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Teacher's Self-regulation in Solving the Problem with Contradiction Information

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Abstract. *The teacher's self-regulation in solving problems with contradictory information needs to be investigated because this certainly has an impact on students' self-regulation abilities. However, research related to this is still limited. Problem with Contradiction Information (PWCI) is appropriate to view self-regulation. This research is a case study which involved teachers in East Java, Indonesia and already have an educator certificate. There are 24 teachers as participants of this research, 14 females and 10 males. The objectives of this study describe how the teacher's response when completing PWCI and how the teacher's self-regulation when solving PWCI. Data were collected through tests and interviews. The results show that (1) There are two types of teacher responses in completing PWCI, the first type is the teacher who answers the questions directly without checking the provided information, the second type is the teacher who is thorough and cross-checks before working on the questions, (2) The emergence of self-assessment teacher regulation when completing PWCI is divided into four, namely, teacher self-regulation appears at the stage of understanding, implementing, re-checking and does not appear when completing PWCI. Most of the teachers are not aware of the contradictions in the questions given.*

Keywords*: teacher, self-regulation, solving problem, problem with contradiction information.*

Introduction

Self-Regulation is one of the based on several critical thinking components that have been mentioned by experts, self-regulation is one of the most important components to have because self-regulation is the main indicator in critical thinking. Self-regulation is an outgrowth of self-control that allows for flexible adaptation to real-world demands (Facione, 1990; McClelland, Geldhof, Morrison, Gestsdottir, Cameron, Bowers, Duckworth, Litte, & Grammer, 2017) states that self-regulation is self-awareness to monitor cognitive activity. Beside McClelland and Facione (Bandura, 1991) states that self-regulation is how humans are able to regulate themselves, influence their behavior by regulating the environment, creating cognitive support, and holding consequences for their own behavior. It can be concluded that self-regulation is the ability of a person to monitor his cognitive activity and can make corrections if there are errors.

Self-regulation divided into two subskills namely self-examination and self-correction (Facione, 1990; Muslem, Usman, Fitriani, & Velayati, 2017). In addition, Facione (1990) said "some activities related to self-examination include; to reflect on one's own reasoning and verify both the results produced and the correct application and execution of the cognitive skills

involved; to make an objective and thoughtful meta-cognitive self-assessment of one's opinions and reasons for holding them; and rational in coming to one's analyses, interpretations, evaluations, inferences, or expressions. While self-corection reveals errors or deficiencies, to design reasonable procedures to remedy or correct, if possible, those mistakes and their causes".

In order to assess a person's self-regulation, it is necessary to give a non-routine problems or unfamiliar questions. This is in line with the opinion of Syarifuddin, Nusantara, Qohar, and Muksar (2019) which states that to see the ability of mathematics is to provide a different situation for the problem. Ill-defined problem is one of the questions that can be used to measure self-regulation, ill-defined problems are often called ill-structured problems or messy problems (King & Kitchener, 1994). Ill-defined problems are a problem with ambiguity and ambiguous goals (Hocking & Vernon, 2017). Furthermore, ill-defined problems are divided into three types of problems: (1) problems with ambiguous (open-ended) information (Douglas, Koro-ljungberg, Mcneill, Malcolm, & Therriault, 2012; Hocking & Vernon, 2017; Lynch, Ashley, Pinkwart, & Aleven, 2009), (2) problems with incomplete information (Lynch et al., 2009) and (3) problems in which there is information conflict (contradictory information) (Douglas et al., 2012; King & Kitchener, 1994).

Many researchs about ill-defined problem has been conducted by the previous researchers such as Nugroho, Nusantara, As'ari, Sisworo, Hidayanto, and Susiswo (2018), Mendonça, De Oliveira, Guerrero, and Costa (2009) and Arifin, Zulkardi, Putri, Hartono, and Susanti (2018). Studies by Nugroho et al. (2018) found: (1) there are two causes of skepticism: (a) the presence of cognitive conflict and (b) the presence of two conflicting outcomes; (2) the phases involved in skepticism and decision making on the ill-logical mathematics problem from stimulus, skeptic, reflective, and decision making. Studies by Mendonça et al. (2009) showed that students found it hard to perform problem statement exploratory reading and interpretation, formulate questions to enlighten the problem, analyze the problem constrains and error occurrence, write tests to check non-obvious situations and also to register effectively the new problem information acquired by discussing with client. While studies by Arifin et al. (2018) produce a valid and practical ill-defined problem-solving for context South Sumatera. The three studies have something in common, where the research participants are students and the context of the ill defined problem is problems with ambiguous (open-ended) information and problems with incomplete information. This provides new research opportunities with subjects other than students with problems in which there is information conflict (contradictory information).

Problems with Contradictory Information (PWCI) is a form of ill-defined problems. PWCI are problems in which there is information conflict (contradictory information) (As'ari, Kurniati, Maharani, & Basri, 2019; Douglas et al., 2012; King & Kitchener, 1994). The use of

PWCI gives a person the opportunity to do good self-regulation and always do an analysis before doing something. If the learner is able to arrange assignments that make students aware that in the problem there is contradictory information, students will experience cognitive conflict and will grow in themselves to always check first whether the question is indeed feasible or not. They will first analyze all available information, check the truth and plausibility before answering it.

To test the ability of self-regulation, cannot use routine questions that have been used so far. The questions that have been used so far are only determined by the accuracy of the process and answers. PWCI provides a different alternative in which problem solving is not only focused on the accuracy of the process and the answer but on the truth of the question itself. By using PWCI, one's self-examination and self-correction capabilities will be seen. When there are questions that have a contradiction in the information provided, if we are forced to solve it then it will not meet the conditions requested. The ability of self-examination will be seen if respondents put the results of their answers to the initial conditions given to the problem, because when tested they certainly will not meet two contradictory conditions. While self-correction is expected when they understand the problem given, because there is a contradiction in the information provided. Students who have good critical thinking skills will be aware of the contradictions in the information provided so that they prefer not to work on the questions and ask the questioner to confirm the information related to the information contained in the question.

The objectives in this study are (1) to describe how the teacher's response when completing Problem with Contradiction Information (PWCI), (2) to describe how the teacher's self-regulation when solving Problem with Contradiction Information (PWCI). Initial identification needs to conduct to find out how the teacher's self-regulation when dealing with PWCI. This can be used to provide an appropriate training for teachers.

Method

This research is a case study research. Case study research is part of qualitative research (Patahuddin & Basri, 2015; Stake, 2000). This type of research concentrates on specific cases based on the interests of researchers (Burns, 2000) which aims: to gain an understanding of a particular case; to develop knowledge, build a theory, or generalize a new conclusion that is different from previous quantitative research (Stake, 1988, 2000). According to Stake (2000), one important aspect in case studies is determining boundaries that aim to focus the research object. The focus of case study research can be one person, a class, an institution, or a problem. In this study, the research question is how the teacher's self-regulation in solving PWCI.

Data collections in this study were tests and interviews. Data analysis was carried out using interactive analysis of Miles and Huberman. Analyze the data of this interactive model has three components, namely: (1) data reduction, (2) data presentation, and (3) drawing conclusions/verification (Nugrahani, 2014). These three main components must be present in qualitative data analysis, because the relationship and interrelationship between the three components that need to be continuously compared to determine direction of the contents of the conclusion as the final result of the research.

Participants of this study are professional teachers who teach in the East Java Province of Indonesia. Educator certificates are formal evidence given to teachers as professional educators (Peraturan Pemerintah Republik Indonesia, 2008; Syamsuri & Nurdin, 2016). Considering that teachers who have educator certificates have the ability and competence in implementing learning (Mulyasa, 2007). There are 24 teachers consisting of 5 teachers with master's degrees and 19 teachers with bachelor's degrees. Information related to participants is presented in Table 1 below.

Table 1. Information related to the participants of the research

No	Criteria	Description	Amount
1	Gender	Man	10
		Woman	14
2	Old teaching	< 10 years	9
		≥ 10 years	15
3	Place of teaching	Pamekasan	8
		Malang	6
		Ponorogo	3
		Tuban	2
		Surabaya	2
		Jombang	3

Participans in the study were asked to answer a problem related to Problem with Contradiction Information (PWCI). The subject is given a problem with two contradictory premises namely $a-b=5$ and $\sqrt{b}-\sqrt{a}=1$, so the value of cannot be determined. The full PWCI used to view teacher self-regulation is shown in the following figure 1.

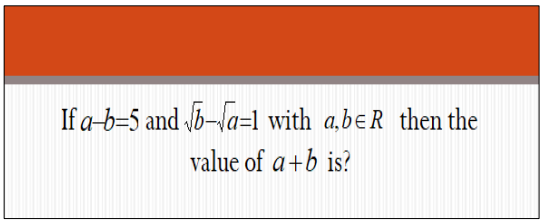


Figure 1. PWCI for teacher

The purpose of this case study is to gain an understanding of how teachers' self-regulation responds to PWCI. Teachers as research subjects were contacted in several ways through social media such as Facebook, WhatsApp (WA) or face to face who voluntarily want to be a

participant in this study. Interviews with research subjects were also conducted in several ways: direct interviews, by telephone or using text messages via WA. Eight teachers were contacted directly, six teachers were contacted by telephone and ten were contacted by telephone. This method is carried out because the research subjects are scattered in several districts in East Java, so it is not possible to obtain data through direct interviews. Based on the results of the teacher's answers, four teachers were then selected to be interviewed further regarding the results of their work. Subject selection is based on the results of the work and participants' willingness

Results and Discussion

The teacher's answer is based on the response given

Based on the answers and the interview results conducted by researchers on 24 teachers as subjects of this study, there were two types of teachers in responding to the PWCI namely (1) do it directly and (2) do not do it by giving several reasons. Teachers' responses to PWCI are presented in Table 2.

Table 2. Recapitulation of teacher responses to PWCI

No	Response	Gender		Amount
		Man	Woman	
1	Not immediately answer PWCI	3	1	4
2	Directly answer PWCI	7	13	20

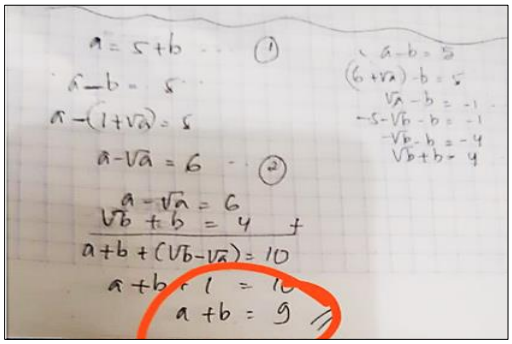
Based on Table 2, it was obtained that most of the teachers, 20 out of 24 teachers or 83% answered the questions directly without understanding and considering the information available on the problem. Whereas 4 out of 24 teachers or 17% did not answer the question directly because they understood the contradiction in the information provided in the given problem. The following are the results of the interviews with subjects representing each category:

The teacher who immediately solved the problem

The following are the results of the interview between researcher (R) and teacher (T3) who immediately answered the questions.

R : *If* $a-b=5$ *and* $\sqrt{b}-\sqrt{a}=1$ *with* $a,b\in R$, *then* $a+b$ *is? Try to find the answer!*

T3 : *(T3 send his answer to researcher via WhatsApp)*



R : *What information given in the question?*
T3 : $a-b=5$ *and* $\sqrt{b}-\sqrt{a}=1$
R : *Did you directly use the information in solving the problem?*
T3 : *Yes*
R : *Why?*
T3 : *Because the information is a premise, so it is definitely correct.*

Based on the interview, it can be concluded that the T3 did not check first the information given on the question.

Teachers who understand the information contained in the problem first

The following are the results of the interview between researcher (R) and teacher (T1) who immediately answered the questions.

R : *If* $a-b=5$ *and* $\sqrt{b}-\sqrt{a}=1$ *with* $a,b\in R$, *then of* $a+b$ *is? Try to find the answer!*
T1 : *Yes*
T1 : *(T1 send his answer to researcher via WhatsApp)*

√b -√a =1
a, b >=0
b>a

Pernyataan yg lain
a - b = 5
Karena a, b >=0
Maka a>b
Kontradiksi dg pernyataan pertama.

Indonesian language

$\sqrt{b}-\sqrt{a}=1$
$a,b\geq 0$
$b>a$
Another statement
$a-b=15$
Because $a,b\geq 0$
Then $a>b$
contradiction with the first statement

English languange

R : *what happens if there are two contradictory information*
T1 : *Related question* $a+b$ *cannot be specified.*

Based on the interview, it can be concluded that the T1 does not immediately do the work, but first checks the information provided on the question.

Self-Regulation teacher in completing PWCI

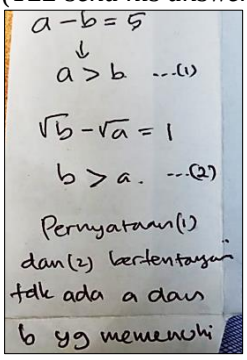
In solving mathematical problems, certainly use the stages that have been raised by Polya (1973). The stages are understanding the problem, making a plan, carrying out the plan and re-

checking. In this section the teacher's self-regulation appears when answering PWCI is reviewed based on the stages in Polya.

The teacher's self-regulation appears at the understanding the problem stage

Four teachers out of 24 or 17% were able to find a contradiction in the problem given at the understanding problem stage. The following are the results of the interview between researcher (R) and teacher (T22) who was able to find a contradiction in the problem at the understanding the problem stage.

R : *If* $a-b=5$ *and* $\sqrt{b}-\sqrt{a}=1$ *with* $a,b\in R$, *then* $a+b$ *is? Try to find the answer!*
T22 : *Ok,*
T22 : *There isn't any possible answer (after a while of looking at the question).*
R : *How you can say that?*
T22 : *(T22 send his answer to researcher via WhatsApp)*



Indonesian language

$a-b=5$
$\downarrow$
$a>b$ .....(1)
$\sqrt{b}-\sqrt{a}=1$
$b>a$ .....(2)
Statements 1 and 2 are contradictory, none of a and b are qualified

English languange

T22 : *Before working on the problem, I always check the information provided. At first glance I saw something strange.*

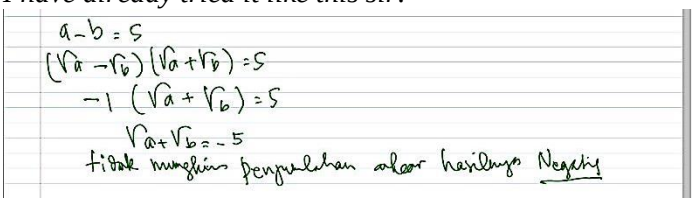
Based on the interview, it can be concluded that T22 conducts self-regulation at the understanding the problem stage, he conducts a self-examination by assessing the information provided in the questions. T22 compares the two information given to the problem, and finds the fact that the two are contradictory.

Teacher self-regulation appears at the implementing plan stage

Four out of 24 or 17% of teachers were able to correct their mistakes at the implementation plan stage. The following are the results of the interview between researcher (R) and teacher (T24) who was able to find fault with the problem given at the implementing plan stage.

R : *If* $a-b=5$ *and* $\sqrt{b}-\sqrt{a}=1$ *with* $a,b\in R$, *then* $a+b$ *is? Try to find the answer!*
T24 : *Ok,*
T24 : *After I tried, there was no answer*

R : *Why?*
T24 : *I have already tried it like this sir!*



Indonesian languange

$a - b = 5$
$(\sqrt{a} - \sqrt{b})(\sqrt{a} + \sqrt{b}) = 5$
$-1(\sqrt{a} + \sqrt{b}) = 5$
$(\sqrt{a} + \sqrt{b}) = -5$
It is impossible for the sum of squared roots to be negative

English languange

R : *Have you checked again?*
T24 : *yes sir (after checking the answer)*
R : *Why* $\sqrt{a} + \sqrt{b}$ *has negative value?*
T24 : *(Thounght for a moment)*
There is something strange about information provided, the two information are contradictory.
R : *So, what do you think? Are you sure you can't find the answer of a+b?*
T24 : *It can not be determined sir.*

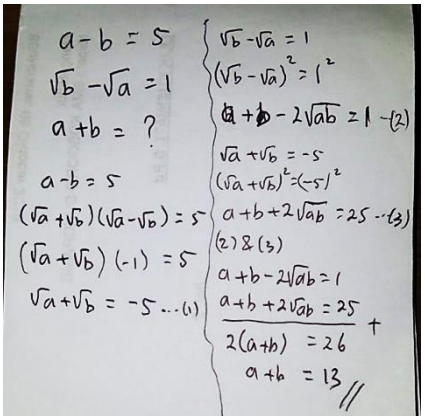
Based on the interview, it can be concluded that T24 has self-regulation in this case he did a self-examination by assessing the credibility of his work. T24 knows that the information contained in the problem is wrong after he uses the information and found the fact of the sum is negative. It is on this basis that T24 finds that the two information provided are contradictory.

The teacher's self-regulation appears at re-checking stage

Two of the 24 teachers or 8% were able to find fault with the problem given at the re-checking stage. The following are the results of the interview between researcher (R) and teacher (T6) who was able to find the fault in problem given at the re-checking stage.

Based on the interview, it can be concluded that T6 did self-regulation when he conducted a self-examination by determining the value and then substituting the results according to the conditions in the problem. T6 realizes that something is wrong after getting the fact that the answer he got is not according to the conditions given. This is what causes T6 to look back at the information in the problem and find the fact that the two information are contradictory.

R : *If* $a - b = 5$ *and* $\sqrt{b} - \sqrt{a} = 1$ *with* $a, b \in R$, *then* $a + b$ *is?*
Try to find theanswer!
T6 : *Ok,*
T6 : *(T6 send his answer to researcher via WhatsApp)*



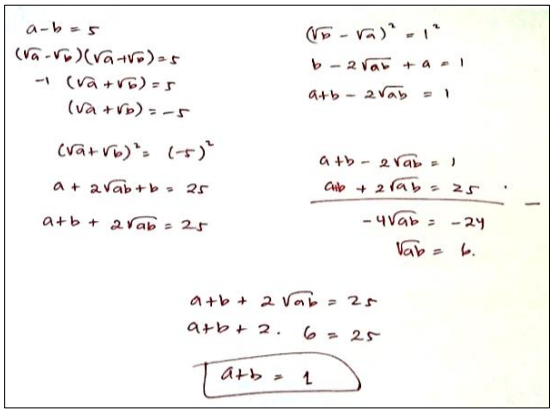
R : *Have you checked again?*
T6 : *(Checking the answer)*
Something is strangel
R : *What is it?*
T6 : *After I eliminate the equestion* $a+b=13$ *and* $a-b=5$, *I get* $a=9$ *and* $b=4$. *But if put it in the equation* $\sqrt{b}-\sqrt{a}=-1$, *contradict the information from the problem.*
R : *What do you think?*
T6 : *(Check again)*
The initial information given was indeed a contradiction, sir. From the information $\sqrt{b}-\sqrt{a}=1$, *so b is greater than a and both are positivet while the information* $a-b=5$ *value a greater than b than the two things are contradictory.*
R : *So, can you answer the question?*
T6 : *No, I can not answer it because the information provided is contradictory*

Teacher self-regulation does not appear during completing PWCI

Four of the 14 teachers or 58% were unable to find a contradiction in the given problem. The following are the results of the interview between researcher (R) and teacher (T20) who was unable to find a contradiction in the PWCI.

Based on the interview, it can be concluded that T20 cannot perform self-regulation properly. T20 is not aware of any contradictions in the information contained in the questions. T20 does not even realize its mistakes when squaring, T20 does not realize that the left side is positive and the right side is negative. T20 also made a miscalculation in the last part of its work. This shows that T20 is not capable of self-correction properly. Even when researchers asked T20 to re-examine his work he was not able to see the mistakes he had made.

R : *If* $a-b=5$ *and* $\sqrt{b}-\sqrt{a}=1$ *with* $a,b\in R$, *then* $a+b$ *is?*
Try find the answer!
T20 : *Ok,*
T20 : *(T20 send his answer to researcher via WhatsApp)*



R : *Are you sure about your answer?*
T20 : *(Re-checking answers)*
yes sir
R : *Are you sure, Mam?*
T20 : *(After a while)*
Yes sir, I'm sure

Based on the results of data analysis and interviews obtained the fact that there are two types of teachers in responding to problems with contradictory information. The first type is the teacher who answers directly on the question without checking the information provided on the question and always assumes that all information provided is correct. The majority of teachers involved in this study belong to this type, this is an indication that there are still many teachers who are not accustomed to critical thinking. These results are in line with the research results of (As'ari, Mahmudi, & Nuerlaelah, 2017) and (Kurniati, Purwanto, As'ari, & Dwiyana, 2019) who find that prospective mathematics teachers are included in the level of not thinking critically. The second type is the teacher who is careful and does a cross-check first before working on the questions, only a few teachers are classified in this type. Teachers of this type are categorized as having good critical thinking skills, because they do analysis, evaluation, and are able to provide explanations well before finally doing inference (Basri, Purwanto, As'ari, & Sisworo, 2019; Facione, 1990). (Nugroho et al., 2018) states that the character of someone who does not easily believe the information he receives is called skepticism. (Cheng, 2014) states that students who are used to doing self-correction have better performance.

There are 24 teachers who are the subjects in this study. They consisted of 14 female teachers and 10 male teachers. Based on the results of data analysis, it was found that 3 out of 10 male teachers (30%) belonged to the teacher who checked the information in the question before working on the problem and 1 in 14 female teachers (7%) who checked the information existing in the problem first before working on the problem. This indicates that men's self-regulation abilities are better than women's. Based on these findings, there is a tendency for men to have the ability to think critically better than women. This result is in line with the research of (Damayanti, 2018; Naafidza, Ainun, & Budiarto, 2014; Sutarji, 2018; Yuwono, Udiyono,

Maarif, & Sulistiana, 2019) who found that men have the ability to think critically better than women. But there are research results that contradict the results of this study, the study found that women have the ability to think critically better than men (Amalia, Sanusi, & Maharani, 2019; Cahyono, 2017; Harso & Gago, 2018; Setyawati, Febrilia, & Nissa, 2020). This indicates that the relationship of the ability to think critically based on gender is uncertain.

Problem with Contradiction Information (PWCI) provides an opportunity to find out the teacher's ability to perform self-regulation. This is in accordance with the opinion of (As'ari et al., 2019) which states that PWCI directs students to not just run mathematical formulas. As'ari further stated that PWCI was directed to help students do reflective thinking first. Reflective thinking is very closely related to self-regulation, someone who does reflective thinking will certainly look back and rethink what they have done. When someone do rethinks, it will do self-regulation, both self-examination and self-correction. Self-examination is done by testing the solution obtained in the initial conditions given to the problem, while self-correction occurs when someone finds an error and makes correction.

Based on the time the teacher's self-regulation emerged when completing PWCI was divided into four. First, the teacher's self-regulation appears at the understanding problem stage, teachers who fall into this category do not directly use the information obtained to complete the PWCI. They identified the information that was known before examining the two information given to the problem and found that there were contradictions in both information and decided not to continue working on the problem. There are four out of 24 teachers (17%) who fall into this category. These teachers can be said as teachers who have high critical thinking skills because they can identify facts in problems, use appropriate knowledge, and solve problems accurately (Rasiman, 2015).

Second, teacher self-regulation appears at the implementing plan stage, teachers included in this category do not check the information provided in the questions. There were four out of 24 teachers (17%), they immediately tried to work on the given problem, but before completing the problem they realized that there was something wrong with the information given because of the addition of two positive numbers with negative results. Teachers who are included in this type always see the results of what they have done, so they immediately realize the irregularities of the results of their work.

Third, the teacher's self-regulation appears at the re-checking stage, the teachers who fall into this category do not check the information provided in the questions. There are two out of 24 teachers (8%), they immediately work on the questions given to completion, they do not realize that there is a contradiction in the question. After being asked to recheck the results of the answers, the teacher realizes that the results obtained are not valid. The teacher tries to do a

self-examination by determining the value and then substitute the results according to the conditions given in the problem. The teacher realizes that something is wrong after seeing the fact that the solution he obtained is not in accordance with the conditions given. This is what causes the teacher to look back at the information and find the fact that the two information are contradictory.

Fourth, teacher self-regulations did not appear during completing the PWCI. Most of the teachers fall into this category of as many as fourteen out of 24 teachers (58%). Teachers who fall into this category do not check the information provided on the problem, they directly work on the problem given to completion, they do not realize that there is a contradiction in the problem. They tend to prioritize procedural abilities in dealing with all problems encountered. There has been no attempt to comprehend the problem given comprehensively in advance. Those who fall into this category can be said as teachers who do not have the ability to think critically because they can only identify facts in the problem (Rasiman, 2015). Teachers in this category have poor self-regulation skills because they have not been able to do self-examination or self-correction. This result is in accordance with research conducted by (Basri et al., 2019) which states that critical thinking skills are still low in the sub-skill self-regulation.

Conclusion

There are two types of teacher responses when answering questions. The first type is reckless teacher who answer questions without first seeing or checking the information provided on the questions. The second type, is the teacher who is always careful and checks on all information when answering questions. Based on data analysis, there is a tendency for participants to belong to the first type teachers, this is certainly a recommendation for policy makers to pay more attention to improving the teacher ability, especially in the self-regulation ability. The limitations of this study are the limited number of respondents and limited references.

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