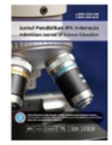
JPII 5 (2) (2016)
247-255

JurnalPendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii



THE EFFECTIVENESS OF TEACHING MATERIALSUBJECTCONCEPT SCIENCE-BASED SCIENCE LITERACY FORDEVELOPING STUDENTS' COMPUTATIONAL THINKINGSKILLS

ABSTRACT

Computational thinking and scientific literacy are competencies that must be possessed by pre-service primary teachers in the 21st century. This study aims to test the effectiveness of science concept teaching material that has been developed in improving computational thinking skills of Primary School Education Department students at UniversitasMuria Kudus Indonesia. This research is part of the Research & Development (R & D) procedure which includes 3 stages, namely preliminary studies, development studies, and validation studies. In this validation phase, the concept of science teaching literacy has been developed in large-scale trials with quasi-experimental control groups design for the fourth semester Primary School Education Department students in 2018/2019 at the school year, where class 4A as the control group and 4C class as an experimental group were taken randomly.. The experimental class consisted of 44 students, while the control class numbered 46 students. After being given an intervention, the two classes were given posttest to determine its effectiveness. Based on hypothesis testing using the right t_{test}, it has t_{count} 2,215 and t table 1.99. Thus, it could be concluded that the teaching materials of developed scientific literacy concepts were effective in improving students' computational thinking skills.

Keywords: Teaching Materials, Scientific Literacy, Computational Thinking Skills

INTRODUCTION

Education is the most element in science development and human resource fostering to be reliable, qualified, and competitive. In this 4.0 Industrial and Evolutional eras, higher education has an important role to prepare competitive human resources in global industries. Syamsuar & Reflianto (2019) stated that competing in this digital era Indonesia needs to immediately improve the ability and skills of human resources through education to achieve competitiveness and high productivity. As a facility to create teacher candidates, PrimaryEducational Teacher Department of UniversitasMuria Kudus has always fixed curriculum content, been preparing its students with needed skills and competency of the 21st century to compete globally. One of the needed skills by the candidates of primary school teachers are computational thinking skill andscience literacy.

Wing (2006) stated that basic skill to be owned by every individual in the 21st century is computational thinking (CT). It is a pattern in solving problems by integrating ideas, data, logics through various disciplines and thought as if it was computer operation (Qualls, 2010). Meanwhile, science literacy is related to the ability of individuals to understand and implement science in his life (Bybee, 2009). The skills and competencies are important for primary and middle schools because they are related to logically reasoning, algorithmically thinking, thinking specifically and using time efficiently, and innovatively thinking (Mohagheghh& Michael, 2016). Therefore, for students of PrimaryEducational Teacher Department of UniversitasMuria Kudus must have those skills. The students must be able to think in complex and solve their faced problems as the realization of professional learning

The preliminary study showed science literacy level of the students was 66.2% on the nominal level (Fakhriyah et al, 2017). It showed that students had difficulties to relate science concepts but they could write scientific terms even though they still had a misconception. Besides that, in one of the science literacy components that the students could not connect to environmental phenomena completely. This causes students difficulties in dealing with complex problems. Because complex problems cannot be separated from critical thinking and problem-solving. Thus, it indicated a low level of students' CT skills. Jacob & Warschauer (2018) revealed that these computational thinking skills have become integrated into social functions to represent fundamental literacies.Thus, it indicated a low level of students' CT skills.

As a new literacy, CT strengthening is needed.Because CT is a new literacy based on conditions of the 21st century, to integrate various kinds of thoughts stared by abstractly thinking, thinking logically, modeling thinking, and constructively thinking (Liu & Wang, 2010). Computational thinking is composed of concepts fundamental to computer science, along with the intellectual skills that are needed for algorithmic thinking, pattern recognition, abstraction, and decomposition (Grover & Pea 2013; Wing, 2006; Wing, 2008).On the implementation, CT is not purposed for the exact field but also social fields, language or humanities because CT thoughts involve various abstract thoughts by identifying and analyzingproblems. This agrees with the opinion of Figueiredo (2017), where CT is not only for scientists but for professionals such as teachers, lawyers, farmers, doctors to solve the problems they face. CT is not only used in the computer field but also in education to develop individual potential and improve the social life of the community. CT teaches individuals to think like an economist, scientist, artist to solve problems using computing (Hemmendinger, 2010).Those problems are identified then are abstracted and put into an algorithm to create automation and conclusion (Jacob et al, 2018). The abstraction activity has a purpose to create certain patterns. Meanwhile, the algorithm has the purpose to explain the steps in detail, automation.

CT skill can be trained by students if they haveproper science literacy. Computational thinking is a new form of literacy, meaning that integrating CT into literacy practices will affect student literacy skills to improve computational results and develop student literacy through computational practice (Jacob & Warschauer, 2018).Therefore, to mediate the development of science with all fixation of curriculum contents and immediate needs for students then there is a need to develop appropriate learning material to current needs, learning material with scientific literacy competence content and has ability to develop CT skills.

Some previous studies improvement by scientific literacy is measured by applying various appropriate learning models, for example Project Based Learning (Afriana et al, 2016). PjBL can improve students' understanding of concepts because students find their own concepts through projects that are worked on (Masfuah & Fakhriyah, 2017). Concept discovery through this project can develop process skills such as observing, classifying, measuring, asking, interpreting, analyzing data, reasoning and critical thinking that can develop scientific knowledge and scientific competencies that are aspects of scientific literacy (Lederman, et al., 2013). PjBL can create active learning, make students think critically in solving problems through projects in groups because the main characteristics of PjBL are student-centered, teaching through skills, process-centered, group-based, and experiential (Uziak, 2016). Besides meaningful learning processes such as these can improve cognitive learning outcomes (Baran &Maskan, 2011), shape environmental care attitudes (Kılınç, 2010; Tseng, et al., 2013), scientific process skills (Özer & Özkan, 2012), and learning effective (Cook, et al., 2012; Movahedzadeh, et al., 2012). Capraro et al (2013) emphasized that Project Based Learning learning naturally involves several different skills, such as reading, writing, mathematical and helping construct conceptual knowledge through assimilation of other different subjects so that it is expected to build students' science literacy and be able to develop CT skills. Therefore, in this study students are given project-based learning to be able to improve their science literacy and CT skills.

Based on the results of the preliminary study,stated that one of the causes of the low level of competence in science literacy and CT students is due to the lack of availability of teaching materials that can develop scientific literacy competencies and CT skills students of Primary Educational Teacher Department of UniversitasMuria Kudus. It was also proven by questionnaire results showing that students wanted to teaching material that develops thinking skills through project-based inquiry and investigation in languages that are easily understood science learning material by integrating various concepts, ideas, sources and phenomena scientific literacy. Science concept teaching materials available in the reading park are still textual or material content oriented. This also occurs in the research of the Word (in Adisendjaja, 2008) which states that the teaching materials available so far emphasize the dimensions of content rather than the dimensions of the process and context, so it is thought to cause low levels of scientific literacy of students in Indonesia.

Therefore, it is needed a certain alternative teaching material to involve science literacy aspects, such as content, process, and science attitudes in a real-life context. Therefore, there is a need to reconstruct the current learning material. Teaching materials are very important to support the learning process in the classroomTherefore, it is needed a certain alternative teaching material to involve science literacy aspects, such as content, process, and science attitudes in a real-life context. Therefore, there is a need to reconstruct the current learning material. Teaching materials are very important to support the learning process in the classroom.

Teaching materials contribute to student learning outcomes. The importance of learning material is caused since it has contributed toward the quality of students' achievement in which it is full of targeted competencies (Bauer, 2010). The learning process with teaching materials will take place systematically and make it easier for students to understand the material being studied. Based on these problems, it is necessary to develop science literacy teaching materials to develop computational thinking skills. According to Taber (2015), textbooks are an indispensable component in the educational process so that available books must be based on current research without scientific errors. Therefore, textbooks are an important role in learning-oriented to certain types of curriculum so that the contents of the book must consider students' cognitive levels, readability, misconceptions, and scientific vocabulary (Abdel-Hameed et al., 2014). Students revealed that they preferred learning materials, even though they enjoyed the flexibility offered by ICT-based teaching materials (Horsley et al., 2010).

In this research, teaching materials are developed based on scientific literacy and computational thinking. This teaching material presents concepts by integrating the scientific context which consists of environment, health, natural resources, disaster and technological science. This teaching material presents material that starts with the context of science in daily lives. After those students are led to analyze the concepts related to the phenomena. After that, students are given problems related to the theory to be carried out investigations, projects, and problem-solving. Problem-solving steps must be taken by students through the CT thinking flow to obtain a solution through the algorithm, abstraction, simulation, and conclusion. From the existing context, students must use CT as they think like a computer by involving the principle of the algorithm by finding solutions and solving problems according to the CT step. Students can arrange the results of their thinking systematically and meaningfully. this opinion is reinforced by the statement of Jacob & Warschauer (2018) algorithmic thinking involves decoding textual or block-based programming commands and sequencing them in syntactically and semantically meaningful ways.This is in accordance with research conducted by Khaeroningtyas et al. (2016) who found that learning by involving science, technology, engineering and mathematics can improve student literacy in science.

The development of science concept learning materials based on scientific literacy has been developed based on the content of science concept materials needed for Primary Educational Teacher Department Universitas Muria Kudus students. The results of the initial stage about the validity of the learning material were: expert judgment validation score was 90.4, showing the learning material movement system was reliable to use(Fakhriyah et al., 2017).Computational thinking is a 21st century scientific literacy. Computational thinking means a scientific literacy mindset that is accompanied by computational thinking (involving technology) to solve problems.the material in teaching materials contains indicators of scientific literacy consisting of content, context, competencies and scientific attitudes. the indicators of science content are reflected in the theory environment along with an in-depth discussion of the material. for the context of science is reflected in the corner of the story that connects science with people's lives related to the environment, natural resources, disasters, and technological science. This story corner is equipped with a thinking corner. while for competencies and attitudes can be seen from practical activities and conclusions. These teaching materials lead students to think by linking the material that has been learned with everyday life based on existing phenomena.

Learning materials have been validated by experts for the suitability of their content. The previous research step had measured the readability test of teaching materials with the cloze test technique. The results of the readability test with the cloze test score average readability of teaching materials in science concepts with science around 55.4 with criteria for teaching materials can be understood and appropriate for students (Fakhriyah et al., 2018). Indirectly can be interpreted that students are able to read and understand things written in teaching materials. With reference to readability, vocabulary contributes to reading fluency (Graves, 2016) and vocabulary knowledge influences text comprehension (Bravo & Cervetti, 2008). From the several steps of research that have been carried out, namely the validation of expert judgment and the readability test of teaching materials, it can be said that the development of teaching materials is appropriate so that their effectiveness needs to be tested.So that that purpose of this research can be obtained is to test the effectiveness of learning science concepts that have been developed to improve the computational thinking skill of Primary Educational Teacher Department of UniversitasMuria Kudus.

METHODS

This research was the third part of Research and Development in which started by preliminary study, developing stage, and validating step (Samsudi, 2006). Based on the results of the preliminary study, it was found that the need for learning materials for science concepts that are lined with science is very necessary to develop students' CT skills. In addition, the measurement of student literacy also shows low results scientific literacy of Primary Educational Teacher Department UniversitasMuria Kudus students was 66, 2% in nominal level and 33, 8% in functional level (Fakhriyah et al., 2017). After conducting a preliminary study, researchers developed learning materials based on scientific literacy to develop CT skills.

The initial step was related to the arrangement of learning material based on preliminary study result. The arrangement was started by analysis of learning achievement, indicator elaborations, and learning material formulation. The developed learning material contained science literacy competencies and CT consisting of cover, table of contents, preface, manual to use, purposes of study, conceptual map, scientific phenomena based science literacy (application and science contexts) as warming up, investigation activities based science competency, science content-based materials, reasoning skills to solve problems based on CT guidelines, summary, assignment, glossary, evaluation, and reference. The development phase of the validation test from the expert, the readability test for teaching materials and the limited scale trial have been completed.

The development phase of the validation test from the expert, the readability test for teaching materials and the limited scale trial have been completed. Validation is carried out by three validators whose task is to assess the content validity and the feasibility of teaching materials. The result of expert validation is known that the average validation of teaching materials is 90,4 with very valid criteria so that teaching materials can be used. The next research step was readability by cloze test technique. The results of the cloze test score average readability of teaching materials science concepts are around 55.4 science with the criteria of teaching materials can be understood and appropriate for students (Fakhriyah et al., 2017). The validation step was an implementation stage of the already developed, evaluated, and revised product and it would be tested on a larger scale. The taken steps of validation were: larger-scale test, readability test and evaluation of computational thinking skill posttest after using the learning material. Thevalidation was done by quasi-experiment design with posttest only control group design (Arikunto, 2019). Both groups were differently intervened, for class 4C – the experimental group, was intervened by using science conceptual learning with the developed learning material. Meanwhile, the control group, class 4A, was given learning by using handout from the lecturer. The researcher did not give any pretest for both groups directly implemented the product and was followed by posttest to find out the effectiveness of the developed learning material.

After a limited scale trial, the massive trial run scale was given under material "Movement System". The material consisted of movement of living creatures, movement of object, and the influences of movement toward a certain object. On this test, there was only one theme given on four meetings with 3 credit allocations for each meeting.

Methods and instruments of the research were questionnaires, and test. Meanwhile, the analysis of data were initial analysis step: (1) analysis of CT competency test instrumentintegrated by science literacy in which was started by measuring content validity, reliability, levels of difficulties and distinguishing power of task number. Before the instrument is used, first, the instrument is validated by experts. Furthermore, the test instrument was tested on Class 4B, amounting to 40 students. The analysis shows that the reliability of the instrument is 0.783 compared to the r table of 0.312. Likewise, the power of differentiation and the difficulty level of tests. That means, the instrument is reliable and suitable for use in research;2) homogeneity test to find out whether the taken sample was homogenous or not to determine experimental or control groups in massive trial run scale.Then, the sample was determined by random sampling technique based on homogeneity test result of midterm test score. Based on Bartleet test, both classes had homogenous variants. Therefore, it could be concluded that all four classes had equal abilities so it could be selected by random sampling. Based on the determination, finally it was gained 4A as control group and 4C as experimental group. Both groups were then given different interventions. 4C class, the experimental group, was intervened by using science conceptual learning with science literacy concept learning material. Meanwhile, the control group, 4A, was given *handout* by the lecturerin its learning process. The researcher did not conduct any pre-test for both groups but directly implemented the product and was followed by post-test to find out the effectiveness of the developed learning material. The steps to do in this test were: students were given the learning material in advance to be studied at home.

The next step was analyzing final stage, covering from: (1) normality test, (2) CT test integrated by science literacy, (3) research hypothesis was tested by t-test with two average differentiation. And (4) descriptive analysis to find out the CT skills of each indicator in the control class and the experimental class.

RESULTS AND DISCUSSION

This research was part of R&D, exactly on validation stage (massive trial run scale) by using quasi-experimental design with *post-test only control group.* Before testing, the researchers conducted expert validation and limited trial run scale. The results of initial stage about validity of the learning material were: *expert judgement* validation score was 90.4, showing the learning material movement system was reliable to use. On limited trial run scale, it showed that the judgement on practicability of the learning material based on response questionnaire of the students was 82.5, categorized very good (Fakhriyah et al, 2017).

The validation stages consisted of *expert validation,* results of limited trial run scale and massive trial run scale. On massive trial run scalewas implemented on fourth semester students of Primary Educational Teacher DepartmentDepartment of UniversitasMuria Kudus in 2018/2019 academic year with four classes: 4A, 4B, 4C, and 4D. Then, the sample was determined by random sampling technique based on homogeneity test result of midterm test score. Based on Bartleet test, both classes had homogenous variants. Therefore, it could be concluded that all four classes had equal abilities so it could be selected by random sampling. Based on the determination, finally it was gained 4A as control group and 4C as experimental group.

Massive trial run scale under sub-material "Movement System" consisted of movement material of living creatures, movement of objects, and the influences of movement toward an object. In this trial run, there was only one theme given in four meetings with 3 credit allocation for each.

On the initial step, students were asked to read the conceptual map and science context that were the application of science in real life. After that, the students were grouped into five teams to conduct simple practice to find the already learned concept.The practices were observation of movement system of low level animal and higher level animal by using microscope, analysis of movement system on plants and humans, and movement of object in which the students lately found gravitational acceleration on certain place. This activity had purpose to train science competency aspect integrated by CT competency. It was strengthened by Yadav et al. (2014) that CT skill was metal activity to abstract problems and formulate solution to be automated. Therefore, it was important to conduct practice to train students in abstracting a certain problem and to find concept based on the accumulated experience. It aligned with Bower et al. (2017) stated that CT skill could be improved through professional learning, among them such as centralized on students through self-conceptual investigation.

Then, after the practice, students discussed and worked on the examples of presented CT tasks in the form of problems or science phenomena in society. It could strengthen and develop the already owned CT skill of the students because the skill was used to explain more complex problem by using abstraction, model, and simulation (Voskoglou & Buckley, 2012).After discussing, the students presented their results. In this step, there was argument and opinion exchanges among students so it could enrich their understandings about the material. After that, the lecturer gave emphasis related to the material.

In the beginning of the learning, students were asked to read about the context and content of science literacy, such as phenomena and science application in daily life. After that, the students were involved in literacy of phenomena consisting of questions to answer and discuss as initial hypothesis. Then, the students practiced to inquire, compose a report, create graphs, abstract and solve problems based on CT guidelines. Therefore, the students could understand the material from learning material properly. Indirectly, it could be understood the students could read and understand written matters inside of learning material although some parts were needed to clarify for reader guideline to more understand the learning material. It was caused by inquiry learning to develop science literacy (Gormally, 2009). Besides that, CT is oriented to inquiry learning is easier for individuals to solve problems (Gao, 2011).

Some criticisms for revision were: there were some foreign terms and writing of scientific terms or formula and denomination in which had not been understood by students so they needed glossary, term assertion, and index to let students understanding them. In the final step, students were given post-test to find out the effectiveness of learning material with concepts of science literacy implemented on experimental group. The evaluation task numbers were given in the form of essay with 16 numbers, consisting of 8 CT indicators. According to Hoover et al. (2016) with CT assessments can potentially be automatic encourage the development of CT.

The determined successive indicators were science conceptual learning material with science literacy was more effective to improve CT skill of experimental group than the control group. The proposed hypothesis was H_0: the average of CT skill of experimental group is lower than average CT skill of control group, H_a: the average skill of CT of experimental group was better than CT skill of control group. Hypothesis test was started by normality test, homogeneity test, and t-test. The recapitulations of normality and homogeneity tests are on Table 1.

Table 1. The Result of Normality and Homogeneity Tests

Tests	Sources of Variations	Post-test of CT Skill of Experimental Group	Post-test of CT Skill of Control Group
Normality	$X^2_{calculated}$	6,87	9,92
	X^2_{table}	11,07	11,07
	Criteria	Normal Data Distribution	Normal Data Distribution
Homogeneity	F calculation	2,00	Both are homogenous
	F table	2,37	

Based on Table 1, it is known both groups have normal data distributions and homogenous variants. Therefore, the hypothesis test was done by using t-test of right party. The recapitulation of the t-test can be seen on Table 2.

Table 2. The Result of Right Party t-test of CT Post-test

Variations	Score of CT Skill Post-Test	
	Experiment	Control
Average	76,69	71,11
dk	44	46
$T_{calculation}$	2,215	
t_{table}	1,990	
Criteria	CT skill of experimental group is better	

Based on Table 2, it is known $t_{calculation} > t_{table}$ so H_0 is denied and H_a is accepted. Therefore, it could be concluded CT skill of students intervened by science conceptual learning material with science literacy was better than students taught by using *handout*. It was strengthened by Brackmann et al. (2017) telling the result of students taught by active participations such as investigation and discussion was better in improving CT skill of students. Besides that, on the book, students did experiment and were given problems related to the material. Students created abstract and pattern of problem solving based on CT guidelines. It aligned with Aho (2012) stating that the core of CT thinking is on abstraction. Besides that, Dong et al. (2019) revealed CT was described as problem solving included formulating problems, managing data logically, presenting data through abstraction, automizing solution, reflecting possible solution efficiency, and generalizing and transfering process to various problems. The flow of CT invites human to think critically, creatively through integral thinking so complex problem can be solved as if it was computer software (Fakhriyah, et al. 2018).This opinion is reinforced by Grover (2015) who states that the CT mindset can build and broaden students' insight because in CT thinking students must be able to use logic and create a model. Voogt et al. (2015) added that CT learning does not require every student to think like a computer but essentially CT learning teaches students to think like an economists, a scientists, and an artists in solving problems that are full of consideration.

After that, a descriptive analysis was done to find out CT skill of each indicator. CT score on each indicator can be seen in Diagram 1.

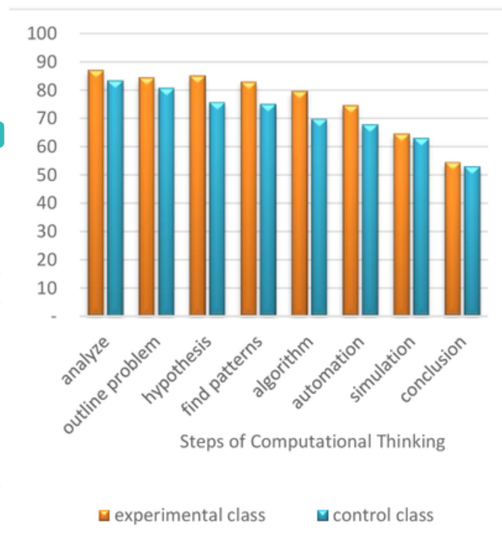


Diagram 1. Analysis of CT Skills of Each Indicator

Based on the diagram, it is known CT skills of students in the experimental class in analyzing, explaining, hypothesizing, and finding patterns of problems show high results.Based on these results, indicators that have a significant difference are indicator algorithms and hypotheses. That is because the experimental class learning is in accordance with the developed teaching material, which is directed learning inquiry finding concepts through investigative activities, experiments and projects in accordance with aspects of scientific literacy and must be worked on in accordance with CT steps, whereas control class learning is done classically using lecturer handout through classical discussion. Teaching material containing investigation, analysis and modeling activities to solve phenomena contribute to CT students (Bower, et al., 2017).Through inquiry, CT skills are eased individuals to solve problems (Gao, 2011). Mishra et al. (2013) reinforce that with CT can move students from being consumers of technology to creating new forms of expression by fostering creativity.In addition, inquiry-based learning and projects can increase student science literacy (Afriana, et al., 2016; Nurwahidah, et al., 2017). Likewise, Ornelas (2017) from his research found that project-based learning can promote student CT.

In the experimental class students' skills of putting into the algorithm, the step was still sufficient. The skills required students to solve problems systematically and orderly. The algorithm activity is based on the content of the developed teaching material, namely students must analyze phenomena, conduct inquiry practicum activities in accordance with aspects of scientific literacy that must be done according to the CT mindset. In the inquiry experiment activities, students must determine the objectives of the practicum and the project and conduct hypotheses. Students must study the literature first. From these activities, they are directed to think critically and creatively to create ideas to find solutions. After obtaining a solution pattern, then students must determine specific steps to solve the problem by choosing the right step information based on the algorithm so that simulation is formed to get a conclusion.

However, on this step, students have difficulties then influenced their concluding skills.Basically, students already know the conclusions or answers of the hypotheses given, but they have not been able to describe the specific steps, choose and use the right information.The essence of CT requires students to think step by step simultaneously and be able to make decisions about the quality and feasibility of information and products produced (Romero et al, 2017). Students are not yet accustomed to systematic problem-solving mindsets to the conclusion skills. the activity of getting students used to thinking CT needs to be done continuously because the algorithmic process involves decoding textual or block-based programming commands and sequencing them in syntactically and semantically meaningful ways (Jacob & Warschauer, 2018). In addition, the low ability of students' algorithms is due to the fact that most of the scientific literacy abilities of students are at the nominal level (Fakhriyah, et al., 2017), where students are only able to understand theory without any explanation using their own ideas, students are able to recognize scientific terms but are unable correct the term and students experience misconceptions (Holbrook &Rannikmae, 2009). The results of the questionnaire also explained that students experienced confusion when explaining the concept in detail and coherently. This indicates that students experience misconceptions and missing concepts.

It suggests for the lecturer to revise the implementation of CT. CT does not aim to teach students to think like a computer scientist, but rather teach students to apply the CT flow to solve problems by integrating various disciplines (Barr & Stephenson, 2011).CT could be done by emphasizing the long term discussion about CT by identifying on which part of the curriculum, where students struggle and sought an opportunity to integrate CT and coding to facilitate them learning (Dong et al, 2019). In addition, Jacob & Warschauer, (2018) defining computational thinking as a literacy provides a way to unify well-researched theories on literacy instruction. According to DiSessa (2001), the decision to define a particular practiceas a literacy relies heavily on socially constructed contexts.

CONCLUSION

This teaching material contains indicators of scientific literacy that direct students to computational thinking. Through the development research step, the content and feasibility of teaching materials are valid, and the results of the readability of teaching materials can be used and easily understood by students. Then the results of wide-scale validation test can show that the developed learning material with scientific literacy competence integrated to CT guidelines showed that the effectiveness of the test of the science conceptual learning material was known that $t_{calculation} > t_{table}$ so H_o is denied and H_a is accepted. So it can be concluded that CT skills of the students are intervened by science conceptual learning material with scientific literacy was better than those learning using lecturer's handouts. The learning material can be implemented in learning to develop CT.

ACKNOWLEDGEMENTS

Our first thank goes to DRPM of the Ministry of Research Technology and Higher Education of Indonesia for providing research grants for cooperation between Universitas. Thanks for supporting research to all parties helping, among them are theDean of FKIP and Head of Primary Educational Teacher

Departmentfor allowing andsupporting this research.

REFERENCES

Abdel-Hameed, F. S., Emara, S. A., & Khine, M. S. (2014). Analysis of Cycle-1 Primary Science Textbooks in the Kingdom of Bahrain for Reflection of Reform. *International Journal for Cross-Disciplinary Subjects in Education, Special Issue*, *4*(3), 2009-2018.

Adisendjaja, Y. H. (2008). Analisis Buku Ajar Biologi SMA Kelas X di Kota Bandung Berdasarkan Literasi Sains. *Bandung: Jurusan Pendidikan Biologi, FMIPA Universitas Pendidikan Indonesia*.

Afriana, J., Permanasari, A., & Fitriani, A. (2016). Project Based Learning Integrated to Stem to Enhance Elementary School's Students Scientific Literacy. *Jurnal Pendidikan IPA Indonesia*, *5*(2), 261-267.

Aho, A., V. (2012). Computation and Computational Thinking. *The Computer Journal*, 55(7): 832-835

Arikunto, S. (2019). Prosedur penelitian suatu pendekatan praktik.

Baran, M., & Maskan, A. (2011). The effect of project-based learning on pre-service physics teachers electrostatic achievements. *Cypriot Journal of Educational Sciences*, *5*(4), 243-257.

Barr, V., & Stephenson, C. (2011). Bringing computational thinking to K-12: what is Involved and what is the role of the computer science education community?. *Inroads*, *2*(1), 48-54.

Bauer, K. (2010). Textbooks and teaching resources: a case study from the early childhood classroom-Australia.

Bower, M., Wood, L. N., Lai, J. W., Howe, C., Lister, R., Mason, R., ... & Veal, J. (2017). Improving the computational thinking pedagogical capabilities of school teachers. *Australian Journal of Teacher Education*, *42*(3), 4.

Brackmann, C. P., Román-González, M., Robles, G., Moreno-León, J., Casali, A., & Barone, D. (2017, November). Development of computational thinking skills through unplugged activities in primary school. In *Proceedings of the 12th Workshop on Primary and Secondary Computing Education* (pp. 65-72). ACM.

Bravo, M. A., & Cervetti, G. N. (2008). Teaching vocabulary through text and experience in content areas. *What research has to say about vocabulary instruction*, 130-149.

Bybee, R., McCrae, B., & Laurie, R. (2009). PISA 2006: An assessment of scientific literacy. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *46*(8), 865-883.

Capraro, R. M., Capraro, M. M., & Morgan, J. R. (Eds.). (2013). *STEM project-based learning: An integrated science, technology, engineering, and mathematics (STEM) approach*. Springer Science & Business Media.

Cook, K., Buck, G., & Rogers, M. P. (2012). Preparing biology teachers to teach evolution in a project-based approach. *Science Educator*, *21*(2), 18-30.

DiSessa, A. A. (2001). *Changing minds: Computers, learning, and literacy*. Mit Press.

Dong, Y., Catete, V., Jocius, R., Lytle, N., Barnes, T., Albert, J., ... & Andrews, A. (2019, February). PRADA: A Practical Model for Integrating Computational Thinking in K-12 Education. In *Proceedings of the 50th ACM Technical Symposium on Computer Science Education* (pp. 906-912). ACM.

Fakhriyah, F., Masfuah, S., & Roysa, M. (2017). The Characteristics of Scientific Literacy-Based Teaching Materials for Developing Computational Thinking Skills. *Proceeding of ICMSE*, *4*(1), 1-6.

Fakhriyah, F., Masfuah, S., Roysa, M., Rusilowati, A., & Rahayu, E. S. (2017). Student's Science Literacy in the Aspect of Content Science?. *Jurnal Pendidikan IPA Indonesia*, *6*(1).

Figueiredo, J. A. Q. (2017). How to improve computational thinking: A case study. *Education in the Knowledge Society*, *18*(4), 35-51.

Gao, Q. (2011). The Computational Thinking-Oriented Inquiry Teaching Mode for Advanced Programming Languange Course. *An Indian Journal BAIJ*, *10*(12), 6287-95.

Gormally, C., Brickman, P., Hallar, B., & Armstrong, N. (2009). Effects of inquiry-based learning on students' science literacy skills and confidence. *International journal for the scholarship of teaching and learning*, *3*(2), n2.

Graves, M. F. (2016). *The vocabulary book: Learning and instruction*. Teachers College Press.

Grover, S. (2015, April). Systems of Assessments" for deeper learning of computational thinking in K-12. In *Proceedings of the 2015 annual meeting of the American educational research association* (pp. 15-20).

Grover, S., & Pea, R. (2013). Computational thinking in K–12: A review of the state of the field. *Educational researcher*, *42*(1), 38-43.

Hemmendinger, D. (2010). A plea for modesty. *Acm Inroads*, *1*(2), 4-7.

Holbrook, J., & Rannikmae, M. (2009). The meaning of scientific literacy. *International Journal of Environmental and Science Education*, *4*(3), 275-288.

Hoover, A., Puttick, G., Barnes, J., Tucker-Raymond, E., Fatehi, B., Harteveld, C., & Moreno-León, J. (2016, October). Assessing computational thinking in students' game designs. In *3rd ACM SIGCHI Annual Symposium on Computer-Human Interaction in Play, CHI PLAY 2016* (pp. 173-179). Association for Computing Machinery, Inc.

Horsley, M., Knight, B. A., & Huntly, H. (2010). The role of textbooks and other teaching and learning resources in higher education in

Australia: change and continuity in supporting learning.

Jacob, S., Nguyen, H., Tofel-Grehl, C., Richardson, D., & Warschauer, M. (2018). Teaching computational thinking to English learners. *NYS TESOL journal*, *5*(2).

Jacob, S. R., & Warschauer, M. (2018). Computational thinking and literacy. *Journal of Computer Science Integration*, *1*(1).

Khaeroningtyas, N., Permanasari, A., & Hamidah, I. (2016). Stem learning in material of temperature and its change to improve scientific literacy of junior high school. *Jurnal Pendidikan IPA Indonesia*, *5*(1), 94-100.

Kilinç, A. (2010). Can project-based learning close the gap? Turkish student teachers and proenvironmental behaviours. *International Journal of Environmental and Science Education*, *5*(4), 495-509.

Lederman, N. G., Lederman, J. S., & Antink, A. (2013). Nature of science and scientific inquiry as contexts for the learning of science and achievement of scientific literacy. *International Journal of Education in Mathematics Science and Technology*, *1*(3), 138-147.

.Liu, J., & Wang, L. (2010, March). Computational thinking in discrete mathematics. In *2010 Second International Workshop on Education Technology and Computer Science* (pp. 413-416). IEEE.

Masfuah, S., & Fakhriyah, F. (2017). Developing the understanding of scientific concept based on the aspect of science literacy for students of elementary school education program through the application of project based learning. *Unnes Science Education Journal*, *6*(3).

Mishra, P., & Yadav, A. (2013). Of art and algorithms: Rethinking technology & creativity in the 21st century.

Mohaghegh, D. M., & McCauley, M. (2016). Computational thinking: The skill set of the 21st century.

Movahedzadeh, F., Patwell, R., Rieker, J. E., & Gonzalez, T. (2012). Project-based learning to promote effective learning in biotechnology courses. *Education Research International*, *2012*.

Nurwahidah, I. W. (2017). Jumadi, and Senam,"The Effects of Project Based Learning Model with Android on Scientific Literacy and Digital Equipedness/ICT Literacy,". *Int. J. Sci. Basic Appl. Res*, *36*(7), 190-205.

Ornelas, N. O. An Ecosystem: Computational Thinking, Project-Based Learning & Logo. *Proceeding*, to be presented at the FabLearn Conference at Stanford University, California at October 2017 (pp. 1-7).

Özer, D. Z., & Özkan, M. (2012). The Effect of the project based learning on the science process skills of the prospective teachers of science. *Journal of Turkish Science Education*, *9*(3), 131-136.

Qualls, J. A., & Sherrell, L. B. (2010). Why computational thinking should be integrated into the curriculum. *Journal of Computing Sciences in Colleges*, *25*(5), 66-71.

Romero, M., Lepage, A., & Lille, B. (2017). Computational thinking development through creative programming in higher education. *International Journal of Educational Technology in Higher Education*, *14*(1), 42.

Samsudi. (2006). *DesainPenelitian Pendidikan.* Semarang: Universitas Negeri Semarang.

Syamsuar, S., & Reflianto, R. (2019). Pendidikan dan tantangan pembelajaran berbasis teknologi informasi di era revolusi industri 4.0. *e-Tech: Jurnal Ilmiah Teknologi Pendidikan*, *6*(2).

Taber, K. S. (2015). Critical analysis of science textbooks: evaluating instructional effectiveness.

Tseng, K. H., Chang, C. C., Lou, S. J., & Chen, W. P. (2013). Attitudes towards science, technology, engineering and mathematics (STEM) in a project-based learning (PjBL) environment. *International Journal of Technology and Design Education*, *23*(1), 87-102.

Uziak, J. (2016). A project-based learning approach in an engineering curriculum. *Global Journal of Engineering Education*, *18*(2), 119-123.

Voogt, J., Fisser, P., Good, J., Mishra, P., & Yadav, A. (2015). Computational thinking in compulsory education: Towards an agenda for research and practice. *Education and Information Technologies*, *20*(4), 715-728.

Voskoglou, M. G., & Buckley, S. (2012). Problem solving and computational thinking in a learning environment. *arXiv preprint arXiv:1212.0750*.

Wing, J. M. (2008). Computational thinking and thinking about computing. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *366*(1881), 3717-3725.

Yadav, A., Mayfield, C., Zhou, N., Hambrusch, S., & Korb, J. T. (2014). Computational thinking in elementary and secondary teacher education. *ACM Transactions on Computing Education (TOCE)*, *14*(1), 5.

JPII Article

ORIGINALITY REPORT

10%	5%	2%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Universitas Muria Kudus Student Paper	2%
2	docplayer.net Internet Source	1%
3	mafiadoc.com Internet Source	1%
4	eprints.unm.ac.id Internet Source	1%
5	link.springer.com Internet Source	1%
6	Submitted to Universitas Negeri Jakarta Student Paper	1%
7	Submitted to Universitas Negeri Semarang Student Paper	<1%
8	Jamal Al-Karaki, Saad Harous, Hassan Al-Muhairi, Yousuf AlHammadi et al. "Towards an innovative computer science & technology curriculum in UAE public schools system", 2016	<1%

IEEE Global Engineering Education Conference (EDUCON), 2016
Publication

9	Submitted to Georgia Southwestern State University Student Paper	<1%
10	"Second Handbook of Information Technology in Primary and Secondary Education", Springer Science and Business Media LLC, 2018 Publication	<1%
11	Submitted to The Hong Kong Institute of Education Student Paper	<1%
12	inspire.redlands.edu Internet Source	<1%
13	Submitted to Universitas Pendidikan Indonesia Student Paper	<1%
14	repository.unair.ac.id Internet Source	<1%
15	pure.uva.nl Internet Source	<1%
16	Submitted to Syiah Kuala University Student Paper	<1%
17	Submitted to Grand Canyon University Student Paper	<1%

18	jurnal.uns.ac.id Internet Source	<1%
19	yayan4ri.blogs.uny.ac.id Internet Source	<1%
20	educationaltechnologyjournal.springeropen.com Internet Source	<1%
21	pt.scribd.com Internet Source	<1%
22	Submitted to Universitas Sebelas Maret Student Paper	<1%
23	Mustafa Serkan Günbatar. "Computational thinking within the context of professional life: Change in CT skill from the viewpoint of teachers", Education and Information Technologies, 2019 Publication	<1%
24	Submitted to University of South Australia Student Paper	<1%
25	Submitted to King's College Student Paper	<1%
26	media.neliti.com Internet Source	<1%
27	Submitted to Northcentral Student Paper	<1%

28	Submitted to Whitireia Community Polytechnic Student Paper	<1%
29	Submitted to General Sir John Kotelawala Defence University Student Paper	<1%
30	Submitted to Universiti Utara Malaysia Student Paper	<1%

Exclude quotes	On	Exclude matches	< 3 words
Exclude bibliography	On		