JISE 10 (2) 2021 : 222–229

Journal of Innovative Science Education

http://journal.unnes.ac.id/sju/index.php/jise

The Effectiveness of Schoology-Assisted PBL-STEM to Improve Critical Thinking Ability of Junior High School Students

Taufan Febrianto[1]✉, Sri Ngabekti[2], Sigit Saptono[2]

[1] SMP Maria Mediatrix Semarang, Indonesia
[2] Pascasarjana, Universitas Negeri Semarang, Indonesia

Article Info

Article History :
Received December 2020
Accepted January 2021
Published August 2021

Keywords:
Problem Based Learning, STEM, Schoology, Critical Thinking

Abstract

Current learning tends to use less varied and teacher-centered methods. The selected learning models and approaches have not been able to motivate students to be able to think critically, so that it affects the science scores in general that do not meet the minimum completeness limit The purpose of this study is to analyze the effectiveness of Schoology-assisted PBL-STEM by Environmental Pollution material in increasing critical thinking skills, as well as student learning outcomes. This study was conducted at Junior High School Maria Mediatrix with 4 classes sample, all of which were experimental classes with a total of 114 students. This study is a quantitative study with quasi-experimental study type. To determine the increase in critical thinking skills used the N-gain score test from the pretest and posttest results of four classes in the study that acted as experimental class. The results of the study and analysis can be concluded that critical thinking skills of students who are taught with problem-based virtual learning with STEM approach assisted by Schoology on Environmental Pollution material obtained an average N-gain score of 0.46, in moderate category, so that learning is said to be effective, and an average increase of indicator providing elementary clarification, building basic support and managing strategy and tactics has a higher N-gain score than inference. From learning completeness aspect, there are 94 students who complete individually, 82.5% of the students complete classically. This study can contribute to the development of virtual science learning, especially in the use of PBL-STEM model with better technical implementation.

✉ correspondence :
Jalan MT. Haryono No.908, Wonodri, Kecamatan Semarang Selatan,
Kota Semarang, Jawa Tengah, Indonesia 50242
E-mail: taufanfebrianto2902@gmail.com

p-ISSN 2252-6412
e-ISSN 2502-4523

INTRODUCTION

The use of technology, information and communication, in 21st century, is the basis of human life in the digital era.There are four integrated abilities that need to be possessed in 21st century, namely critical thinking and problem solving, creative and innovative, collaboration and good communication (van Laar et al*.,* 2018). The abilities of 21st century can be obtained through innovation in learning that emphasizes contextual problems or projects, communication and collaboration, creative and innovative work, and students become learning centers (Zubaidah, 2016).

Global competition, technological developments, population movements, political and environmental challenges encourage the development of skills and knowledge for students to succeed and survive in the 21st century. (Scott, 2015a). According to Rahayuni (2016) and Ennis (2013), the main characteristic of science learning lies in its complexity to analyze and decide on a problem through high-level thinking which is part of critical thinking. In the field of science, based on the results of the 2015 PISA (OECD, 2018), Indonesia is at the 61st level out of 70 participating countries. This illustrates the correlation between scientific skills and critical thinking of Indonesian students.

In general, the delivery of material in learning process at Junior High School Maria Mediatrix tends to still use less varied method. Learning activities are mostly in the form of demonstration, lecture, or discussion. The learning model or approach used has not been effective in motivating students to think critically, so that it has an effect on not maximum natural science score.

Problem Based Learning (PBL) which originates from real problems in daily life (Sahin, 2010), is a good and appropriate learning model to foster student interest and attention in learning (Balim et al., 2014). This model makes students the center in problem solving (Dischino et al*.,* 2011; Etherington, 2011). Through PBL students can apply their knowledge to solve problems (Jo & Ku, 2011). PBL makes students "*learn how to learn*" jointly (Dischino et al*.,* 2011).

From interview results with several teachers, indicators of critical thinking of any information that were absorbed were not optimal. Based on this, a learning model is needed that can improve these abilities. PBL is one of the models to choose from (Ridho et al., 2020; Fakhriyah, 2014).

PBL has learning foundation, which is as close as STEM (Science, Technology, Engineering and Mathematic). STEM consists of components of science, technology, engineering and mathematics that are taught in an integrative manner related to problem-based learning and its contextual application (Rahmadani, 2016).

STEM focuses on complex relationships between scientific disciplines (integrated learning) related to problems in life (Mcfarlane, 2013). Characteristic of the STEM is the implementation of innovative instructional methods such as Problem Based Learning, Project-Based Learning and Inquiry Based Learning (Bicer, 2015). Currently, learning focuses on improving and developing problem-solving skills as one of the skills in the 21st century (Jang, 2016). With STEM students are better and more active in problem solving, innovators, inventors, technology users, independent learners, and logical thinkers, (Stohlmann, 2012).

Critical thinking is an important component in STEM learning, because students are taught to be problem solvers (Linder et al*.,* 2016). From the understanding that students have based on science, technology, engineering and mathematics, through STEM learning, they are able to solve and draw conclusions from a problem (Robert & Cantu, 2012). The use of STEM integrated PBL is expected to improve students' critical thinking skills to be able to solve problems. STEM helps students in learning science, engineering technology, and in solving problems in the real world (National Study Council, 2011). STEM approach can help and determine solutions in solving complex problems (Jang, 2015), of course, if PBL is STEM-oriented, and encourages students' critical thinking skills. PBL steps are modified by integrating STEM components in each cycle.

ICT in PBL-STEM cannot be separated from the use of technology. One form of learning technology is e-Learning using a Learning Management System (LMS) (Stantchev et al., 2014). In science learning, LMS provides various activities and different learning methods (Cavus & Alhih, 2014). LMS in STEM provides better learning outcomes in the problem-solving process

through a contextual approach (Quarless & Nieto, 2013).

Schoology is a sample of LMS. Schoology in PBL-STEM is used to meet the needs of teaching materials, and graphic technology in the form of audio video helps students understand abstract concepts.

Based on description in introduction, it is necessary to analyze the effectiveness of Schoology-assisted PBL-STEM on Environmental Pollution material to improve the critical thinking skills of junior high school students. This is very possible because PBL can be oriented to STEM, and with the use of contextual videos, real life problems can be illustrated, cases in PBL-STEM will be more authentic. The objective of this study is to determine the effectiveness of PBL-STEM assisted by Schoology in improving students' critical thinking skills on Environmental Pollution material. The purpose of this study is providing contribution to the development of virtual science learning, especially in the use of the PBL-STEM model with better technical implementation.

METHODS

This study is a quantitative study with a quasi-experimental study type. This type of study makes students not feel like the object of study, so that the study results will be more valid and measurable.

This study used a design without pretreatment measurements or without a control group. This type of study is a one group pretest-posttest design. The pretreatment will show whether the treatment has an effect if it is removed. The design of one group pretest and posttest (One-group pretest-posttest design) can be seen in Figure 1.

O_1	x	O_2

Figure 1. One-group pretest-posttest design

Remarks:

O_1 : pretest of experimental class group

X : natural science learning with Schoology-assisted PBL STEM approach

O_2 : posttest of experimental class group

This study begins by determining the experimental group as a whole. The experimental group will be given a pretest, then given treatment with application of Schoology-assisted PBL-STEM as shown in diagram of Figure 2.

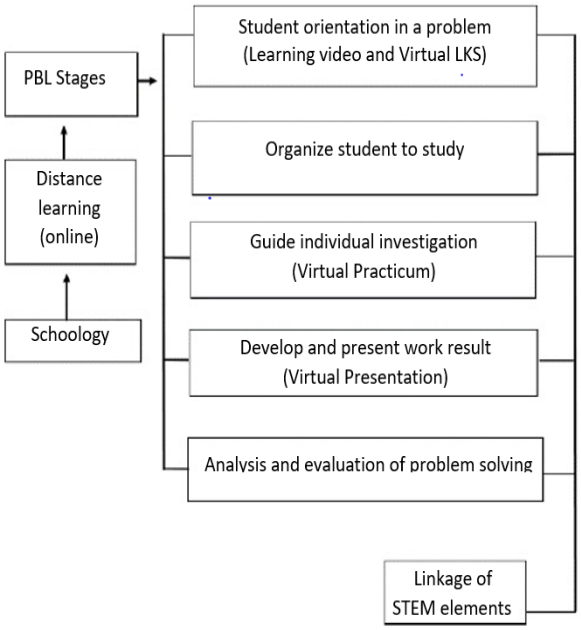

Figure 2. Stages of Schoology-assisted PBL-STEM

After that, this group was given a posttest, and obtained difference between pretest and posttest scores (gain value). Pretest and posttest scores become a description of students' critical thinking skills before and after treatment. This study was use multiple choice questions with four answer choices and the reasons for selecting answers. The instrument was adopted from Ennis (2011), and adapted to the needs of the study. Meanwhile, the taxonomic level of the question bloom is adjusted to the adopted critical thinking indicator. Critical thinking skill test instrument adopted from Ennis (2011) is chosen four indicators, namely: provide elementary clarification consists of 5 questions with question numbers 2,4,6,15,17, building basic skills consists of 4 questions with question numbers 3,7,8,11, inference consists of 6 questions with question numbers 1,5,14,16,18,19, and arranging strategy and tactics consists of 5 questions with question numbers 9,10,12,13,20.

The study class consisted of 114 students, all of whom were experimental classes experienced treatment using Schoology-assisted PBL-STEM learning.

Data for critical thinking skills were obtained from the results of the N-gain pretest and posttest multiple choice questions with an explanation of answer choices. The reasons for the answers given are to strengthen whether students' choice of answers is based on student understanding. The

data analysis used the N-gain score test from pretest and posttest results. The test uses SPSS 21. If between the pretest and posttest there is an increase in the N-gain score greater than or equal to 0.3, then learning is said to be effective.

RESULTS AND DISCUSSION

Result

Students' critical thinking skills were analyzed using N-gain which can be seen in Figure 3.

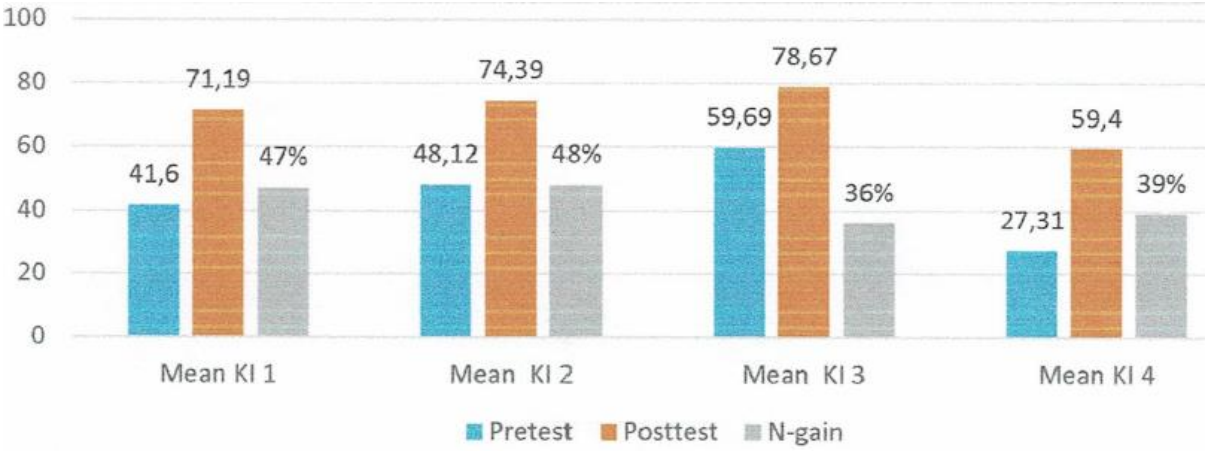

Figure 3. Students' critical thinking abilities seen from each critical thinking indicator

Remarks:
E1,2,3,4 = experimental group 1,2,3,4
K1 = mean Provide elementary clarification indicator
K2 = mean building basic skills indicator
K3 = mean Inference indicator
K4 = mean set strategy and tactics indicator

Table 1. Improved critical thinking skills with overall N-gain score.

Group	Pretest	Posttest	N-gain	%
E1	46.60	70.70	0.43	43
E2	42.50	71.17	0.48	48
E3	45.89	73.20	0.47	47
E4	44.00	70.20	0.47	47
Mean	44.70	71.30	0.46	46

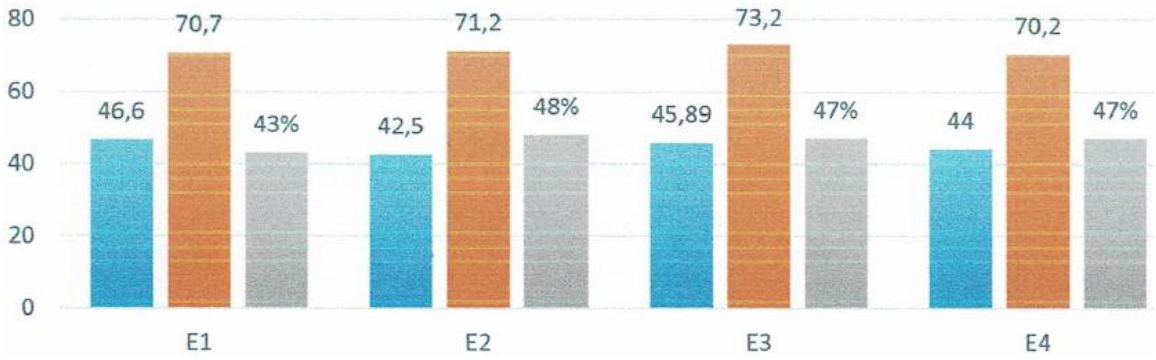

Figure 4. Pretest, posttest, and N-gain mean in every class

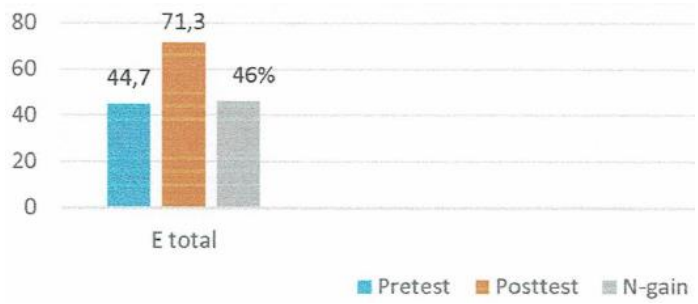

Figure 5. Pretest, posttest, and N-gain mean in total class

Completeness of Learning Outcomes

Minimum completeness criteria (MCC) in the study for HOTs = 60 questions, and 80% or more of the students had reached MCC, then the data were obtained as in table 2.

Table 2. Completeness of Learning Outcomes

Completeness	Group				Total/
	E1	E2	E3	E4	percentagee
Total students	25	30	28	31	114
MCC > 60	20	24	25	25	94
MCC < 60	5	6	3	6	20
Class average score	70.2	71.2	73.2	70.2	
Individual	20	24	25	25	94
Classical (%)	80	80	89	81	82.50

Discussion

At the beginning of virtual learning, all students obtain pretest as a description of their initial ability. Every step of the problem-based learning activity, STEM elements are included in each phase of the learning. The initial activity was to raise actual problems in daily life through student worksheets, then students did practicum virtually related to PBL-STEM on Environmental Pollution material.

Students use Schoology at the learning stage which is carried out as space to share information, material, worksheet links and learning videos used. In the final stage, a posttest is carried out to determine the increase in the average N-gain score of the learning process using Schoology-assisted PBL-STEM.

The process of implementing virtual learning with STEM education approach, asking science questions and defining problems, planning andinvestigating, using mathematics; information technology and computers; and computational thinking, and obtaining, evaluating and communicating information (Afriana et al*.,* 2016), means that teaching and learning content and interdisciplinary practice of knowledge that includes science and mathematics through the integration of engineering practices, in this case video-assisted virtual practice, and design using the relevant engineering technology. This is basically very supportive when using PBL which is done virtually. The way to support the implementation of STEM is in the form of familiarizing activities with STEM approach in the classroom by utilizing IT. (Anggraini et & Huzaifah, 2017).

Schoology as part of the Learning Management System is used as part of the e-learning model. Problem-Based Learning with virtually Schoology-assisted STEM approach can be said to be in accordance with learning during the Covid-19 pandemic when the study was conducted. Virtual learning with the help of LMS Schoology, in the experimental class has a significant contribution to the improvement of students' critical thinking skills on Environmental Pollution material from the moderate N-gain category that has been obtained. This is in line with the results of study by Irawan *et al.,* (2017) which explains that Schoology has a significant effect on student learning outcomes. Learning using LMS proves that on the other hand it also has a positive effect if its use makes innovation in the learning process (Rosy, 2018). Full learning activities are carried out in a network or called virtual learning. Another study that also

supports Ardianti et al. (2019) which states that blended learning with Schoology-assisted STEM approach is effective to use.

Based on study results, it turns out that problem-based virtual learning with Schoology-assisted STEM approach obtained an average N-gain value of 0.46. Based on the range, the N-gain score falls into the medium category.

Meanwhile, from the point of view of increasing the average of each indicator, namely providing elementary clarification with an N-gain of 0.47, building basic support, with an N-gain of 0.48, arranging strategies and tactics. with an N-gain of 0.39 and inference with an N-gain of 0.36 each also has an average N-gain in the medium category. For the concluded category (N-gain 0.36), students were still considered to have difficulties compared to other indicator categories.

Indicator concludes based on bloom taxono my of the cognitive domain at cognitive analysis level (C4) which requires a special understanding of the material and aspects that have been studied and is able to relate them. Students at Junior High School of Maria Mediatrix are also not familiar with the questions that fall into the category of high-order thinking or known as High Order Thinking skills (HOTs). Certainly, teacher-centered learning patterns cannot be separated from the results that have been obtained. This can be seen from not optimal N-gain. In general, when viewed from moderate category N-gain results, from pretest mean of 44.7, it increased to 71.30 from the posttest results, problem-based learning with STEM approach and assisted by Schoology has a positive impact on improving students' critical thinking skills. This is supported by studies which state that PBL-STEM can improve students' critical thinking skills or problem solving (Cahyaningsih & Roektiningroem, 2018; Agustin, Lesmono & Widodo, 2020; Iolanessa, Kaniawati & Nugraha, 2020; Adiwiguna at al., 2019; Ariyatun & Octavianelis, 2020; Satriani 2017; Onsee & Nuangchalerm, 2019).

From the aspect of learning completeness, 94 out of 114 students completed individually and 82.5% of the students completed classically. In general, the average value of the 4 study classes was 71.2. When viewed from overall class average, experimental class has reached an average above 70. In terms of results, it is not optimal, because online learning for the first time during Covid 19 pandemic, by all means, has many technical obstacles, which causes information or material transfer process becomes constrained. Moreover, in terms of technical and material readiness, surely, it needs more thorough preparation.

Regarding the use of videos in the Schoology-assisted PBL STEM learning, videos are compiled based on authentic problems about environmental pollution that occur especially in Semarang city. Based on the results of the questionnaire from the students' answers, most students stated that they felt helped by the learning videos that were shared with the LMS Schoology. Other studies that support the use of videos related to PBL include videos that are integrated in PBL helping structured learning in mastering material (Barth et al., 2019; Bridges, 2015; Watson & Fang, 2010; Snelson, 2017). Video study integrated with PBL also helps students communicate and solve problems (Abraham et al., 201; Lu & Chan, 2015; Pyle et al., 2019).

The author hopes that this study can contribute to the development of virtual science learning, especially in the use of the PBL-STEM model with better technical implementation.

CONCLUSION

Based on study results and discussion that has been stated, it can be concluded that problem-based virtual learning with Schoology-assisted STEM approach is effective for improving critical thinking skills.

REFERENCES

Abraham,A., Adiga,I., Melaka,B.G. (2011). Orienting Incoming Medical Students to the Process of PBL through Video *Education for Health,* Volume 24, Issue 2, http://www.educationforhealth.net/

Adiwiguna, P. S., Dantes, N., & Gunamantha, I. M. (2019). Pengaruh Model Problem Based Learning (Pbl) Berorientasi Stem Terhadap Kemampuan Berpikir Kritis dan Literasi Sains Siswa Kelas V Sd Di Gugus I Gusti Ketut Pudja. J*urnal Pendidikan Dasar Indonesia*, 3(2), 94–103

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. https://doi.org/10.15294/jpii.v5i2.5493

Agustin, M. D., Lesmono, A. D., Widodo, H. M. (2020). Mode Problem Based Learning (PBL) dengan Pendekatan Science Technology Engineering Mathematics (STEM) dalam Pembelajaran Fisika Materi Elastisitas di Kelas. *Jurnal Pembelajaran Fisika*, 9(2), 50–54.

Anggraini, F. I., & Huzaifah, S. (2017). Implementasi STEM dalam pembelajaran IPA di Sekolah Menengah Pertama. *Prosiding Seminar Nasional Pendidikan IPA 2017. STEM Untuk Pembelajaran Sains Abad 21. 23 September 2017*, *1998*, 722–731.

Ardianti,S., Sulisworo,D., Pramudya ,y.(2019). Efektivitas Blended Learning Berbasis Pendekatan STEM Education Berbantuan Schoology untuk Meningkatkan Critical Thinking Skill Pada Materi Fluida Dinamik.*Prosiding Seminar Nasional Pendidikan KALUNI* Volume 2 –240-246 DOI: http://dx.doi.org/10.30998/prokaluni.v2i0.67

Ariyatun, Octavianelis, D., F. (2020). Pengaruh Model Problem Based Learning Terintegrasi STEM Terhadap Kemampuan Berpikir Kritis Siswa. *Journal of Educational Chemistry,* 2(1), 33–39. https://doi.org/10.21580/jec.2020.2.1.5434

Balim, A.G., Turkoguz, A., Ormanci, U., Kacar, S., Evrekli, E., & Ozcan, E. (2014). Teachers' views about problem-based learning through concept cartoons. *Journal of Baltic Science Education*, 13(4), 458-468.

Barth, V. L., Piwowar, V., Kumschick, I. R., Ophardt, D., & Thiel, F. (2019). The impact of direct instruction in a problem-based learning setting.

Bicer, A., Capraro, R. M., Capraro, M. M., Oner, T., & Boedeker, P. (2015). STEM Schools vs. Non-STEM Schools: Comparing Students' Mathematics Growth Rate on High-Stakes Test Performance. International Journal on New Trends in Education and Their Implications, 6(1), 138–150.

Bridges,S. (2015).An emic lens into online learning environments in PBL in undergraduate dentistry . Pedagogies: An International Journal, 2015 Vol. 10, No. 1, 22–37,http://dx.doi.org/10.1080/1554480X.2014.999771

Cavus, N., & Alhih, M. S. (2014). Learning Management Systems Use in Science Education. Procedia - Social and Behavioral Sciences, 143, 517–520. https://doi.org/10.1016/j.sbspro.2014.07.429

Cahyaningsih, F., Roektiningroem, E. (2018). the Effect of Stem-Pbl on Critical Thinking and Cognitive Outcome'S. *E-Journal Pendidikan IPA*, *7*(5), 239–244.

Dischino, M. (2011). Increasing the STEM Pipeline through Problem- Based Learning. Proceedings of the 2011 IAJC-ASEE International Conference. ISBN 978-1-60643-379-9

Ennis, R.H., (2011). The Nature Of Critical Thinking: An Outline Of Critical Thinking Despositions And Abilities: University Of Illinois

Ennis, R.H. (2013). Critical thinking across the curriculum (CTAC) OSSA ConferenceArchive.44.https://scholar.uwindsor.ca/ossaarchive/OSSA10/papersandcommentaries/44

Etherington, M. B. (2011). Investigative primary science: A problem-based learning approach. *Australian Journal of Teacher Education*. 36 (9). 36-57.

Fakhriyah, F. (2014). Penerapan problem based learning dalam upaya mengembangkan kemampuan berpikir kritis mahasiswa. *Jurnal Pendidikan IPA Indonesia,* 3(1), 95–101.https://doi.org/10.15294/jpii.v3i1.2906

Iolanessa, L., Kaniawati, I., Nugraha, M. G. (2020). Pengaruh Model Problem Based Learning (PBL) Menggunakan Pendekatan STEM dalam Meningkatkan Keterampilan Pemecahan Masalah Siswa SMP. *WaPFi (Wahana Pendidikan Fisika*), 5(1):113-117

Irawan, V.T., Sutadji, E. and Widyanti (2017). Blended Learning Based On Schoology: Effort Of Improvement Learning Outcome And Practicum Chance In Vocational High School. Cogent Education. Volum 4, Hal.1-10.

Jang, H. (2015). Identifying 21st Century STEM Competencies Using Workplace Data. *Journal of Science Education and Technology*. 25, 2, Pp. 284-301.

Jo, S., & Ku, J.-O. (2011). Problem based learning using real-time data in Science Education for the gifted. *Gifted Education International*, 27, 263-273.

Linder, S., Emerson, A., Heffron, B., Shevlin, E., Vest, A., & Eckhoff, A. (2016). STEM Usein Early Childhood Education: Viewpoints From the Field. YC Young Children, 71(3), 87-91. Retrieved from http://www.jstor.org.libproxy.unl.edu/stable/ycyoungchildren.71.3.87

Lu,J. Chan,L.K. (2015). Differ in Socio-Cognitive Processes? Some Comparisons Between Paper and Video Triggered PBL. Hongkong: The University of Hong Kong. *Interdisciplinary Journal of Problem-Based Learning*,9(2).http://doi.org/10.7771/1541-5015.1495

McFarlane, D.A. (2013). Understanding the Challenges of Science Education in the 21st Century: *New Opportunities for Scientific Literacy* . Vol. 4, pp 35-44

National Research Council. 2012. Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century. Washington DC, National Academies Press.

OECD 2018 PISA 2015 results: creative problem solving student's skills in tackling real-life

Onsee, P., & Nuangchalerm, P. (2019). Developing Critical Thinking of Grade 10 Students through Inquiry-Based STEM Learning. *Jurnal Penelitian Dan Pembelajaran IPA*, 5(2), 132. https://doi.org/10.30870/jppi.v5i2.5486

Pyle,E. Hung,W. (2019). The role of subject presence type on student motivation in a PBL learning environment Springer Nature B.V. 2019 Advances in Health SciencesEducationhttps://doi.org/10.1007/s10459-019-09889-2 1 3

Quarless, D., & Nieto, F. (2013). Exploring Hybrid Instruction in Science: Using LMS for Contextual, Interdisciplinary Active Learning Enrichment. *Journal of Educational Technology Systems*, *41*(3), 279–292. https://doi.org/10.2190/et.41.3.f

Rahayuni, G. (2016). Hubungan Keterampilan Berpikir Kritis Dan Literasi Sains Pada Pembelajaran Ipa Terpadu Dengan Model PBM Dan STM. *Jurnal Penelitian dan Pembelajaran IPA*, Vol. 2, No. 2, 131-146.

Rahmadani, D. (2013). Short Analysis Review of Developing Method Study in Integrating Science, Technology, Engineering, and Mathematics (STEM) Approach in Problem Based Learning Model towards Students' Problem Solving Ability Advances in Social Science, Education and Humanities Research (ASSEHR), volume (57)140-142

Ridho,S., Wardani,S., Saptono, S. (2020). Development of Local Wisdom Digital Books to Improve Critical Thinking Skills through Problem Based Learning. *Journal of Innovative Science Education. 9(1), 1-7.*

Roberts, A. & D. Cantu. (2012). Applying Stem Instructional Strategies To Design And Technology Curriculum. Technology Education in the 21st Century, *Proceeding of the PATT 26 Conference.* Linkoping Uviversity, Stockholm. Setyorini,W. & P.

Rosy, Brillian. (2018). Schoology, Changing A Negatif Thinking Pattern About Use of Social Media. *Indonesian Journal of Informatics Education*, 2(1): 1-6.

Sahin, M. (2010). Effects of problem-based learning on university students' epistemological beliefs about physics learning and conceptual understanding of Newtonian Mechanics. *Journal of Science Education and Technology,* 19(3), 266-275. https://doi.org/10.1007/s10956-009- 9198-7 Sockalingam

Satriani, A. (2017. Meningkatkan Kemampuan Berpikir Kritis Siswa Dalam Pembelajaran Kimia Dengan Mengintegrasikan Pendekatan Stem Dalam Pembelajaran Berbasis Masalah. *Prosiding Seminar Nasional Pendidikan IPA.*,207–213.

Scott, C.L. 2015a. The Futures of Learning 1: Why must learning content and methods change in the 21st century? UNESCO *Education Research and Foresight, Paris.* [ERF Working Papers Series, No. 13].

Snelson, C. (2017). Video production in content-area pedagogy: a scoping study of the research literature. *Learning, Media and Technology.* Department of Educational Technology, Boise State University, Boise, ID, USA

Stantchev, V. , Palacios, R.C., Acosta, P.S. , Misra, S. (2014). "Learning management systems and cloud file hosting services: A study on students' acceptance," *Computers in Human Behavior, pp.* Volume 31, 612–619

Stohlmann, M., Moore, T., & Roehrig, G.(2012).ConsiderationsforTeaching Integrated STEMEducation. *Journal of Pre-College Engineering Education Research ,2* (1).

van Laar,E., Deursen,A.J.A.M., van Dijk,J.A.G.M. and de Haan,J. (2020). Determinants of 21st-Century Skills and 21st-Century Digital Skills for Workers: *A Systematic Literature Review.* DOI: 10.1177/2158244019900176 journals.sagepub.com/home/sgo

Watson,W.R., Fang,J. (2012). PBL as a Framework for Implementing Video Games in the Classroom. USA: Purdue University. *International Journal of Game-Based Learning*

Zubaidah,S. (2016). Keterampilan Abad ke-21: Keterampilan yang Diajarkan Melalui Pembelajaran. *Jurusan Biologi – FMIPA – Universitas Negeri Malang*