Stimulating Students' Higher-Order Thinking Skills on Heat and Temperature Concepts

by Viyanti Viyanti

Submission date: 25-Jun-2020 02:44PM (UTC+0700)
Submission ID: 1349426740
File name: igher-Order_Thinking_Skills_on_Heat_and_Temperature_Concepts.pdf (444.53K)
Word count: 4403
Character count: 24459

JURNAL PEMBELAJARAN FISIKA

http://jurnal.fkip.unila.ac.id/index.php/JPF

Vol 7 (2), 2019, 103-112 ISSN: 2302-0105 (p); 2684-9828 (e)

Stimulating Students' Higher-Order Thinking Skills on Heat and Temperature Concepts

Indah Slamet Budiarti[1,2]*, Suparmi[2], Sarwanto[2], Harjana[2], Viyanti[3]

[1]Cendera[illegible]sih University, Jl. Raya Sentani Abepura Jayapura, Indonesia

[2]Sebelas Maret University, Jl. Ir. Sutami 36A Jebres Surakarta, Indonesia

[3]Lampung University, Jl. Prof. Dr. Ir. Sumantri Brojonegoro Kota Bandar Lampung, Indonesia

e-mail: indah_budiarti@yahoo.com

Received: December 4, 2019 *Accepted: December 30, 2019* *Published: December 31, 2019*

Abstract: The innovative way to improve the quality of human resources is elevated through education as one of the basic foundations of human life. Education is a booster to form ideas, express thoughts, share feelings, and live a life as an individual. Education is also a significant factor that can change society and give new color to the community. This study aims to describe the process of stimulating students' higher-order thinking skills in heat and temperature concepts. This research uses a descriptive method. The population in this study were high school students in Class XI in the city of Jayapura. The sampling technique in this study was purposive sampling so that a sample of 50 students was obtained. Research data collection using observation techniques and in-depth interviews. The results showed that students were able to build higher-order thinking skills by demonstrating cognitive activity focusing on the following processing classes: 63.7% of analysis skills, 23.9% of evaluation skills, and 12.4% of synthesis skills. These results represent the activity of the higher-order thinking skills stimulus process on heat and temperature concepts in learning. The process of this study could be functioned as an alternative strategy to encourage students to show the pattern of their higher-order thinking skills in the process of teaching and learning. These are important findings in this study.

Keywords: heat and temperature concepts, higher-order thinking skills, cognitive activity

DOI: http://dx.doi.org/10.23960/jpf.v7.n2.201907

INTRODUCTION

The emerging of various field transformations leads to the transition era of 21st century education. The stage of this transformation demands deeper knowledge and a higher level of understanding of the concepts in teaching and learning in order to promote the development of high-order thinking skills. One of the focus of 21st-century learning objectives is producing learners who are capable of global competitiveness. This can be accomplished by embedding learners and educators: an in-depth understanding of knowledge; problem-solving skills; and thinking critically, creatively, and an innovative way. In other words, learners are encouraged to develop their thinking skills to a higher level through innovative ways and integrated into one concept to another through the learning process.

The beginning of actual comprehensive changing in science education around the world is based on the view of constructivist theories. Constructivist theories explicitly direct the teacher to change their learning model by shifting the emphasis of learning from textbooks-centered and teacher-centered to become more broadly students-centered. Students need a higher level of study in which not only to memorize the learning-based exploration and research phenomenon (NRC, 1996). Constructivist theories stimulate students as learners to gain experience that enables them to build knowledge based on experience in order to promote higher-order thinking skills (Cobb, 1994).

The transformation is in line with expert opinion that promotes thinking skills to be the focus of educational objectives over the last few decades (Boddy, Watson, & Aubusson, 2003). As for some definitions of thinking skills according to experts: (1) Thinking skills are defined as cognitive abilities (Leou, Abder, Riordan & Zoller, 2006); (2) Thinking skills are an essential differentiating skill between lower-order thinking skills and higher-order thinking as the pattern shows students' ability in thinking of complex terms (Miller-Bolotin & Nashon, 2012); (3) Thinking skills cannot be defined, but the process of higher-order thinking skills can be recognized (Resnick, 1987). Related to that, higher-order thinking skills can be conceptualized as complex thinking to produce some problem-solving solutions. The high level of thinking skills referred to in this article is a skill that contains learners' learning experiences focusing on the stimulus process: analysis, evaluation, and synthesis (Wilks, 1995).

In contradiction, the fact found in the field based on pilot study and former research revealed that: (1) low-pitting ability affects the lack of student thought processes in the conventional learning process rather than inquiry-based learning process (Madhuri, Kantamreddi, & Prakash Goteti, 2012); (2) (ten Dam & Volman, 2004) The low readiness of students conducting investigations and examining troubleshooting alternatives is a situation that slows the student thought process and (3) (Fernandez, Holbrook, Naaman, & Coll, 2013) Quality of learning cannot be achieved because students as learners have a tendency to memorize concepts. Higher-order thinking skills are essentials in driving success in the modern life of students to be human as the initial step speeds up the complexity of learners' thinking. In addition to that higher-order thinking skills required learners to make rational decisions based on the contextual phenomena.

Physics as one of science learning objectives based on daily life is an important foundation to meet the needs of learning in the field of science. The objective of learning physics as science focuses on meaningful learning, where students can master the basic concepts of physics so that they can be used to probe and solve everyday problems. (Norris & Philips, 2012) revealed that the ability of learners to give arguments and explanations about the physics process is greatly emphasized in learning. Powered by (E. J. Lopez, Shavelson, Nandagopal, Szu, & Penn, 2014) that the development of structured knowledge becomes an important factor in determining students' ability to solve contextual and daily problems. But in fact, some studies revealed that the main problem of learners in physics learning is basic concepts of learning physics such as mechanics and also heat and temperature concepts (Burrows & Mooring, 2015; Cooper, Grove, & Underwood, 2010). In line with (Phang, Abu, Ali, & Salleh, 2012), the lack of basic concepts mastery learning own by students science learners influenced the ability to master and understand the other concepts which are more difficult such as modern physics. It also leads to an inability to solve problems. It is alarming because one of the 21st-century educational objectives depends on the successful development of mastery of basic concepts of physics. Therefore, it is necessary to emphasize activities that help students build an understanding of the various basic concepts of relevant physics to ensure that it stimulates students' higher-order thinking skills on heat and temperature concepts.

METHOD

The main focus of this research is students' higher-order thinking skills. This study aims to describe the process of stimulating students' higher-order thinking skills in heat and temperature concepts. The higher-order thinking skills stimulus has been done through the skills that contain learners' learning experiences in a high level of thinking which are the skills of analyzing, evaluating, and synthesizing (Wilks, 1995). To find out the focus of the analysis of the stimulus higher-order thinking skills, the qualitative descriptive method is used as a method for this research.

This research uses a descriptive method. The population in this study were high school students in Class XI in the city of Jayapura. The sampling technique in this study was purposive sampling so that a sample of 50 students of class XI in Jayapura senior high school in the academic year 2018/2019 was obtained. Research data collection using observation techniques and in-depth interviews. The research instruments used were essay tests with multiple options for heat and temperature concepts with a total of 10 questions. The test instrument was constructed based on skills that contain the complexity of learners' thinking. The test instrument was validated through empirical trial. Data analysis was done by scoring and calculating the percentage of learners who answer right and wrong. Scoring results are analyzed descriptively based on the following percentage interpretation: (1) Score is 0 if there is no student showed the pattern of thinking skills indicators; (2) Score is 1-25 if there is only a small part of the student showed the pattern of thinking skills indicators; (3) Score is 26-50 if there are half of the students showed the pattern of thinking skills indicators; (4) Score is 51-75 if there are more than half of students showed the pattern of thinking skills indicators; (5) Score is 76-99 if there are almost entirely students showed the pattern of thinking

skills indicators; and (6) Score is 100 if all students who participated as subjects in this study showed the pattern of thinking skills indicators.

RESULT AND DISCUSSION

The higher-order thinking skills are the process of students' thinking with higher cognitive order. The order is observed when learners are able to distinguish implicitly ideas or ideas that represent: the ability to analyze, evaluate, and synthesize. The ability of learners to distinguish the ideas that are trained in the probing and solving the problems are presented in Figure 1 for the process of analyzing (analysis skills), Figure 2 for the process of evaluating (evaluation skills), and Figure 3 for the process of synthesizing (synthesis skills). all of the three indicators have been explained in detail to show the pattern of students' higher-order thinking skills when understanding heat and temperature concepts.

The Process of Analyzing (Analysis Skills)

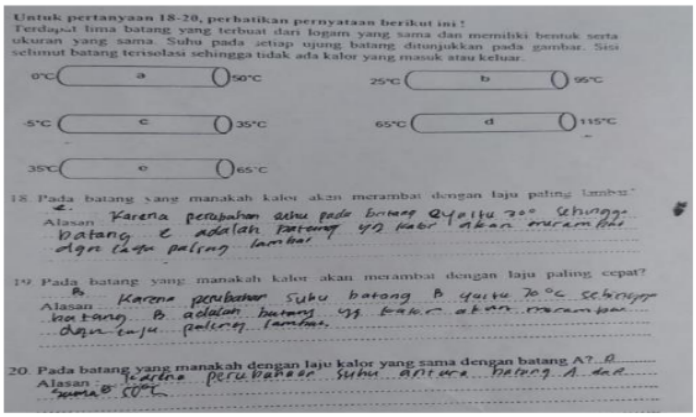

Figure 1. The process of stimulating students' analysis skills

Figure 1 shows the students' answer sheets in the process of analyzing. It represents students' analysis skills. The ability of students to analyze the problems presented by the teacher (e.g. *On which stem the heat will propagate at the slowest rate?*). The questions would have been triggering students' thinking skills of probing and solving the problem by analyzing the cases. Basically, students have been able to respond to problems by submitting answers on the answer sheet "*Due to changes in temperature on the stem e which is 30^0 so that the stem e is a heat rod that will propagate at the slowest rate"*. At this stage of learning, the teacher has managed to practice the ability to analyze to map the basic concepts of physics in the flow of thought with an image stimulus. The salient characteristics of the work of students describe organized knowledge and understand using knowledge effectively. Then, the pattern of students' analysis skills of thinking can be determined.

The stage of classifying and organizing information based on the question is presented by students on how students have been able to probe and map the problems.

Organizing students' knowledge is the basis for students' thinking skills to solve problems presented by the teacher. This is in line with the opinion of an expert (Yin, 2002) claiming students' responses as an adequate form for qualitative data acquisition. This result also is supported by the opinion of (Kurniati, Harimukti, & Jamil, 2016) that revealed the students' higher-order thinking skills occur in the learning process if students are able to relate new information they get to the information they already own and have in their memories from long term phase. Students are able to rearrange the information aimed at finding a solution to a situation that is difficult to solve. Higher-order thinking skills need to be trained in their use in the learning process to solve problems interrelated with one another. The skills of analysis owned by students illustrate that they already know to learn from experience. (Seng, 2007) revealed that learners' experiences as hard-thinking protocols are strategies that are widely used to study cognitive processes. (Bramwell-Lalor & Rainford, 2014) ensures that students are always motivated in building their cognitive levels.

Based on the results obtained in this study, there are 63.7% of students who are skilled at analyzing skills. Students were able to analyze the cases of the heated stem. Students mostly analyzed this problem using their abilities through daily observation in a heated spoon when eating hot soup. This finding is supported by the results of (Anggraini, Herlina, & Nyeneng, 2018). The results stated that students were able to analyze cases of heated metal-based tools because they obtain it every day.

The Process of Evaluating (Evaluation Skills)

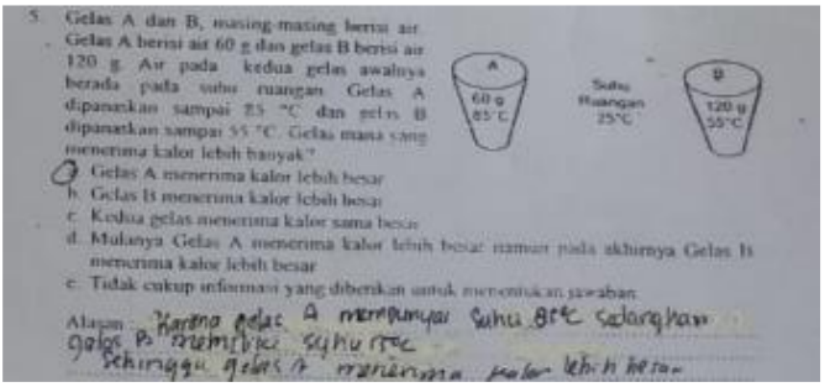

Figure 2. The process of stimulating students' evaluation skills

Figure 2 shows the students' answer sheets in the process of evaluating. It represents students' evaluation skills. The process of students evaluating problems in achieving learning outcomes is reflected through the case of heat in the glass. The activities of evaluating students begin with the problems presented by the teacher (e.g. *Glass A and B both contain water on certain volume. Glass A contains 60 grams of water and glass B contains 120 g of water. Water on both glasses is originally stored at room temperature. Then, the A glass is heated to 85^{0}C and the B glass is heated to 55^{0}C. Which glasses are received more heat than another?*). The problems presented by the teacher have trained the skills of evaluating. Evaluating activities is the process

of accessing the knowledge that is distributed evenly in the glass which at the time of completing it requires centralized knowledge. Therefore, the learning experience that is packaged in the form of a problem is very affecting the high level of thinking skills of learners. It can be seen from the response given to students "*Glass A received a larger heat by reason because glass A has a temperature of 85^{0}C while the B glass has a temperature of 55^{0}C so that the glass A has a larger heat*".

Students have been learning about the concept of sustainability on the equilibrium of state. Students have as a record in learning physics that is capable of encouraging learners integrally affects the ability to think in higher-order of forming and resolving the problems given. The evaluation activities translated in the form of problems in Figure 2 are able to develop the concept to a higher level of thinking so that students can develop their skills. (Bramwell-Lalor & Rainford, 2014) reveals that analysis, evaluation, and synthesis will be considered higher-order thinking skills, as are other examples of such skills include: tiered questions, decision-making, and critical and systemic thought. (Burrows & Mooring, 2015) found that students who understood the concept better demonstrated a higher concept of conception. It is also reflected in the completion of the evaluation problem presented by learners in the answer sheet as seen in Figure 2. Evaluation thinking skills can be learned and enhanced through the process of learning physics as science as stated by (Priyaadharshini & Vinayaga Sundaram, 2018). It is because learning physics as a part of science develop a sense of curiosity and a critical attitude towards natural phenomena happened in daily life. It is recognized by (E. Lopez et al., 2011) that the students who have mastered the concepts can clearly and precisely solve the problem in the question.

Based on the results obtained in this study, there are 23.9% are skilled at evaluating skills. Students can evaluate heat in the different glass based on their temperature. It is caused by their observation through contextual phenomena about glass filled with hot water and glass filled with cold water. Both have different heat because of energy balancing between the glasses filled with water and the environment surroundings. This finding is supported by (Pertiwi, Suyatna, & Suyanto, 2019) that stated students were having critical thinking skills to support analyzing problems they face every day.

The Process of Synthesizing (Synthesis Process)

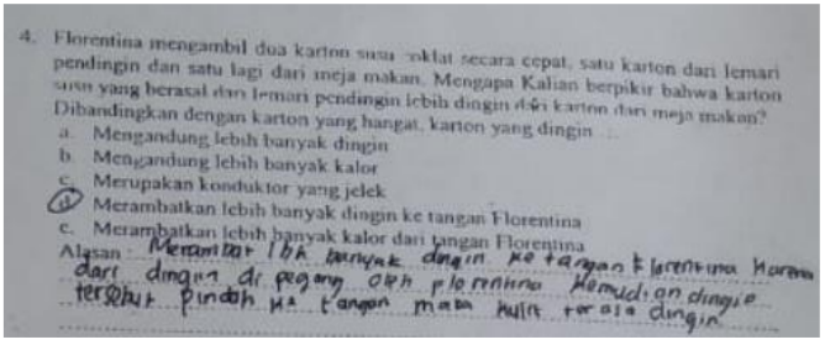
4. Florentina mengambil dua karton susu coklat secara cepat, satu karton dari lemari pendingin dan satu lagi dari meja makan. Mengapa Kalian berpikir bahwa karton susu yang berasal dari lemari pendingin lebih dingin dari karton dari meja makan? Dibandingkan dengan karton yang hangat, karton yang dingin
a. Mengandung lebih banyak dingin
b. Mengandung lebih banyak kalor
c. Merupakan konduktor yang jelek
d. Merambatkan lebih banyak dingin ke tangan Florentina
e. Merambatkan lebih banyak kalor dari tangan Florentina
Alasan : Merambat lbh banyak dingin ke tangan Florentina karena dari dingin di pegang oleh florentina kemudian dingin tersebut pindah ke tangan mana kulit terasa dingin

Figure 3. The process of stimulating students' synthesis skills

Figure 3 shows the students' answer sheet in the process of evaluating. It represents students' evaluation skills. The learners' process achieving learning outcomes effectively with the stimulus of synthesizing skills. Higher-order thinking skills are closely related to understanding, where students can apply what they have learned in the context of a new situation (Novak, 2019). Related to this is the required presentation of the problem by the teacher who explicitly describes the skills of the synthesize (e.g. *Florentina took two cardboard chocolate milk rapidly one carton comes from the refrigerator and another from the table packed. Why do you think that the milk carton that comes from the fridge is cooler than the carton from the dining table?*). The problems presented by the teacher as a facilitator to research-based exploration activities based on real-world phenomena. This problem is very appropriate in order to develop the basic concept of physics to ensure that students have successfully developed their knowledge so that students' higher-order thinking skills can be elevated. According to (Krathwohl, 2002), it is important to stimulate students' cognition to the highest levels (creating levels), but the mastery of basic concepts is also necessary to propagate the higher concepts. Basic concepts must be understood first before students jump into the higher concepts.

The part of the process in synthesizing solutions to the problems given the successful students do that lead to the process of solving the problem of "*It is cooler to the hands of Florentina because of the cold held by Florentina then cold moved to the hand then skin feels cold already*". The students' statement on the answer sheet illustrates that there are different forms of higher-order thinking skills of students that have been implemented. This means that students have been able to understand the basic concept of heat transfer with the application of taking milk cartons from inside the refrigerator. The students know there is freon as it is a kind of volatile substances due to low air pressure. The mechanism of action in the role of freon in a refrigerator is done by taking the heat stored in a freezer. Consequently, the freezing space becomes cold. This is similar to the phenomenon of taking the milk cartons that have been stored from the refrigerator and placed in our hands the object quickly evaporates while taking the heat from our hands, consequently, the hand becomes feeling cold. Taking into consideration that the skills presented by learners have focused on identifying the extent to which the presented problems have been well solved by students in order to promote the development of higher-order thinking skills. Moreover, the process of cognitive activity presented by students is able to describe the ability to compare students, building arguments is an example of developing a high level of skills with the stimulus of synthesizing problems. (Krathwohl, 2002) defines the level of analytical cognition, synthesis, and evaluation as a category of higher-order thinking skills to demonstrate more complex cognitive activity compared the level of knowledge, understanding, and application. In line with the opinion that the ability to solve problems think creatively and critically, and the ability to ask questions about the value of higher-order thinking skills highlighted by (Heong et al., 2012).

Based on the results obtained in this study, there are 12.4% are skilled in synthesis skills. Students who are able to do these skills tend to always have a lot of ideas and they are going to use the ideas in probing and solving problems. Based on the finding, it can be seen that students' attempts to suggest ideas to solve the problems given were obtained. This finding also is supported by the research results of

(Anggistia, Suyanto, & Nyeneng, 2018) that stated students have mastered synthesis skills if they could suggest ideas to solve problems using various representations.

CONCLUSION

The conclusion of this study is that students have been able to build higher-order thinking skills by showing cognitive activity focused on classifying the following processes: 63.7% of students are skilled at analyzing, 23.9% are skilled at evaluating and 12.4% are skilled at synthesis. These results represent that the activity of stimulating higher-order thinking skills temperature and heat material in learning as an alternative strategy encouraging students to think in the learning process becomes an important finding to the education field and also future research.

ACKNOWLEDGMENT

The author would like to acknowledge and thank the supporting roles in this research: Drs. La Junaidi, M.Pd.Si. and Iriani Tambay, S.Pd. as fellow physics teachers in SMAN 1 Jayapura, Dephy Megawati, S.Pd. as a fellow physics teacher in SMAN 4 Jayapura, and Waris Irianti, S.Pd. as a fellow physics teacher in SMA Yapis Pembangunan V Jayapura.

REFERENCES

Anggistia, D., Suyanto, E., & Nyeneng, I. D. P. (2018). Pengaruh Model Pembelajaran Berbasis Masalah Terhadap Hasil Belajar Fisika Siswa SMA. *Jurnal Pembelajaran Fisika*, *6*(1). https://doi.org/10.1017/CBO9781107415324.004

Anggraini, R., Herlina, K., & Nyeneng, I. D. P. (2018). Desain LKPD Berbasis Scientific Approach Untuk Melatih Keterampilan Berpikir Kreatif Siswa Pada Materi Suhu dan Perubahannya : Penelitian Pendahuluan. *Jurnal Pembelajaran Fisika*, *6*(2).

Boddy, N., Watson, K., & Aubusson, P. (2003). A trial of the Five Es: A referent model for constructivist teaching and learning. *Research in Science Education*, *33*(1), 27–42. https://doi.org/10.1023/A:1023606425452

Bramwell-Lalor, S., & Rainford, M. (2014). The Effects of Using Concept Mapping for Improving Advanced Level Biology Students' Lower- and Higher-Order Cognitive Skills. *International Journal of Science Education*, *36*(5), 839–864. https://doi.org/10.1080/09500693.2013.829255

Burrows, N. L., & Mooring, S. R. (2015). Using concept mapping to uncover students' knowledge structures of chemical bonding concepts. *Chemistry Education Research and Practice*, *16*(1), 53–66. https://doi.org/10.1039/c4rp00180j

Cobb, P. (1994). Constructivism in Mathematics and Science Education. *Educational Researcher*, *23*(7), 4. https://doi.org/10.3102/0013189X023007004

Cooper, M. M., Grove, N., & Underwood, S. M. (2010). Lost in Lewis Structures: An Investigation of Student Difficulties in Developing Representational Competence -

Journal of Chemical Education (ACS Publications and Division of Chemical Education). *Journal of Chemical Education*, *87*(8), 869–874. Retrieved from http://pubs.acs.org/doi/abs/10.1021/ed900004y%5Cnpapers3://publication/uuid/0110294F-D726-4B72-B74D-5680BE706928

Fernandez, C., Holbrook, J., Naaman, R. M., & Coll, R. K. (2013). How to Teach Science in Emerfing and Developing Environment. In *Teaching Chemistry - A Studybook* (pp. 299–326). United States: Sense Publishers.

Heong, Y. M., Yunos, J. M., Othman, W., Hassan, R., Kiong, T. T., & Mohamad, M. M. (2012). The Needs Analysis of Learning Higher Order Thinking Skills for Generating Ideas. *Procedia - Social and Behavioral Sciences*, *59*, 197–203. https://doi.org/10.1016/j.sbspro.2012.09.265

Krathwohl, D. R. (2002). A Revision of Bloom's taxonomy: An Overview. *Theory Into Practice*, *41*(4), 352. Retrieved from http://books.google.com/books?id=JPkXAQAAMAAJ&pgis=1

Kurniati, D., Harimukti, R., & Jamil, N. A. (2016). Kemampuan Berpikir Tingkat Tinggi Siswa Smp Di Kabupaten Jember Dalam Menyelesaikan Soal Berstandar Pisa. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *20*(2), 142. https://doi.org/10.21831/pep.v20i2.8058

Leou, M., Abder, P., Riordan, M., & Zoller, U. (2006). Using "HOCS-centered learning" as a pathway to promote science teachers' metacognitive development. *Research in Science Education*, *36*(1–2), 69–84. https://doi.org/10.1007/s11165-005-3916-9

Lopez, E. J., Shavelson, R. J., Nandagopal, K., Szu, E., & Penn, J. (2014). Ethnically diverse students' knowledge structures in first-semester organic chemistry. *Journal of Research in Science Teaching*, *51*(6), 741–758. https://doi.org/10.1002/tea.21160

Lopez, E., Kim, J., Nandagopal, K., Cardin, N., Shavelson, R. J., & Penn, J. H. (2011). Validating the use of concept-mapping as a diagnostic assessment tool in organic chemistry: Implications for teaching. *Chemistry Education Research and Practice*, *12*(2), 133–141. https://doi.org/10.1039/c1rp90018h

Madhuri, G. V., Kantamreddi, V. S. S. N., & Prakash Goteti, L. N. S. (2012). Promoting higher order thinking skills using inquiry-based learning. *European Journal of Engineering Education*, *37*(2), 117–123. https://doi.org/10.1080/03043797.2012.661701

Milner-Bolotin, M., & Nashon, S. M. (2012). The essence of student visual-spatial literacy and higher order thinking skills in undergraduate biology. *Protoplasma*, *249*(SUPPL. 1), 25–30. https://doi.org/10.1007/s00709-011-0346-6

Norris, S. P., & Philips, L. M. (2012). Reading Science: How a naive view hinders so much else. In *Metacognition in science education: Trends in current research* (pp. 37–56). https://doi.org/10.1017/CBO9781107415324.004

Novak, J. D. (2019). Enhancing Critical Thinking using LCDS-Based Interactive Electronic School Book in Physics. *Jurnal Pembelajaran Fisika*, *7*(1), 7–18.

https://doi.org/10.5860/choice.36-1103

NRC, N. R. C. (1996). *National Science Education Standards* (Vol. 26). Washington, DC: National Academy.

Pertiwi, D., Suyatna, A., & Suyanto, E. (2019). Enhancing Critical Thinking using LCDS-Based Interactive Electronic School Book in Physics. *Jurnal Pembelajaran Fisika*, *7*(1), 7–16.

Phang, F. A., Abu, M. S., Ali, M. B., & Salleh, S. (2012). Faktor penyumbang kepada kemerosostan pelajar dalam aliran sains: satu analisis sorotan tesis. *Eprints Utm*, 17.

Priyaadharshini, M., & Vinayaga Sundaram, B. (2018). Evaluation of higher-order thinking skills using learning style in an undergraduate engineering in flipped classroom. *Computer Applications in Engineering Education*, *26*(6), 2237–2254. https://doi.org/10.1002/cae.22035

Resnick, L. B. (1987). Education and Learning to Think. In *Education and Learning to Think*. https://doi.org/10.17226/1032

Seng, G. H. (2007). The Effects of Think-Aloud in a Collaborative Environment to Improve Comprehension of L2 Texts. *The Reading Matrix*, *7*(2), 29–45.

ten Dam, G., & Volman, M. (2004). Critical thinking as a citizenship competence: Teaching strategies. *Learning and Instruction*, *14*(4), 359–379. https://doi.org/10.1016/j.learninstruc.2004.01.005

Wilks, S. (1995). *Critical & Creative Thinking: Strategies for Classroom Inquiry*. University of Virginia: Pearson Education.

Yin, R. K. (2002). *Case Study Research Design and Methods* (Third Edit). UK, London: Sage Publications.

Stimulating Students' Higher-Order Thinking Skills on Heat and Temperature Concepts

ORIGINALITY REPORT

18%	13%	14%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	pubs.rsc.org Internet Source	5%
2	worldwidescience.org Internet Source	2%
3	jurnal.fkip.unila.ac.id Internet Source	1%
4	Submitted to UIN Sunan Gunung DJati Bandung Student Paper	1%
5	Intan Baizura Abd Ghani, Nor hasniza Ibrahim, Noraffandy Yahaya, Johari Surif. "Enhancing students' HOTS in Laboratory Educational Activity by using Concept Map as an Alternative Assessment Tool", Chem. Educ. Res. Pract., 2017 Publication	1%
6	link.springer.com Internet Source	1%
7	www.science.gov	

	Internet Source	1%
8	Submitted to Universiti Teknologi MARA Student Paper	1%
9	Submitted to University of Warwick Student Paper	<1%
10	Petronela Agata Moong, Chandra Sundaygara, Hena Dian Ayu. "PENGARUH MODEL PEMBELAJARAN MEA DENGAN METODE SCAFFOLDING TERHADAP PENGUASAAN KONSEP FISIKA DITINJAU DARI SRL", Jurnal Pendidikan Fisika, 2020 Publication	<1%
11	Submitted to University of Stellenbosch, South Africa Student Paper	<1%
12	Adrian Sin Loy Loh, R. Subramaniam. "Mapping the knowledge structure exhibited by a cohort of students based on their understanding of how a galvanic cell produces energy", Journal of Research in Science Teaching, 2018 Publication	<1%
13	www.bioinformation.net Internet Source	<1%
14	garuda.ristekdikti.go.id Internet Source	<1%

15	jurnal.uns.ac.id Internet Source	<1%
16	Rizki Hegia Sampurna. "Accommodating Religious Practices in the Workplace: The Case of Indonesian Workers in Taiwan", Society, 2019 Publication	<1%
17	Zahrotun Nafi'ah, Vita Ria Mustikasari, Novida Pratiwi. "Pengembangan instrumen tes two-tier multiple choice untuk mengukur kemampuan berpikir tingkat tinggi peserta didik SMP pada materi suhu dan kalor", JIPVA (Jurnal Pendidikan IPA Veteran), 2019 Publication	<1%
18	W Prawita, B A Prayitno, Sugiyarto. "Students' profile about analytical thinking skill on respiratory system subject material", Journal of Physics: Conference Series, 2019 Publication	<1%
19	Ken Nee Chee, Noraffandy Yahaya, Nor Hasniza Ibrahim. "Factors of students' performance based on cognitive level in a mobile learning environment", International Journal of Mobile Learning and Organisation, 2018 Publication	<1%
	Submitted to CSU Northridge	

20	Student Paper	<1%
21	www.ijrte.org Internet Source	<1%
22	files.eric.ed.gov Internet Source	<1%
23	Submitted to Walden University Student Paper	<1%
24	studentsrepo.um.edu.my Internet Source	<1%
25	Emerging Technologies for STEAM Education, 2015. Publication	<1%
26	"The Palgrave Handbook of Critical Thinking in Higher Education", Springer Science and Business Media LLC, 2015 Publication	<1%
27	"Teaching Chemistry – A Studybook", Springer Nature, 2013 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		