03-2020

by Adam Malik

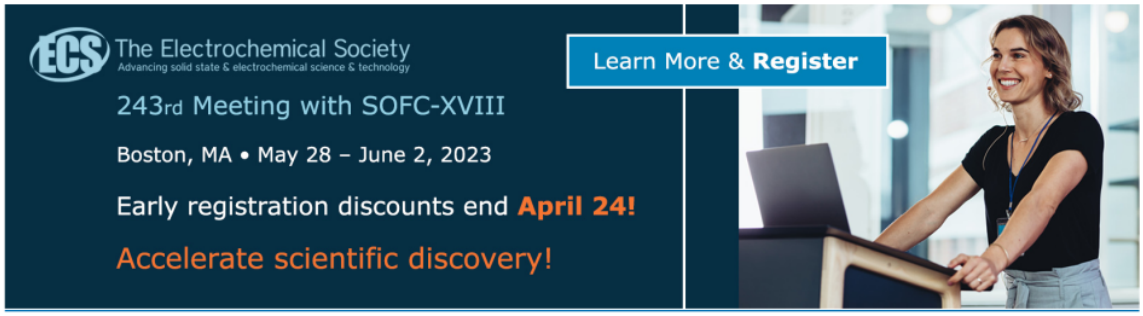
Submission date: 08-Apr-2023 10:01AM (UTC+0700)
Submission ID: 2058785466
File name: 03_Prosiding_Internasional_Dr._Adam_Malik,_M.Pd.pdf (879.5K)
Word count: 3797
Character count: 20227

Journal of Physics: Conference Series

PAPER · OPEN ACCESS

Optimizing students critical thinking skills related to heat topics through the model of content, context, connection, researching, reasoning, reflecting (3C3R)

To cite this article: A Malik *et al* 2020 *J. Phys.: Conf. Ser.* **1521** 022001



Optimizing students critical thinking skills related to heat topics through the model of content, context, connection, researching, reasoning, reflecting (3C3R)

A Malik[1*], Y Yuliani[1], C Rochman[1], R Zakwandi[1], A Ismail[2], and M Ubaidillah[3]

[1]Pogram Studi Pendidikan Fisika, Universitas Islam Negeri Sunan Gunung Djati, Jl. A. H Nasution No. 105, Bandung 40614, Indonesia
[2]Pogram Studi Pendidikan Fisika, Institut Pendidikan Indonesia, Jl. Pahlawan No. 32, Garut 44151, Indonesia
[3]Tadris Biologi, IAIN Syekh Nurjati Cirebon, Jl. Perjuangan Sunyaragi, Kesambi, Cirebon 45131, Indonesia

[*]coresponding author's email: adammalik@uinsgd.ac.id

Abstract. The purpose of this study was to determine the implementation of learning by using the 3C3R model and improving students' critical thinking skills on the topic of heat. The population of this study was all class X of SMAN 25 Bandung, amounting to six classes, the sample was class X MIA6. Sampling used a simple random sampling technique. The research method used a pre-experimental method with a one-group pretest-posttest research design. Data on the results of the implementation of learning with the 3C3R model were obtained from the observation sheet and critical thinking skills of the students' using essay. The results showed that the average teacher activity was 98.23% with a good category, while the average activity of students was 88.93% in the good category. In addition, there was an increase in students' critical thinking skills in the heated topic with an N-gain value of 0.65 in the medium category. The results of the hypothesis test show that t-count > t-table (17.25 > 2,045). Thus, there is an increase in students' critical thinking skills after applying the 3C3R model to the topic of heat.

1. Introduction

One of the goals of physics in high school is so that students are able to master the knowledge, concepts, and principles of physics and have the skills to develop knowledge, which can be applied in everyday life and as a provision to continue education at a higher level. Students are directed to be critical of natural phenomena that occur around them and creatively solve every problem related to the phenomenon [1]. Thus, physics learning can actually hone the process of complex thinking skills.

Complex thinking is called a high-level thinking process that consists of critical thinking, creative thinking, problem-solving, and decision making [2]. One of the drivers of the advancement of education is to involve critical thinking in learning [3]. Based on the results of preliminary studies through interviews with teachers and students, learning observations and students' Critical Thinking Skills (CTS) test shows that so far teacher-centered learning is monotonous, students lack focus in learning, student curiosity still needs to be explored, active in learning is only dominated by a number

of students and the results of the KBK test students show that the average is still low at 41% in the heat topic.

One solution to improve students CTS, the Content, Context, Connection, Researching, Reasoning, Reflecting (3C3R) model is a learning model that is oriented to the Problem Based Learning (PBL) approach which has two components, namely core components and processing components. The core components consist of Content, Context, and Connection. This 3C component relates to the content or concept of learning that will be processed by the 3R processing component which consists of Researching, Reasoning, and Reflecting that supports the cognitive process of problem solving and thinking skills possessed by students [4]. The use of the 3C3R model is considered appropriate because this learning model can stimulate students to use their thinking skills and to understand the concepts learned [5].

Learning model Content, Context, Connection, Researching, Reasoning, Reflecting (3C3R) is a new innovation in the Problem Based Learning. 3C3R has a conceptual framework for design problems in the form of model 3C3R theory, focusing on two aspects of the design [4, 6].

The critical thinking is to analyze arguments and generate insight into each meaning and interpretation, to develop a cohesive and logical pattern of reasoning, understanding the assumptions and biases underlying each position. Finally, it can provide a reliable, concise and convincing presentation model. The critical thinking is not just logical thinking because critical thinking must have confidence in values, rationale, and belief before logical reasons can be obtained from it [7]. Critical thinking skills developed to refer the indicators put forward by Ennis [8], namely: provide a simple explanation; build basic skills; conclude; make further explanations; strategies and techniques.

Based on several previous studies, it was shown that learning using the 3C3R model could improve students' critical thinking skills [9], students' problem-solving skills [10, 11], improve student abilities [12], and student learning outcomes [4]. improve. This research is different from previous research, the application of the 3C3R model is expected to improve students' critical thinking skills on the topic of heat. Besides, the implementation of the 3C3R model at each learning meeting was analyzed using an observation sheet by the observer. The purpose of this study was to determine the implementation of the 3C3R learning model and its effect on improving students' critical thinking skills on hot topics.

2. Methods

This study used the pre-experimental method with the design of one group pretest-posttest. The selected population is all students of class X SMAN 25 Bandung which consists of six classes, with a simple random sampling technique, selected a sample of X MIA 6 with a total of 37 people. Before being treated, students were given a pretest question in the form of a description of ten questions first to find out the students' initial critical thinking skills in the heat topic. Then the sample was treated in the form of a 3C3R model application. After learning is complete, posttest is given to find out the improvement of students' thinking skills before and after being given treatment.

Before the pretest and posttest questions are used for research, the questions are analyzed first from the aspects of validity, reliability, level of difficulty and distinguishing power. Test results show the level of validity of categorized questions is high. The reliability level of the questions shows a high category. The difficulty test results showed eight medium categorized questions and three easy categorized questions. The result of distinguishing power shows two questions with good distinguishing power, five questions with sufficiently distinguishing power, and three questions with poorly distinguishing power. Students' Critical Thinking Skills (CTS) improvement was obtained from the average gain normalized <g> . The equation to calculate the average gain normalized <g> was presented in equation (1) [13].

$$< g >= \frac{< S_{post} > - < S_{pre} >}{< S_{maks} > - < S_{pre} >} \quad (1)$$

The results of the CTS pretest and posttest of students were tested for normality and hypothesis testing. During the learning activities, the activities of teachers and students were observed by observers, with the aim of knowing the implementation of the 3C3R model.

The study conducted three repetitions with a learning duration of 135 minutes. The first meeting discusses the topic of temperature and expansion, the second meeting discusses the topic of heat and the Black principle, and the third meeting discussed the heat transfer. Each meeting is conducted three stages of learning which are opening activities, main activities and closing activities. Implementation of the 3C3R model is implemented in a series of main learning activities. The implementation of 3C3R model learning was observed by the observer using the observation sheet. How to fill in the observation sheet of each meeting by putting a checklist (√) in the "Yes" or "No" column. For the "Yes" column, there are three categories of value choices, 3, 2, and 1. If column 3 is selected, the value is good, if column 2 is good enough, and if column 1 is less good. As for the "No" column, the value is 0. The next steps are as follows: 1) Calculate the total score of teacher and student activity scores that have been obtained; 2) Change the number of scores that have been obtained to be a percentage value; 3) Categorizing the percentage achieved with criteria consisting of 33 <value ≤ 55 (not good); 56 <value ≤ 77 (good enough); 78 <value ≤ 100 (Good).

3. Result and Discussion

Implementation of the 3C3R model

Based on the results of the implementation analysis using the learning model Content, Context, Connection, Researching, Reasoning, Reflecting (3C3R) from each meeting experienced an increase. As for each increase can be seen in Table 1.

Table 1. Implementation of learning every meeting

Meeting	Average value of activity implementation (%)		Category
	Teacher	Student	
1st meeting (temperature and expansion)	96.03	80.57	Good
2nd meeting (heat and the Black principle)	99.16	90.88	Good
3rd meeting (heat transfer)	99.50	95.35	Good
Average	98.23	88.93	Good

The average teacher activity was 98.23% and 88.93% of students with the implementation category were good. This shows that the implementation of the teacher and students at each stage of the overall data is well implemented [14].

From the data from the observation of teacher and student activities, it shows that at the first meeting most students have not been able to learn actively, either in the stages of researching, reasoning, or in presentation and responding activities. The teacher becomes difficult in giving instructions for changing the stages of learning carried out. Students have not been able to complete the task on time. The learning situation is still familiar with the learning model that is more teacher-centered and unfamiliar with the 3C3R model that is applied.

The activities of teachers and students at the second meeting showed an increase. Students begin to be active in learning both at the stages of researching, reasoning, or reflecting. But there is an obstacle at the stage of reasoning connection that is where students do experiments. Teachers have difficulty in the trial activities because each group needs more guidance from the teacher regarding the experiments conducted so that at the second meeting the learning time is almost insufficient. However, learning activities at the second meeting as a whole improved well.

At the third meeting, the activities of students were increasingly active when learning took place. Students are familiar with using the 3C3R model. They have understood every step done. Students at the researching stage are very active in seeking information, the reasoning stage has been able to analyze various phenomena in everyday life or from direct observation after the experimental activities. Students show high curiosity so learning takes place very interactively. Overall student activity improved well. In addition, the 3C3R learning model has advantages that can train students to find out (researching), sharpen reasoning (reasoning), and communicate (reflecting) both in terms of content, context, or connection.

The implementation of teacher and student activities at each stage of the 3C3R model is shown in Figure 1.

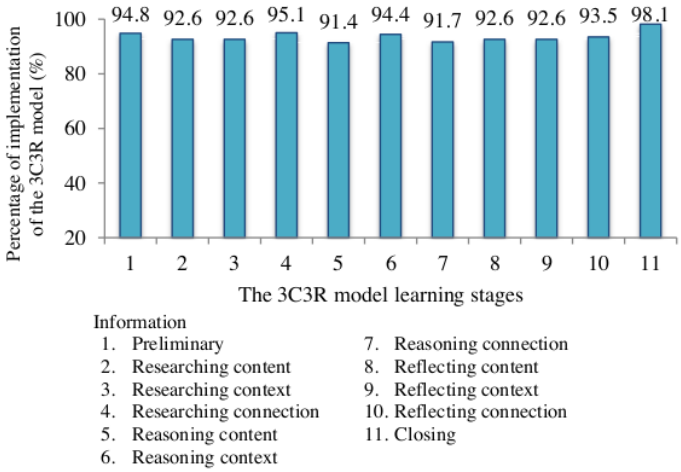


Figure 1. Implementation of learning in each stage of the 3C3R model

The stage that reaches the highest value is the stage of researching connection and at the stage of reasoning, content gets the lowest value. At the stage of the researching connection, each meeting students are trained to find information from the demonstrations conducted by the teacher. From the demonstrations they observed, students must be skilled in giving conclusions by connecting the content and context they have found. When the demonstration about heat material, students are more enthusiastic in this learning phase. One of the factors that support the success of learning in improving critical thinking skills, students should be active and directly involved in the teaching and learning process. In line of opinion in states that skills that are repeatedly trained will become habitual or automatic [15].

Students at the content reasoning stage are expected to have the ability to analyze problems related to heat material contained in the student activity sheet. Students tend to discuss the problem more jokingly and there are some students who do not involve themselves actively in discussion activities. As a result learning at this stage is carried out with a low value. In other states that learning is an active process so that if students are not involved in various learning activities like students' responses to teacher stimuli, it is impossible for students to achieve good learning outcomes [16].

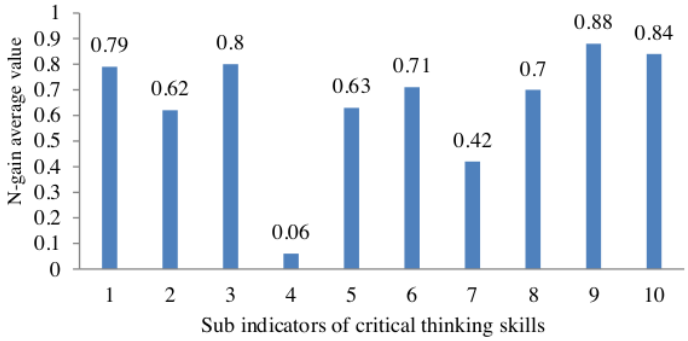
Some obstacles encountered in learning when applying the 3C3R model. First, the 3C3R learning model has many stages so it is difficult to instruct each stage to students. Second, students are not accustomed to implementing learning with discussion and practicum methods but are familiar with the lecture method so that students need more time to discuss problem-solving and laboratory.

3. 2. Improving student's critical thinking skills

Improvement of students' critical thinking skills in heat material based on the results of the pretest a posttest was 27.67 with the average pretest and posttest respectivel 4.00 and 81.67. The value of N-gain of students' critical thinking skills obtained at 0.65 is included in the medium interpretation [17].

Based on the results of statistical analysis of pretes data with normal and posttest distributions normally distributed so that the hypothesis test uses the t-test the significance level α = 5%. Hypothesis test results show t-count = 17.25 > t-table = 2.045, it can be concluded that there is an inc ase in students' thinking skills after the 3C3R model is applied to the heat topic.

The improvement of students' critical thinking skills is because the 3C3R model has advantages that support critical thinking skills, namely the 3C3R process component which consists of researching, reasoning, and reflecting. During the learning process students are trained to look for information in terms of content, context, and connection actively then use their reasoning to solve each problem. Learning is done independently and in groups, where students are trained to learn independently first then join groups to jointly solve problems. Improving students' critical thinking skills in each sub-indicator is shown in the following Figure 2.



Information:
1. Analyzing arguments
2. Ask questions and answer challenging questions
3. Consider the credibility of a source
4. Observing and considering the results of observations
5. Induces and considers the results of induction
6. Make and consider the value of the decision
7. Define terms and consider definitions
8. Identifying assumptions
9. Determine actions
10. Interacting with other people

Figure 2. Increased every sub critical thinking skill

The sub-indicator of critical thinking skills which has the lowest N-gain value is observing and considering the results of the low category observation of 0.06. This is because students do not have the desire to think further about the results of observations that have been made. Students are said to think critically if they have tried to analyze the argument carefully, look for valid evidence, and produce objecti conclusions to be trusted and used as a basis for doing something [18-21].

The highest N-gain value of 0.88 is found in the sub-indicators of critical thinking determining the action. This is because, at each meeting, students are trained to find information and sharpen their reasoning for everyday events related to the learning material being studied. Students do not feel alienated when given questions to find solutions to events that occur in everyday life related to heat material. Learning will be meaningful for students if they actively interact with concrete objects. This is in agreement with Santoso [15] stating that learning with the development of direct experience and

real conditions will produce memorable and long-lasting knowledge. Thus, it is expected that physics learning will be more meaningful.

4. Conclusion

We have succeeded in conducting research on the application of the Content, Context, Connection, Researching, Reasoning, Reflecting (3C3R) models to improve students' thinking skills related to the topic of heat. The results showed that the implementation of the 3C3R model at each meeting was carried out well and experienced an increase. The average teacher activity is 98.23% with a good category, and the average activity of students is 88.93% in the good category. There was an increase in critical thinking skills students after applying 3C3R models in heat topic. The overall N-Gain value of 0.65 is included in the medium category. Thus the application of the 3R3C model can improve students' high-level thinking skills and can be applied to other physics topics.

5. References

[1] Qian M and Clark K R 2016 Game-based Learning and 21st century skills: A review of recent research *Comput. Human Behav* **63** pp 50–58
[2] Korkmaz Ö, Çakir R and Özden M Y 2017 A validity and reliability study of the computational thinking scales (CTS) *Comput. Human Behav* **72** pp 558–569
[3] Marni S and Harsiati T 2019 Critical Thinking Patterns of First-Year Students in Argumentative Essay *Journal for the Education of Gifted Young Scientists* **7** pp 683-697
[4] Hung W 2006 *The 3C3R Model: A Conceptual Framework for Designing Problems in PBL* (Carolina: IJPBL)
[5] Hung W 2009 The 9-*Step Problem Design Process for Problem-Based Learning: Application of the 3C3R Model* (Dakota: Elsevier)
[6] Hung W 2015 Problem-based learning: Conception, practice, and future. In Authentic problem solving and learning in the 21st century *Springer* pp 75–92
[7] Cottrell S 2017 *Critical Thinking Skills: Effective Analysis, Argument and Reflection* (Macmillan: Red Globe Press)
[8] Ennis R H 1991 An elaboration of a cardinal goal of science instruction *Educationa Philosophy and Theory* **23** pp 31-34
[9] Bueno P M, Rivas S F and Saiz C 2015 Critical thinking skills assessment with pencrisal test in a hybrid approach to PBL in E.de Graaff, Guerra A, Kolmos A and Arexolaleiba N A (Eds.) *Global Research Community: Collaboration and Developments* (pp 213-222) Denmark: Aalborg Universitetsforlag
[10] Astari W Y, Santyasa W and Artawan P 2014 The Effects of 3C3R-problem based learning towards the science (physics) problem solving skill at grade viii students of a SMPN in academic year 2013/2014 *Jurnal Pendidikan Fisika Undiksha* **1**
[11] Othman H, Salleh B M, Sulaiman A and Konting M 2014 3C3R model and malaysian experience in training of trainers for problem-based learning *Pensee Journal* **76** pp 53-68
[12] Tawfik A A, Trueman R J and Lorz M M 2013 Designing a PBL environment using the 3C3R method *Int. J. Des. Learn* **4** pp 11-24
[13] Cheng K K, Thacker B A, Cardenas, R L and Crouch C H 2004 Using online homework system enhances students learning of physics concepts in an introductory physics course *Am. J. Phys*. **72** pp 1447–1453
[14] Astra I M 2018 Character building in physics learning for Indonesia children *J. Phys. Conf. Ser*., **1040** 012043
[15] Thrailkill E A, Trask S, Vidal P, Alcalá J A and Bouton M E 2018 Stimulus control of actions and habits: A role for reinforcer predictability and attention in the development of habitual behavior *J. Exp. Psychol. Anim. Learn. Cogn* **44** pp 370
[16] Wlodkowski R J and Ginsberg M B 2017 *Enhancing Adult Motivation to Learn: A Comprehensive Guide for Teaching All Adults* (New Jersey: John Wiley & Son)

[17] Serevina V 2018 Development of e-module based on problem based learning (pbl) on heat and temperature to improve student's science process skill *Turkish Online J. Educ. Technol* **17** pp 26–36
[18] Abrami P C, Bernard R M, Borokhovski E, Waddington D I, Wade C A and Persson T 2015 Strategies for teaching students to think critically: A meta-analysis *Rev. Educ. Res* **85** pp 275–314
[19] Bernal D D 2002 Critical race theory, latino critical theory, and critical raced-gendered epistemologies: Recognizing students of color as holders and creators of knowledge *Qual. Inq.* **8** pp 105–126
[20] Reinharz S 2017 *On Becoming a Social Scientist: From Survey Research and Participant Observation to Experimental Analysis* (New York: Routledge)
[21] Tiruneh D T, Verburgh A and Elen J 2014 Effectiveness of critical thinking instruction in higher education: A systematic review of intervention studies *High. Educ. Stud.* **4** pp 1–17

Acknowledgement
The researcher expressed his gratitude to the Principal, Physics Teacher and students of SMAN 25 Bandung who had given permission and helped in the research.

03-2020

ORIGINALITY REPORT

23%	20%	18%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	visitasi.umy.ac.id Internet Source	3%
2	faculty.uobasrah.edu.iq Internet Source	2%
3	N Purnama, M Hasan, M Syukri. " Implementing inquiry learning on the acid-base concept to increase science process skills and students' interest in entrepreneurship ", Journal of Physics: Conference Series, 2020 Publication	1%
4	Adam Malik, Agus Setiawan, Andi Suhandi, Anna Permanasari. "Enhancing pre-service physics teachers' creative thinking skills through HOT lab design", AIP Publishing, 2017 Publication	1%
5	jurnalfkip.unram.ac.id Internet Source	1%
6	Submitted to Universitas Pendidikan Indonesia Student Paper	1%

7	Xue, Haihong, Jihong Qian, Lianwen Wang, Xiaojun Yuan, Yi Chen, Weilan Wu, Yan Chen, and Kun Sun. "3C3R Modified PBL Pediatric Teaching of Chinese Medical Students", PLoS ONE, 2013. Publication	1 %
8	repository.uin-malang.ac.id Internet Source	1 %
9	Worakanya Kaewklom, Pinit Khumwong, Chanyah Dahsah. "Opinions of Primary Science Teachers on 4C3RA+ Guidelines to Design STEM Lesson Plans", Journal of Physics: Conference Series, 2019 Publication	1 %
10	ical.conference.upi.edu Internet Source	1 %
11	ijpsat.ijsht-journals.org Internet Source	1 %
12	W Hidayat, Wahyudin, S Prabawanto. "Improving students' creative mathematical reasoning ability students through adversity quotient and argument driven inquiry learning", Journal of Physics: Conference Series, 2018 Publication	1 %
13	ijcrsee.com Internet Source	1 %

14	eprints.uad.ac.id Internet Source	1 %
15	S D A Permatasari, B Budiyono, H Pratiwi. "Analysis of mathematical creativity in the field of geometry in junior high school students", Journal of Physics: Conference Series, 2020 Publication	1 %
16	I Helsy, I F Faozah H A, N Windayani, D Nasrudin. "The effect of kefir whey addition on soap characteristics", IOP Conference Series: Materials Science and Engineering, 2018 Publication	1 %
17	Suryani Jati Rahayu, Sukarmin, Puguh Karyanto. "Analysis of Junior High School Students' Critical Thinking Skills Profile in Surakarta", Journal of Physics: Conference Series, 2019 Publication	1 %
18	jppipa.unram.ac.id Internet Source	1 %
19	repository.lib.ncsu.edu Internet Source	1 %
20	garuda.kemdikbud.go.id Internet Source	<1 %

21	"The Wiley Handbook of Problem - Based Learning", Wiley, 2019 Publication	<1 %
22	A Arnellis, E Z Jamaan, N Amalita. "Efforts to Improve Mathematics Teacher Competency Through Training Program on Design Olympiad Mathematics Problems Based on Higher Order Thinking Skills in The Junior High School", IOP Conference Series: Materials Science and Engineering, 2018 Publication	<1 %
23	Arif Billah, Mohammad Masykuri, Sarwanto, Sajidan. "Analysis of critical thinking in junior high school students through science learning in Indonesia: A systematic review", Journal of Physics: Conference Series, 2021 Publication	<1 %
24	F Y E B Karo, H Sinaga, T Karo. "The use of konjac flour as gelatine substitution in making panna cotta", IOP Conference Series: Earth and Environmental Science, 2021 Publication	<1 %
25	Submitted to Universitas Riau Student Paper	<1 %
26	eudl.eu Internet Source	<1 %
	i-jeh.com	

27	Internet Source	<1%
28	iopscience.iop.org Internet Source	<1%
29	journal.unnes.ac.id Internet Source	<1%
30	download.atlantis-press.com Internet Source	<1%
31	vdoc.pub Internet Source	<1%
32	www.iejee.com Internet Source	<1%
33	www.journal.ibrahimy.ac.id Internet Source	<1%
34	www.sciencegate.app Internet Source	<1%
35	core.ac.uk Internet Source	<1%
36	ijisrt.com Internet Source	<1%
37	journal.uinsgd.ac.id Internet Source	<1%
38	vbn.aau.dk Internet Source	<1%

39	Dian Safitri, Agus Setiawan, Andi Suhandi, Adam Malik, Siti Ashri Sahida Lisdiani, Sapriadil. "The Effects of Higher Order Thinking (HOT) Laboratory Design in Hooke Law on Student's Creative Thinking Skills", Journal of Physics: Conference Series, 2019 Publication	<1%
40	Education Innovation Series, 2015. Publication	<1%
41	P Siahaan, A Suryani, I Kaniawati, E Suhendi, A Samsudin. "Improving Students' Science Process Skills through Simple Computer Simulations on Linear Motion Conceptions", Journal of Physics: Conference Series, 2017 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		