

The Profile of 21st Century Learning:

Enhancing critical thinking and problem solving skills at Senior High School

Marsha Putri Kun Uminingtyas, Sukarmin Sukarmin
 Physics Education Department of Post Graduate Program
 Universitas Sebelas Maret
 Surakarta, Indonesia
 marshaputri95@student.uns.ac.id,
 sukarmin67@staff.uns.ac.id

Risa Suryana
 Physics Department of Post Graduate Program
 Universitas Sebelas Maret
 Surakarta, Indonesia
 rsuryana@staff.uns.ac.id

Abstract—The concept of 21st Century Learning is to make graduates having competencies in mastering the skill of thinking, complex communication and solving a problem which is very important according to the current global dynamics need. The 21st Century Learning is a new paradigm of learning being applied in Indonesia. This method has been adopted by several countries in the world such as Hong Kong, Switzerland, and the U.S. Based on several observations, the application of the 21st Century Learning in Indonesia especially Surakarta still has to be enhanced. Therefore, the objective of this research was to analyze the implementation and assessment of 21st century learning which had been done by Physics teachers of the senior high school in Surakarta. The subjects were 13 Physics teachers from 7 senior high school in Surakarta. The techniques of collecting data were interview, documentation and using a questionnaire. This research used concurrent triangulation strategy and descriptive analysis method. The implementation of the learning process and assessment of critical thinking and problem solving skills towards students in senior high school had attempted to build critical thinking and problem solving skill through various activities such as discussion, doing some experiment, observation through many literatures and having an oral presentation. However, the assessment instruments which had been used had not reflected the efforts to assess critical thinking and problem solving skill, so that they had not described these abilities. The assessment of thinking skills was limited to students' cognitive abilities, that was proved by the results of exam questions documentation where each item was at the level of C3 Blooms' Taxonomy in majority. The implementation and assessment of critical thinking and problem solving skills require the precise instruments in order to measure a students' ability. Teachers need some training to develop critical thinking and problem solving instruments.

Keywords—21st century learning; critical thinking skills; problem solving skills

I. INTRODUCTION

The Indonesian government has changed the school curriculum into curriculum 2013 to improve the quality of education in Indonesia. The curriculum 2013 has been implemented in the 21st century, when technological developments are increasingly rapid and information is easily accessible. The 21st century is an era of competition, students are required to have the ability to know how to learn and think intelligently and selectively in choosing valid and relevant

information [1]. 21st century skills emphasize high-level thinking skills, communication skills, and cooperative skills. The theory of 21st Century Learning was published by the Partnership of 21st Century Skills (P21), enGauge of 21st Century Skills, Assessment & Teaching 21st Century Skills (AT-21CS), and the National Educational Technology Standards (NETS) [2, 3]. 21st Century Learning is a method that is being implemented in Indonesia, which has been adopted by several countries in the world such as Hong Kong, Switzerland and the United States. The needs of today's global dynamics such as to shape graduates who have the competence in mastering thinking skills, complex communication and solving very important problems is the concept of 21st Century Learning's concept [4].

The main tools of 21st century skills are critical thinking and problem solving (expert thinking), creativity and innovation (discovery and invention), as well as communication and collaboration (complex communication) [5]. Expert thinking competence where students have to be able using various reasoning, systemic thinking, interpret data, make decisions, produce arguments, and solve problems. This is in line with the 21st century education goals, such as being able to think critically in choosing valid and relevant information and being able to solve problems in daily life [3]. Based on experience and observations, the application of 21st century learning in Indonesia especially Surakarta is still a challenge. Therefore, the purpose of this study is to analyze the implementation and assessment that has been carried out by the high school Physics teachers in Surakarta towards 21st Century Learning. In addition, the research is also focused on assessing critical thinking and problem solving skills.

Critical thinking is reflective thinking that focuses on deciding what to believe and do [6]. Critical thinking is very important in high school education. In terms of critical thinking, students are required to use certain cognitive strategies that are appropriate to test the reliability of the idea of solving problems and overcoming errors or deficiencies [7]. So that it can be understood that critical thinking is the ability to think logically, reflectively, and productively that is applied in assessing the situation to make good judgments and decisions. Indicators of critical thinking skills are logic and reasoning, the ability to find relevant information and assess the credibility of sources, the ability to interpret and predict

data, the ability to argue, the ability to assess inference, and the ability to make decisions [8]. Problem solving ability is one of important abilities that students must possess. Problem solving is a mental and intellectual process in finding a problem and solving it based on accurate data and information, so that the accurate conclusions can be drawn [9]. Problem solving is a life skill that involves the process of analyzing, interpreting, reasoning, predicting, evaluating and reflecting [10]. The ability to solve problems is to apply knowledge that has been previously owned into new situations that involve high-level thinking processes. Indicators of problem solving abilities, including: identifying problems, identifying irrelevant problems, describing various problem solving strategies, using analogies, solving problems based on data, and presenting solutions to problem solving [11].

Critical thinking is a learning process that needs to be constantly practiced and incorporated into daily lessons [12]. The previous research had shown that scores from the assessment of critical thinking can predict real-world outcomes. Individuals with higher critical thinking scores have negative life events [13]. Critical thinking is very important, in order for students to make decisions accurately, and to act logically without getting excited in the event of matters, they should take applicable beginning in primary school, lasting till high school [14]. Teachers had some conception of the critical thinking and it tended to be narrow and they need to utilize appropriate teaching methods and materials in order to find out the classroom areas which are appropriate to teach critical thinking skills [15, 16]. Problem solving skill includes divergent (creative or lateral) and convergent (critical) thinking processes has an important knowledge transfer role because it can connect knowledge and action, declarative and procedural knowledge [17]. Problem solving skills help individuals in solving problems in all stage of life not only in academic life [18]. Teachers need to have a good problem solving skills because the education-instruction process is an important process [19]. Perceptions and views about problem solving process of the teachers are of great importance for them to teach the problems to their students and use problem solving skills in their life [20]. Critical thinking and problem solving are the skills that should be developed starting from the first steps of education. It is very important, because individuals who have not developed these skills during their education cannot have a critical perspective on social, individual and cultural events, or avoid solving problems [21].

This research not only investigate teacher's attitudes, perceptions and views towards critical thinking and problem solving skills, but also analyze the implementation process in class and the assessment which had been done by teacher concerning critical thinking and problem solving skills. This research limited to state senior high school in Surakarta and the subject were Physics teachers. This is a descriptive method research, examining the results stemming from either qualitative or quantitative analysis. In addition, this research focused on the implementation also including the assessment of critical thinking and problem solving skills.

II. METHODS

This research used descriptive method which was supported by qualitative data and simple analysis quantitative data to produce a better understanding of research problems. This research subjects were 13 high school Physics teachers from 7 different high schools in Surakarta. The sampling technique used quota sampling, due to the limited number of subjects of Physics teachers in state high schools in Surakarta. Research location in Surakarta city, Central Java province, Indonesia. The study was carried out from May until July 2018. The study was conducted in the teachers' room where the surroundings' environment was conducive enough for interviews. The data collection techniques used interview, documentation, and using a questionnaires. Interviews were conducted to determine students' ability to think critically and solve problems in learning activities. The interview activities were all recorded with the permission of teacher. Questionnaires were used to find out the attitudes, perceptions, and views of teachers towards critical thinking and problem solving skills.

Questionnaire instruments had been used in the previous research, it consisted of 8 closed statement items using Likert scale which was used to determine the teacher's attitude towards critical thinking skills, position and importance in Physics learning [15, 16]. Questionnaire was adapted into 5 Likert scales from the lowest scale, namely '1 = Strongly Disagree' to the highest scale, namely '5 = Strongly Agree'. Questionnaires which used to find out the perceptions and views of teachers regarding problem solving abilities had been used in previous research, it consisted of 5 open questions with 1 closed answer [20]. The development of the questionnaire examined and the existing literature also took expert views. Documentation was carried out for exam questions and students' answers to the final examination of 1st semester in 11th grade in Physics subject. Documentation was used to find out the type of assessment which had been done to measure students' thinking skills.

This research used concurrent triangulation strategy where quantitative and qualitative methods were carried out together and had a balanced proportion, both in data collection also the time of analysis [22, 23]. The data obtained was compared so that it could be found which data could be combined and differentiated. Data analysis was carried out descriptively. Data analysis was carried out during the research through in-depth interviews, documentation and questionnaires which been analyzed quantitatively and qualitatively. The data analysis process began when the researcher was still in the research field and after the researcher was not in the research field. The data which obtained from the research field was studied and reviewed then. After that, a core summary was made from the interview process, documentation, and questionnaire to improve understanding of the obtained data.

The data validity used data triangulation techniques. The obtained data in the research field (interview data, documentation data, and questionnaire results) will be analyzed using other references and interpretations from researchers. In this study, two triangulations were used namely data source triangulation and theory triangulation. Triangulation of data sources was to explore the truth of certain information through

various methods of data collection. Triangulation of theory could increase the depth of the author's understanding in exploring theoretical knowledge deeply on the results of data analysis that had been obtained. This research was carried out based on the permission given by the school. Permits from the center (city level) had passed disposition stage before the research was conducted.

III. RESULTS AND DISCUSSION

This research was aimed to analyze the implementation of critical thinking and problem solving skills towards 21st Century Learning. This study would collect the data by interviewing Physics teachers and giving them a questionnaire. The questionnaire used to collect the relevant data such as the attitudes of Physics teacher towards critical thinking learning, the perceptions and views of Physics teachers towards problem solving learning, and the kind of assessment which had been done by Physics teachers of the senior high school in Surakarta towards 21st Century Learning

A. The Attitudes of Physics Teachers towards Critical Thinking Learning

TABLE I. THE ATTITUDES OF PHYSICS TEACHERS TOWARDS CRITICAL THINKING LEARNING

Item Question	Index (%)	Interpretation
I have a clear idea about the definition of critical thinking.	84,6%	strongly agree
As a teacher, teaching critical thinking skills is an important part of my job.	84,6%	strongly agree
I build critical thinking explanations and exercises into most of my lessons.	80%	agree
Students in Surakarta generally are good at critical thinking.	75,4%	agree
It is not necessary to increase the role of critical thinking into the curriculum.	30,8%	strongly disagree
Teaching critical thinking in the classroom is not the job of the teacher.	29,2%	strongly disagree
Critical thinking is especially important in Physics teaching.	92,3%	strongly agree
Training about how to teach critical thinking skills for teachers in Surakarta is needed.	90,8%	strongly agree

The questionnaire consists of five Likert-scale items. The scales were coded including 1 = strongly disagree, 2 = disagree, 3 = fairly agree, 4 = agree, and 5 = strongly agree [24]. Interpretation score criteria based on intervals [25, 26]:

- 0% < score ≤ 36% strongly disagree
- 36% < score ≤ 52% disagree
- 52% < score ≤ 68% fairly agree
- 68% < score ≤ 84% agree
- 84% < score ≤ 100% strongly agree

Table 1 shows that teacher strongly agree that they have a good idea about the definition of critical thinking and assume

that it is an important part of Physics learning. Teachers also agree that they build critical thinking explanations and exercises into most of their lessons. In addition, teacher also strongly agreed that teacher training towards critical thinking skills is needed because critical thinking is important in Physics teaching.

B. The Perceptions and Views of Physics Teachers towards Problem Solving Learning

TABLE II. THE PERCEPTIONS AND VIEWS OF PHYSICS TEACHERS TOWARDS PROBLEM SOLVING LEARNING

No	Question and Answer	f	%
1.	What does the problem mean?		
	The event needed to solve	4	31
	The obstacles needed to overcome	3	23
	Trouble / Difficulty/ Negative	2	15
	The event that has solution	2	15
	The event that has to be solved because it makes a difficulty	1	8
2.	A statement about event that is not as expected	1	8
	What to do firstly when meet the problem?		
	To search the solving method by thinking	4	31
	To search the source of the problem	4	31
	To understand and describe the problem	3	23
3.	To search and collect information	2	15
	What to do to solve the problems meet in daily life?		
	To search the solution way	9	69
	To determine the source of the problem	3	15
4.	To be calm	1	8
	To search the solution way considerably	1	8
	What are the problem solving processes needed to following to solve the problem met?		
	To apply the most suitable the solution	5	38
	To search / to get information	4	31
5.	To hypothesize	3	23
	To produce the solution way	1	8
	What can be done to develop individuals' problem solving skills?		
	With the solving application of the problem	5	38
	With formal and informal learning	3	23
	To help for solving the problem	3	23
To give information	1	8	
To meet with the problem	1	8	

Based on Table 2, Physics teacher mostly answer if problem is the event which needed to be solved. They will search the solving method and search the source of them if they meet the problem. Physics teacher will search the solution way to solve the problems which they meet in daily life. They answer that they need to search or get information as the processes of problem solving for the following step. Problem solving is the key feature in the profession especially as a teacher because teachers are required to have a wide range of competencies in order to respond all of the challenges in their job life [17]. According to teachers' perceptions and views, individuals or students need to use the solving application of the problem in order to develop their problem solving skills. The solving application can be a good assessment which can cultivate, train, and improve their ability in solving problems. Even though, the obstacle of many examination for example central examination are in finding the result by using test techniques and the necessity of completing the examination in

a limited time. This is a teachers' role to train their students in order to be a good problem solver [27].

C. Interview with the Physics Teacher

The question of the interview with the Physics teacher were based on the indicators of critical thinking and problem solving skills [8, 11]. The interview were focused on teachers' role in the class and how the implementation of students' critical thinking and problem solving skills in learning process.

1) Critical thinking in learning process:

a) Logic and reasoning: Students had to get guidance from their teacher to link Physics concept. Most of them were in the middle level on using logical and reasoning. Students were guided from easy concept to the complex one in order to understand well. Teacher acted as a good facilitator if there was a problem in discussion.

b) The ability to find a relevant information and assess source credibility: Students were instructed to study and read the subject matter first before the lesson. They searched the information from books and internet. They also asked their teacher whether the concepts were right or not. They needed a confirmation about the information. Teacher helped them for analyzing the concepts together.

c) Interpretability and data prediction: Students are still confusing when they have to analyze the data. Teacher have to direct their students. Students were given some data or they did some experiment to get it. The first thing that they had to do were completely understood about the aim and the concept of the experiment. If the data which they get was not relevant with theory, they did an error analysis.

d) Argumentation ability: In general, their argumentation ability was quite good. Teacher become an observer and a judge when discussion time, students are free to exchange their opinions. They were arguing each other and also gave an explanations related to the subject matter.

e) Ability to assess inference: Some of the students about 4 until 5 students had a good ability to assess inference. They having an unexpected reason and sometimes they explained their arguments to help the others understanding the concept. Based on their own experience in daily life, did some experiments, and had read some references, students had many concepts background which had been accommodated.

f) The ability to make decision: Students could make a good decision through process. In an exam, based on how teacher gave the subject matter to their students. Almost 50% students had a good ability to do their exam. In discussion session, teacher had to direct their students gained the right conclusion.

2) Problem solving in learning process:

a) Identifying problems: Teacher gave some questions before starting the lesson. Most of the questions are related to daily life. Students started discussion and tried to identify the problems and answered the questions. From observing, students are being encouraged and directed by their teacher.

b) Identifying irrelevant problems: Based on the students, if they were smart and had a good based concept,

they could easily identified the irrelevant problems. There were some students who asked actively and some of them were passive. Teacher always asked the students again about their belief towards problem identification which being done, after that students reviewed it again.

c) Describing various problem solvings' strategies: Students could describe various problem solvings' strategies from observing, internet browsing, and group discussion. Students had a discussion with their friends, if they did not know something they would ask their teacher. Based on learning syntax, sometimes presentations were required.

d) Using an analogy: Teacher often used questions in order to test their students' analogy ability. In learning activity, teacher asked about an example related to the subject matter. Students were pretty good to answer the question, their analogies were based on their daily life.

e) Solving problems based on data: Students discussed, demonstrated, experimented and analyzed data with the others. Students concluded the concept together. Teacher had to direct their students to the correct concept. If the results were inappropriate compared with the right one, then the student would repeat the experiment or did an error analysis.

f) Presenting problem solvings' solutions: Based on the subject matter learning, sometimes presentation was needed. The application of problem especially in assignment, the questions are sorted based on the level of difficulty. Students were instructed to accomplish and they were required to be responsible for their work. Students came to in front of the class for explaining to their friends.

D. Teachers' Questionnaire about Students' Thinking Ability Assessment

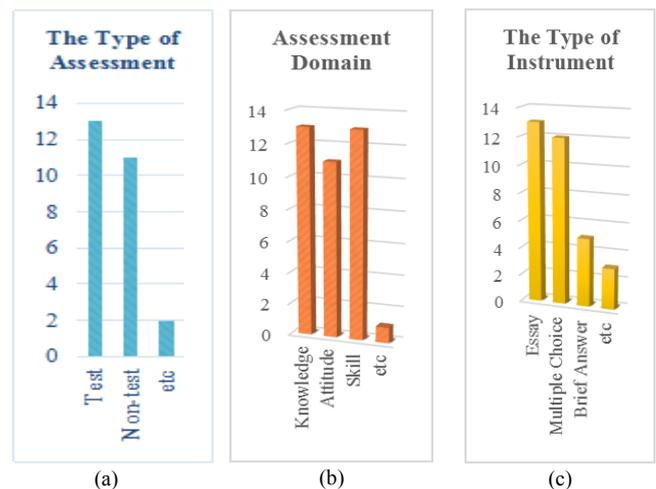


Fig. 1. (a) Type of assessment (b) the domain of assessment, and (c) the type of instrument.

Based on Figure 1, teachers mostly used test to assess students' abilities in knowledge and skill domain. The other type of assessment which were used by teachers were recitation in the form of assignments, practices, solving questions on the whiteboard as individual assessment, having an oral interview or questions which were answered directly by students. The type of instruments which commonly used by teachers were

essay, multiple choice, and brief answer. Based on the interview, teachers also used true-false test, matching, and verbal test in order to give variation of test. Preliminary research using questionnaires obtained results that teachers thought if multiple choice tests can not show students' thinking skills. According to the previous research, multiple choice tests had disadvantages, because the opportunity for students to answer correctly is greater and multiple choice tests provide lower information about students' thinking ability than essay test. The essay test form was better used to measure students' thinking abilities [28]. Teacher uses the essay test more often but the objection of essay test is the duration of correction time.

E. Documentation of Question and Students' Answer Final Examination of 1st Semester in 11th Grade

There are the sample question from Final Examination in 11th Grade in Figure 2, the example students' answer in Figure 3, and The percentage of final exam's instrument according to Blooms' taxonomy for (a) multiple choice and (b) essay test in Figure 4.

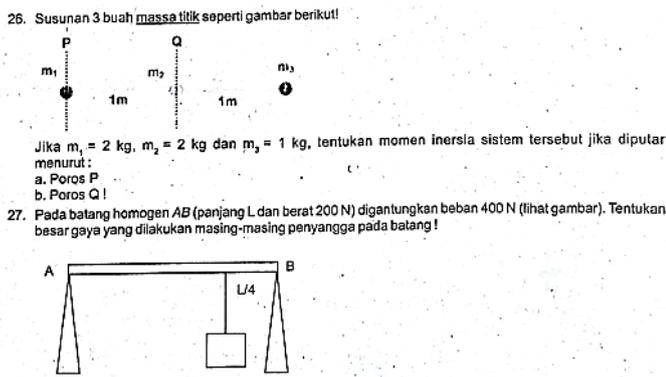


Fig. 2. The example question about rotational motion in final examination of 1st semester.

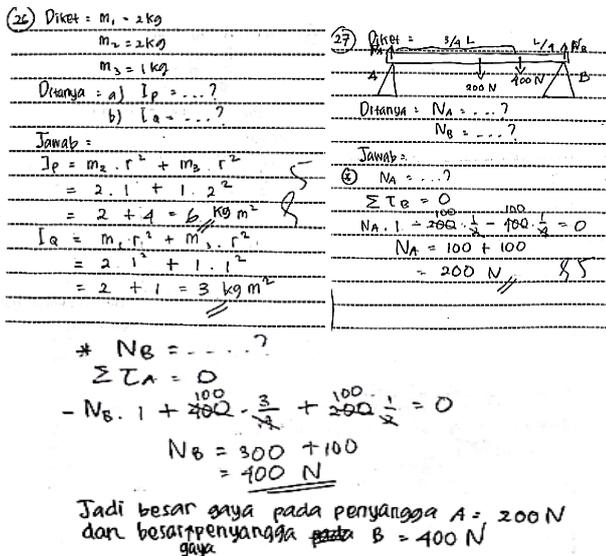


Fig. 3. The example of students' answer about rotational motion in final examination of 1st semester.

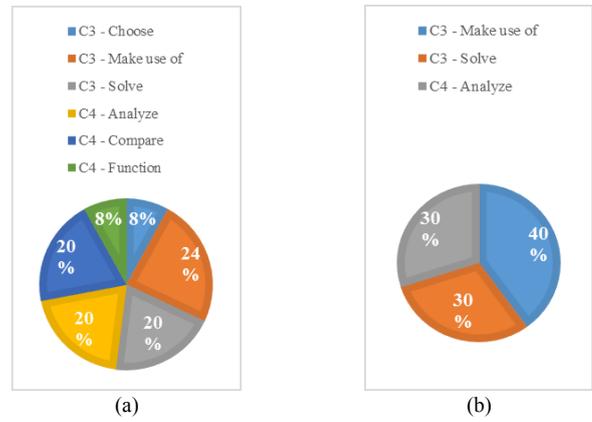


Fig. 4. The percentage of final exams' instrument according to Blooms' taxonomy for (a) multiple choice and (b) essay test.

Based on Figure 1 (c), teacher uses essay test mostly in learning activity, the documentation results of the exam questions in a school from the preliminary research that has been carried out will be concerned in essay question, show that the questions given to students often emphasize at mathematical aspects and rarely use scientific applications in daily life (Figure 2). The questions given have not fully led to the ability to think critically and the ability to solve problems, because in fact the cognitive levels in majority are still at the C3 level Blooms' Taxonomy as seen as Figure 4 [10]. Student has a good problem solving skills, it is proved that he/she can solve the question with using the precise formula and provide the right solution in the end. Students in answering questions emphasize the use of mathematical formulas and calculations. Students do not even give conceptual explanations to the answers because the questions are limited to mathematical (Figure 3).

Based on Table 1 and Table 2, it can be concluded that critical thinking and problem solving skills are very needed. According to the preliminary research that had been done by the researcher, the results of interviews with 13 high school Physics teachers in Surakarta shows students' thinking abilities measured in learning are limited to cognitive abilities. Teachers rarely measure critical thinking and problem solving skills. According to the relevant research, students are prefer assignments and activities with simple answers than the difficulty of thinking [28]. Lacking of understanding the problem is the major obstacles in the domain of problem solving skills in Physics [29]. Whereas, the demands of the 2013 curriculum are to develop all potential of the students and to grow the ability of thinking critically, solving problems, and being adaptive to the times.

Students' thought in making inferences, analogies, evaluations and explore deep understanding regarding the specific knowledge as seen as interviews' data are related to problem solving and this process is one of essential elements in critical thinking [30, 31]. The relation between Physics learning process and understanding concept are very close. That makes student who learn Physics can apply the concept well not only remember the mathematical aspect. The important purpose of Physics education is guiding students to be capable in using some representation to solve problems and

having a good conceptual understanding in Physics [32]. Students' critical thinking and problem solving skills can be developed by confronting teachers with current problems through practices in teacher training instead of theoretically based courses [21].

IV. CONCLUSION

The implementation of the learning process and assessment of critical thinking and problem solving skills towards the students in the senior high school still has to be enhanced because it had not been done optimally. Teachers' attitudes, perceptions, and views towards critical and problem solving are good enough, in line with the purpose of learning. The learning process mostly had been directed to cultivate and train critical thinking and problem solving skills. On the contrary, the assessment of thinking skills was limited to students' cognitive abilities, that were proved by the results of exam questions documentation where each item was at the level of C3 and some of them are at the level of C4 in Blooms' taxonomy. When giving some questions to their student, teacher emphasizes on mathematical aspects and rarely uses science applications in daily life. The assessment of critical thinking and problem solving skills require the precise instruments in order to measure a students' ability. Teachers need some training to develop critical thinking and problem solving instruments. The future research which focused on teachers training to develop and to make a good instrument to measure critical thinking and problem solving skills together in one study is needed.

ACKNOWLEDGMENT

MPKU would like to say her gratitude to her father for his continuous prayers and her beloved mother in Heaven. Authors would like to thank for all teachers who be the subjects for this research, who had given their help to finish this article.

REFERENCES

- [1] D. F. Halpern, "Thought of Knowledge: An Introduction to Critical Thinking (4nd Edition)", New Jersey: Lawrence Erlbaum Associates Publisher, 2003.
- [2] Pacific Policy Research Center, "21st Century Skills for Students and Teachers", Honolulu: Kamehameha Schools, Research & Evaluation Division, 2010.
- [3] Partnership of 21st Century Skills. 21st Century Skills, Education & Competitiveness, 2008, www.p21.org/storage, accessed on August, 24th 2018.
- [4] Hart Research Associates, "It takes more than a major: Employer priorities for college learning and student success", 2013.
- [5] K. Kay and V. Greenhill, "Twenty-First Century Students Need 21st Century Skills", Bringing School into the 21st Century, Explorations of Educational Purpose, vol. 13, Springer, Dordrecht, 2011.
- [6] H. E. Robert, "Critical thinking assessment", Theory Into Practice, vol. 32, no. 3, 1993, pp. 179-186.
- [7] S. Muhibbin, "Psikologi Pendidikan dengan Pendekatan Baru", Bandung: PT. Remaja Rosdakarya, 2013.
- [8] J. Y. F. Lau, "An introduction to critical thinking and creativity: Think more think better". New Jersey: John Wiley & Sons Inc, 2011.
- [9] O. Hamalik, "Proses Belajar Mengajar", Jakarta: Bumi Aksara, 2004.
- [10] W. L. Anderson and R. D. Krathwohl, "A taxonomy for learning, teaching, and assessing: A revision of Blooms' taxonomy of educational objectives", New York: Addison Wesley Longman Inc, 2009.
- [11] S. M. Brookhart, "Assess high order thinking skills in your classroom", Virginia: ASCD, 2010.
- [12] S. C. Chee and K. C. Phaik, "Teacher Perceptions of Critical Thinking Among Students and its Influence on Higher Education", International Journal of Teaching and Learning in Higher Education Volume 20, Number 2, 2009, pp. 198-206.
- [13] A. B. Heather, "Halpern Critical Thinking Assessment Predicts Real-World Outcomes of Critical Thinking", Applied Cognitive Psychology, Appl. Cognit. Psychol, vol. 26, 2012, pp. 721-729.
- [14] S. Okan, "Assessment of High School Students' Critical Thinking Skills", Procedia - Social and Behavioral Sciences, vol. 46, 2012, pp. 5315-5319.
- [15] S. Paul, "A survey of attitudes towards critical thinking among Hong Kong secondary school teachers: Implications for policy change", Thinking Skills and Creativity, vol. 6, 2011, pp. 14-23.
- [16] A. Fatemeh and T. Abdorreza, "A Survey of EFL Teachers' Attitudes towards Critical Thinking Instruction", Journal of Language Teaching and Research, vol. 6, no. 2, 2015, pp. 388-396.
- [17] O. Judit and G. Gajdos, "Teachers' Professional Development on Problem Solving: Theory and Practice for Teachers and Teacher Educators", Rotterdam: Sense Publishers, 2016.
- [18] F. Ö. Armağan, Ş. U. Sağır, and A. Y. Çelik, "The effects of students' problem solving skills on their understanding of chemical rate and their achievement on this issue", Procedia Social and Behavioral Sciences, vol. 1, 2009, pp. 2678-2684.
- [19] G. Yavuz, Ç. Arslan, and D. C. Gülten, "The perceived problem solving skills of primary mathematics and primary social sciences prospective teachers", Procedia Social and Behavioral Sciences, vol. 2, 2010, pp. 1630-1635.
- [20] I. E. Didem, "The Perceptions and Views about Problem Solving Process of Pre-Service Science Teachers", Procedia - Social and Behavioral Sciences, vol. 141, 2014, pp. 308 - 312.
- [21] S. K. Fatma, S. Ceren, and H. Y. Ibrahim, "Determine The Relationship Between The Disposition of Critical Thinking and The Perception About Problem Solving Skills", Procedia - Social and Behavioral Sciences, vol. 191, 2015, pp 657-661.
- [22] J. W. Creswell, C. V. L. Plano, M. L. Gutmann, and W. E. Hanson, "Advanced mixed methods research designs", Handbook of mixed methods in social and behavioral research, pp. 209-240, Thousand Oaks, CA : SAGE, 2003.
- [23] M. K. Jessica, "Using Mixed Methods to Establish the Social Validity of a Self-Report Assessment: An Illustration Using the Child Occupational Self-Assessment (COSA)", Journal of Mixed Methods Research vol. 5, 2011, pp. 52.
- [24] L. Rensis, "A Technique for the Measurement of Attitude", Archive of Psychology, no. 140, 1932, pp. 44-53.
- [25] A. Muhammad, "Metode Penelitian Pendidikan", Bandung: Angkasa, 2009.
- [26] A. Zainal and P. Sugeng, "Pemahaman Siswa terhadap Pemanfaatan Media Pembelajaran berbasis Livewire pada mata pelajaran Teknik Listrik kelas X Jurusan Audio Video di SMK Negeri 4 Semarang", Edu Elekrika Journal, vol. 4, no. 1, 2015.
- [27] E. A. Elif, "Prospective Teachers' Beliefs about Problem Solving in Multiple Ways", Universal Journal of Educational Research, vol. 4, 2016, pp. 1727-1733.
- [28] A. Mohammad and S. Akram, "Teachers' perception of the barriers to critical thinking", Procedia - Social and Behavioral Sciences, Vol 70, 2013, pp. 1-5.
- [29] M. B. R. Vijaya and P. Buncha, "Students Problem-Solving Difficulties and Implications in Physics: An Empirical Study on Influencing Factors", Journal of Education and Practice, Vol.8, No.14, 2017, pp. 59.
- [30] B. M. Colley, A. R. Bilics, and C. M. Lerch, "Reflection: A Key Component to Thinking Critically", The Canadian Journal for the Scholarship of Teaching and Learning, vol. 3, no. 1, 2012, pp. 1-19.

[31] A. Kitchenham, "The Evolution of John Mezirow's Transformative Learning Theory", *Journal of Transformative Education*, vol. 6, no. 2, 2008, pp. 104-123.

[32] S. Sukarmin, R. Dewi, and S. Suparmi, "Profile Analysis of Students' Concept Understanding on Heat and Temperature", *Journal of Education and Learning (EduLearn)*, Vol. 12, No. 3, 2018, pp. 350-356.