with the results of Yalcin and Bayrakceke's research (2010), students who learn using the 5E Learning Cycle model understand the concept better. The ability to think creatively and students' learning motivation also experienced a significant increase through the 5E Learning Cycle learning model (Hardiyasa et al., 2014; Manuhutu, 2011).

Practicing creative thinking to students through learning activities must be well planned, therefore learning tools are needed that support activities to train creative thinking in learning. These learning tools include syllabus, lesson plans, student worksheets, student textbooks, and assessment sheets that can support the learning process to train creative thinking skills.

Method

This research is development research that develops learning tools including lesson plans, worksheets, student textbooks, and assessment instruments. This research consists of two stages of implementation, namely the stage of developing learning tools and the stage of testing the devices that have been developed. The device development stage uses the Dick-Carey model which has been adapted to the needs of development research. The testing phase of the learning device uses the One Group Pretest-Postest Design (Tuckman, 1978). The subject of this study was the 5E Learning Cycle-based learning tool that had been developed, while the test subjects were class VI students at SDN Kalilangkap 02 on environmental material around semester 2 of the 2014/2015 school year. Data collection techniques in this research are documentation, observation, questionnaires, and tests. The instruments used to collect data were prepared by adapting previous research instruments and were developed according to research needs. The instruments included: 1) learning device validity sheets; 2) observation sheet of learning implementation; 3) student activity observation sheets; 4) observation sheet of constraints in learning; 5) a test instrument for the ability to think creatively; 6) student response questionnaire. Data analysis techniques in this study used descriptive qualitative.

Result and Discussion

Learning Device Validity

The developed learning tools were validated by two expert validators and obtained the following results: The average result of lesson plan validation on the format aspect is 3.50 with the valid category, the content aspect is 3.61 with the very valid category, and the language aspect is 3.67 with the very valid category (Ratumanan & Laurens, 2011). These results indicate that the lesson plan developed is generally in the proper category to be used in learning. The average reliability of the lesson plan validation instrument is 89.64% and is included in the reliable category (Borich, 1994).

The average validation results on worksheets in the format aspect were 3.63 with a very valid category, 3.75 for the content aspect with a very valid category, and 3.50 for the language aspect with a valid category. The average reliability of the student worksheets validation instrument is 91.15%. These results generally indicate that the worksheets that have been developed are suitable for use in learning and are reliable. Student textbooks obtained an average validation result on the format aspect of 3.70 with the very valid category, the content aspect of 3.57 with the valid category, the language aspect of 3.67 with the very valid category, and the physical aspect of 3.67 with very valid category. The average reliability of student textbook validation was 91.95% in the reliable category. These results indicate

that the developed student textbook is feasible to be used as a student guide in the learning process. The results of the validation of the creative thinking test from the content aspect are in the valid category and from the language aspect they are easy to understand, thus the instrument is feasible to use.

Practicality of Learning Devices

Observation of lesson plan implementation

Based on the results of observations made by two observers using the observation sheet on the implementation of the lesson plan, the results are as shown in Table 1.

Table 1. Observation Results of Lesson Plan Implementation

Number	Learning Stage	Average	Category	Implementation
1	Introduction	3.89	Good	√
2	Core activity	3.83	Good	√
3	Closing	3.61	Good	√
4	Management Time	3.67	Good	√
5	Class situation	3.92	Good	√
Performance percentage (%)				100

The initial stage of learning is the introduction. The average score of all aspects of learning activities in the preliminary stage of the three meetings was 3.89 in the good category (Ratumanan & Laurens, 2011). This shows that all activities included in the preliminary stage, namely: prayer activities at the beginning of the lesson, motivating students, conveying learning objectives can be carried out properly. These three activities are included in the engagement phase which emphasizes motivational activities to attract students' attention and enthusiasm for learning. Good preliminary activities can increase students' curiosity so that students are more enthusiastic about participating in the next learning stage. Increasing student enthusiasm and motivation for learning can also improve students' creative thinking skills (Munandar, 2009).

The next stage is the core activity. The average score on core activities is 3.83 which is in the good category (Ratumanan & Laurens, 2011). The core activity consists of four phases, namely exploration, explanation, elaboration, and evaluation, which on average are all in the good category. This shows that the learning carried out has been going according to the learning plan that has been developed. Providing opportunities for students to explore knowledge in group settings in core activities provides experience for students to be actively involved in constructing their own knowledge. In addition, group settings allow interaction between students and other friends to help form new ideas and enrich students' intellectual development (Ibrahim, 2012). When students are involved in group activities, there will be a scaffolding process, where students in a group work together and provide assistance to group members who are less able in the learning process (Slavin, 2011). The core activity stage also facilitates students to convey findings, ideas or exchange opinions regarding the results of observations they have discussed through the media of scientific posters made according to their group's creativity.

The average closing activity score is 3.61 in the good category (Ratumanan & Laurens, 2011). This is because the teacher provides opportunities for students to be actively involved in concluding material and asking questions about material that has not been understood before learning ends. The teacher also familiarizes students with praying at the end of the lesson. However, in the activity of concluding the learning material that has been studied, an average score of 3.33 is in the pretty good category. This is because students are not used to being actively involved in concluding learning, so they need a lot of guidance from the teacher. For the second and third meetings, the activity of concluding the subject matter experienced an increase in the average score which indicated that students were getting trained to be active in concluding the subject matter.

The time management aspect has an average score of 3.67 in the good category (Ratumanan & Laurens, 2011). Time management at the first meeting only got an average score of 3.00 because students were not familiar with the learning model that was applied so that it required more time at each stage of learning than the time planned. However, this has been corrected in the second and third meetings which get a better average score than the first meeting so that overall it can be said that the teacher can use time effectively and efficiently in managing the class. The class atmosphere aspect obtained an average score of 3.92 in the good category. This shows students and teachers are enthusiastic in implementing learning activities. A pleasant classroom atmosphere, providing broad opportunities for students to express opinions and present new ideas is a good environment for developing students' creative thinking skills (Munandar, 1992).

Student Activity

The highest percentage of student activity was involved in class discussion activities, namely 19.17%, at the first meeting, 19.38% at the second meeting, and 19.38% at the third meeting. Discussion activities facilitate students to confirm the knowledge that has been obtained through a process of brainstorming with students from other groups as well as from the teacher. This activity also provides a wide opportunity for students to dare to express their opinions and ideas

related to the environmental pollution material being studied. The wider the opportunities given to students to discuss, express opinions or ideas that students have developed, the more trained their creative thinking skills are (Feldhusen and Treffinger in Risdiana, 2014).

Exploratory activities, answering questions and expressing opinions, as well as being involved in solving problems applying or expanding knowledge also have a high percentage of activities. This shows that learning with the 5E Learning Cycle model is learning that emphasizes the active role of students in building their own knowledge, finding ideas, and obtaining meaning by students themselves (Arends, 2008). Active involvement of students in learning makes it easier for students to assimilate and accommodate new information so that students can easily understand the knowledge they are learning (Slavin, 2011).

The percentage of student activities that are less relevant to learning also decreases at each meeting. This shows that the learning atmosphere created can attract student enthusiasm so that students focus on learning activities. When students are interested in learning and involve themselves actively in learning activities, students tend not to engage in activities that are less relevant (Aydin and Yilmaz, 2010).

The Effectiveness of Learning Devices

Creative Thinking Test Results

Students' creative thinking ability is measured using a creative thinking ability test which consists of five test units. The five unit tests prepared represent indicators of the ability to think creatively, namely fluency, flexibility, originality and elaboration. The verbal creative test developed in this study is related to environmental pollution. The percentage of students' creative thinking ability test scores measured through the pre-test and post-test were then converted into categories ranging from the non-creative category to the very creative category (Khanafiyah and Rusilowati, 2010).

The results of the pre-test of students' creative thinking abilities showed that 2 students were in the uncreative category, 19 students were in the less creative category, 8 students were in the moderately creative category, and only one student was in the creative category. Students feel that the creative thinking ability test as tested is something new and they have never done it before so the results obtained are not optimal.

The results of the post-test showed that 25 students achieved a percentage score in the very creative category, and 5 students entered the creative category. These results indicate that students' creative thinking skills have developed after participating in learning using the developed 5EL Learning Cycle learning tools.

This is reinforced by an increase in students' creative thinking skills as indicated by the average N-gain value of 0.77 in the high category (Hake, 1999). It is assumed that the increase in students' creative thinking skills is an effect of the 5E Learning Cycle that they have implemented. Students' creative thinking abilities can develop if a conducive learning environment is provided to stimulate their creative thinking. Providing broad opportunities to develop ideas and express ideas developed to solve problems presented in learning can students find in the exploration, explanation, and elaboration phases in the 5E Learning Cycle model. The results obtained were also reinforced by the results of previous research, namely research conducted by Susantini et al (2012), Hardiyasa et al (2014), Manuhutu (2011) which stated that the 5E Learning Cycle Model helps improve creative thinking skills, learning outcomes, and motivation. student achievement.

Each phase in the 5E Learning Cycle learning model has the potential to be able to train the skills needed in the 21st century which include higher order thinking skills (Bybee, 2009). Bybee's statement is also reinforced by the research results of Aydin and Yilmaz (2010) who concluded that the 5E Learning Cycle model has a major influence on students' high-level cognitive skills. The ability to think creatively is part of higher order thinking skills.

The increase in students' creative thinking skills occurs because in the 5E Learning Cycle learning students are trained to dare to express as many opinions or ideas as possible to respond to problems in the form of pictures or a phenomenon that is presented. Students are also actively involved in the learning process. Students will be able to learn and absorb knowledge well if they can be actively involved in the learning process (Slavin, 2011).

The first phase of the 5E Learning Cycle, namely engagement, invites students to examine the phenomena from the images displayed and submit opinions according to their imaginations about the images. This trains students' fluency in imagining and thinking. This phase is also used as a starting point for activities to grow and develop students' curiosity about the material they will learn (Aydin and Yilmaz, 2010). This student curiosity will later be actualized in the form of positive scientific activities and attitudes in learning, for example through asking questions, expressing opinions, and exploring knowledge through textbooks or various activities provided to facilitate the process of extracting information and knowledge. by students. Students who in the early learning activities already have a high curiosity will be encouraged to have a more positive attitude towards the science learning that will be studied (Sayuti et al., 2012).

The exploration and explanation phases involve students in observing and solving problem activities in student worksheets that require fluency and flexibility of thinking to be able to solve problems from various points of view. The exploration phase provides opportunities for students to express, consider, organize ideas, discuss investigative steps, and provide experience in conducting exploration or investigations that involve higher-order thinking skills (Tuna and Kacar, 2013). In the explanation phase, elaboration skills and originality

in thinking are also trained when students prepare to present their observations through scientific posters that are interesting and as different as possible from other groups. Originality of ideas also emerged and was trained when they faced the elaboration phase, especially at the third meeting where students were required to provide ideas for the use of the waste they had chosen. This is supported by the results of Risdiana's research (2014) which states that the 5E Learning Cycle model can train students' creative thinking skills and conceptual understanding. The results of the analysis of each unit test and indicators of creative thinking ability are presented in Table 2.

Table 2. Analysis Results for Each Test Unit and Creative Thinking Indicator

Unit Test	Total Score		Improvement		Creative indicator to	Improvement	
	O1	*O2*	N<g>	Category		N<g>	Category
I	39	85	0,90	High	I	0,89	High
II	33	83	0,88	High			
III	36	83	0,85	High	II	0,85	High
IV	28	69	0,69	Currently	III	0,69	Currently
V	24	68	0,65	Currently	IV	0,65	Currently

Based on the results of the analysis in each unit test for creative thinking ability (Table 4.2), it can be seen that the total pre-test score of students in unit 1 is 39 and in the post-test the total score of students is 85 with an N-gain of 0.90 which is in the high category. Unit 2 also experienced an increase of 33 and a post-test result of 83 with an N-gain of 0.88 which was in the high category. The increase in scores obtained by students indicated that students were more able to think fluently so that they could provide more relevant answers after going through the learning process. The total score of Unit 3 also experienced an increase as indicated by the N-gain score of 0.85 in the high category. This shows an increase in students' ability to think flexibly from various perspectives to express ideas and solve the problems presented.

Unit test 4 asks students to think of an idea about an unusual use for a written object. The total score for this unit has increased from 28 at the pre-test to 71 at the post-test with an N-gain of 0.69 which is in the medium category. This increase shows that after learning students are able to think flexibly to provide answers and see a problem from a different perspective so as to produce new, original ideas. Unit test 5 is about what the consequences are, students are asked to think in detail. The results of the analysis in this unit have increased to the moderate category with an N-Gain score of 0.65. The total score obtained by students at the pre-test was 24 and at the post-test was 67. This shows that students have been able to detail their thoughts in developing ideas and expanding their ideas to solve problems. Based on the results of calculating N-gain in units 4 and unit 5 is only in the moderate category.

Based on Table 4.2, it can be seen that the biggest scorer on the post-test results of students' creative thinking is the score of indicators I (fluency) and indicator score 2 (flexibility). The N-gain scores from sub-unit tests 1, 2, and 3 which represent indicators of fluency and flexibility are also greater than the N-gain scores from sub-unit tests 4 and 5 which represent indicators of originality and elaboration. This is due to the activities provided during the learning process are used more to train indicators of fluency and flexibility than originality and elaboration, therefore it is necessary to have continuous training and a larger portion of activities to further develop students' creative thinking abilities, especially indicators of originality and elaboration.

Levinger Filsaime (2008), states that if the teacher is able to train higher-order thinking skills, then students will have the ability to think creatively and critically which is much needed in building an independent personality that is able to manage its own learning process (self-regulated learning), and construct its own knowledge. so that it can be said that students who have high creative thinking skills will also obtain high learning outcomes.

Student Response to Learning

Based on the results of the analysis of students' responses to learning using the 5E Learning Cycle-based device developed, it was obtained that an overall average of 96.61% of students gave a positive response in the very strong category, and 3.39% of students gave a poor response to learning in the very strong category. very weak (Riduwan, 2010). This shows that students have an interest, are happy, and support the implementation of learning using the learning tools that have been developed. Students who give an unfavorable response are less actively involved and enthusiastic in learning. This positive response from students was reinforced by the results of research from Prastiwi and Anggaryani (2014) which stated that students gave a positive response to the implementation of the 5E learning cycle that had been carried out.

Conclusion

Based on the results of the analysis and discussion of the results of research on device development and application of the 5E Learning Cycle to train creative thinking skills, the following things were found: Science learning tools based on the 5E Learning Cycle to train creative thinking skills that have been developed are

declared valid and can be used in science learning activities in elementary schools. The practicality of science learning tools developed through the implementation of trial 2 can be seen from: The percentage of implementation of all stages of learning in lesson plan 1, lesson plan 2, and lesson plan 3 is 100% each with very well implemented categories, while the average score at each learning stage is included in the good category. The results of observing student activity in trial 2 revealed that the dominant percentage of activity during the three meetings was an activity that involved students actively in learning such as being actively involved in class discussion activities, analyzing data, and carrying out data collection activities. Based on the results above, it can be concluded that the science learning tools based on the 5E Learning Cycle that have been developed are practically implemented in learning to train creative thinking skills. The effectiveness of learning devices through implementation in trial 2 is seen from: The application of science learning tools based on the 5E Learning Cycle can train students' creative thinking skills, namely: an average N-gain of 0.77 in the high category. Students respond very positively to the results of device development and implementation of learning with guided inquiry. This can be seen from the results of the analysis of student response data as much as 96.61% of students gave a positive response with a very strong category.

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Reference

Arends, R.I. (2008). *Learning to Teach Seventh Edition. Translated by Helly Prajitno S. and Sri MS*. Yogyakarta: Student Libraries.

Borich, G. (1994). *Observation skills for effective teaching*. New York: Mac Millan Publishing Company.

Bybee, R.W., Taylor, J.A., Gardner, Pamela V.S., Janet, C.P., Anne, W., Nancy, L. (2016). *The BSCS 5E Instructional Model: Origins and Effectiveness*. Mark Dabling Boulevard: Colorado Springs, CO.

Bybee, R. W. (2009). *The BSCS 5E Instructional Model and 21ST Century Skills*. A Commissioned Paper Prepared For a Workshop on Exploring The Intersection of Science Education and The Development of 21ST Century Skills.

Filsaime, D. K., (2018). *Revealing the Secrets of Critical and Creative Thinking*. Jakarta: Library Achievements.

Hake. (1999). *Analyzing change/gain scores*. American Edicational Research Associations.

Hardiyasa, I. M., Suma, K., Sadia, I. W. (2014). Pengaruh model siklus belajar 5e terhadap keterampilan berpikir kreatif dan motivasi berprestasi siswa. Jurnal Pendidikan Dan Pembelajaran IPA Indonesia, *4*(1). Retrieved from https://ejournal-pasca.undiksha.ac.id/index.php/jurnal_ipa/article/view/1064

Husamah, Yanur, S. (2013). *Competency Achievement Based Learning Design*. Jakarta: Library Achievements.

Ibrahim, M. (2012). *Problem Based Learning. Surabaya*. Unesa University Press.

Khanafiyah, S., & Rusilowati, A. (2010). Penerapan pendekatan modified free inquiry sebagai upaya meningkatkan kreativitas mahasiswa calon guru dalam mengembangkan jenis eksperimen dan pemahaman terhadap materi fisika. *Jurnal Penelitian Pendidikan,* 27(2). Retrieved from https://ejournal.undip.ac.id/index.php/berkala_fisika/article/view/3043

Manuhutu, S. (2011). *Pengaruh Penerapan Strategi Pembelajaran Learning Cycle Melalui "5e" Dalam Mengembangkan Kemampuan Berpikir Kreatif Siswa: Studi Eksperimen Pada Mata Pelajaran Ekonomi Kelas X Smu Negeri 11 Ambon*. Doctoral dissertation, Universitas Pendidikan Indonesia. Retrieved from https://ejournal.unpatti.ac.id/ppr_paperinfo_lnk.php?id=729

Munandar, U. (1992). *Mengembangkan Bakat Dan Kreativitas Anak Sekolah.* Jakarta: PT. Gramedia Widiasarana Indonesia.

Munandar, U. (2009). *Pengembangan Kreativitas Anak Sekolah*. Jakarta: PT. Rineka Cipta.

Piirto, J. (2011). *Creativity for 21st Century Skills*. Rotterdam: Sense Publishers.

Prastiwi, C.A.S., Anggaryani, M. (2014). Penerapan Strategi Pembelajaran Learning Cycle Tipe 5E dengan Materi pesawat Sederhana Sebagai Upaya Meningkatkan Hasil Belajar Siswa SMP Negeri 2 Gedangan Kelas VIII. *Inovasi Pendidikan Fisika*, 3(2), 37-40. https://doi.org/10.26740/ipf.v3n2.p%25p

Qarareh, A.O. (2012). The Effect of Using the Learning Cycle Method in Teaching Science on the Educational Achievement of the Sixth Graders. *International journal of Educational Science*, *4*(2), 123-132. https://doi.org/10.1080/09751122.2012.11890035

Ratumanan, T. G., Laurens, T. (2011). *Evaluasi hasil belajar yang relevan dengan kurikulum berbasis kompetensi*. Surabaya: YP3IT kerjasama dengan Unipress.

Riduwan. (2010). *Skala pengukuran variabel-variabel penelitian*. Alf. Bandung.

Risdiana, H., Suyatno, S., & Poedjiastuti, S. (2014). Implementasi Model 5e Learning Cycle Untuk Meningkatkan Penguasaan Konsep Dan Kemampuan Berpikir Kreatif Siswa SMA. *JPPS (Jurnal Penelitian Pendidikan Sains), 3*(2), 367-375. https://doi.org/10.26740/jpps.v3n2.p367-375

Sayuti, I., Rosmaini, S., & Andayannhi, S. (2012). Penerapan Model Pembelajaran Learning Cycle 5E Untuk Meningkatkan Sikap Ilmiah Dan Hasil Belajar Biologi Siswa Kelas XI IPA 4 SMA Negeri 5

Pekanbaru. *Jurnal Pendidikan, 3*(1). https://jp.ejournal.unri.ac.id/index.php/JP/article/view/1006

Slavin, R.E. (2011). *Educational Psychology Theory and Practice. Ninth Edition*. Jakarta: PT. Index.

Susantini, R., Widha, S., Haryono. (2012). Pembelajaran Kimia Menggunakan Siklus Belajar 5E dan Inkuiri Bebas Dimodifikasi Ditinjau dari Kemampuan Berpikir Analisis dan Kreativitas Siswa. *INKUIRI, 1*(1), 60-68. Retrieved from https://digilib.uns.ac.id/dokumen/download/27733/NTg2NzM=/Pembelajaran-Kimia....pdf

Thomson, S., Lisa, D.B., Sarah, B. (2014). *PISA in Brief: Highlights from the Full Australian Report*. ACER: Australian Council of Educational Research.

Tuckman, B. W. (1978). *Conducting Educational Research Second Edition*. USA: Harcourt Brace Jovanovich, Inc.

Tuna, A., Kacar, A. (2013). The Effect of 5E Learning Cycle Model in Teaching Trigonometry on Students' Academic Achievement and the Permanence of Their Knowledge. *International Journal on New Trends in Education and Their Implications*, *4*(1), 73-87. Retrieved from http://www.ijonte.org/FileUpload/ks63207/File/07.tuna.pdf

Yalcin, F.A., Bayrakceke, S. (2010). The Effect of 5E Learning Model on Pre Service Science Teachers Achievement of Acids-Bases Subject. *International Online Journal of Educational Sciences, 2*(2), 508-531.

Yamin, M. (2008). *Paradigma pendidikan konstruktivistik: implementasi KTSP dan UU no. 14 tahun 2005 Tentang Guru dan Dosen*. Gaung Persada Press