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A Strategy of Scaffolding Development to Increase Students' Problem-Solving Abilities: The Case of Physics Learning with Causalitic-Thinking Approach*

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ABSTRACT

Unlike general approaches to learning, the Causalitic-Thinking Approach, aims to construct phenomena that have more than one possible answer. However this approach requires scaffolding strategies. This study aims to investigate the strategy of developing scaffolding in learning with the Causalitic-Thinking Approach to increase students' problem-solving abilities; namely, understanding, selecting, differentiating, determining, applying, and identifying. An embedded experimental two-phase design with a sample of 33 senior high school students (21 -females, 12 -males). The differences between pre- and post-tests, and between the problem-solving ability -gain of the low and high groups were tested with Wilcoxon signed-ranks-test. Results show that the scaffolding that was implemented was effective in increasing problem-solving abilities but there was no significant difference between the two groups of students.

Keywords: Scaffolding, causalitic-thinking, and problem-solving.

INTRODUCTION

Lyudmila, Smirnova, and Mounts (2016) and Holton and Clarke (2006) stated that the term of scaffolding was first introduced by Jerome Bruner. In the 1970s, the term was used to refer to the assistance that was given to the learner by the teacher, or a more knowledgeable peer, in providing comprehensible input and aimed at moving the learner into the zone of their proximal development. Later, Wood, Bruner, and Ross (1976) defined scaffolding as a series of activities to facilitate the child in learning. The activities begin by encouraging the child to participate in actions, the tutor then interprets any discrepancies to the child, and finally, take on a confirmatory role.

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McKenzie (1999) agreed that scaffolding provides clear instructions, clarifies purpose, and keeps students on task. In additions, it also offers an assessment to clarify expectations, points students to worthy sources, reduces uncertainty, surprise, and disappointment, delivers efficiency and creates momentum (as quoted by Lyudmila, Smirnova, & Mounts, 2016).

To improve the quality of learning, many experts have studied how learning should be held. Zubaidah, Fuad, Mahanal, and Suarsini (2017) integrated the differentiation science inquiry with the mind map technique to improve the creative thinking skills of students, and Rokhmat, Marzuki, Hikmawati, and Verawati (2015, 2017a, 2017b, and 2017c) used the causalitic-thinking approach (CTA) to increase problem-solving ability (PSA) in physics learning. Specifically, the teacher divides the main task (or question) into more detailed tasks (or questions) which the students have to solve. Rokhmat (2013) and Rokhmat et al (2015, 2017a, 2017b, & 2017c) developed a scaffolding worksheet to assist students in solving physics problem and to increase their PSAs. Dawkins, Hedgeland, and Jordan (2017) developed scaffolding in the structure of questions to reduce the gap of gender, while Maries, Lin, and Singh (2017) investigated the appropriate designing of scaffolding to improve student's representation consistency.

Quintana and Reiser et al. (2004) used scaffolding to design a software tool for scientific inquiry. Veerappan, Suan, and Sulaiman (2011) used it to help facilitate the challenges of developing effectiveness in journal writing. Further, Walqui (2006) used scaffolding in the structure and process of the learning of adolescent students. Wilson and Devereux (2014) mentioned that the designing of scaffolding involves sequenced and structured sub-tasks, which leads to completion of the major task.

According to constructivist learning, the permanent learning only occurs when the students are actively engaged in the learning process. Piaget and Vygotsky are accepted as the fathers of the constructive approach. As Dahar (1988, 1991) quotes, Piaget stated that the theory emphasized the process of discovering knowledge which is constructed by means of assimilation and accommodation. Ratumanan (2004:45), as quoted by Slavin (2000), stated that the Vygotsky's theory had two implications: cooperative learning and the use of scaffolding in it. Next, Slavin (2000) added that in cooperative learning, heterogeneous groups of the students were advisable.

All the studies that were discussed above strongly advise the implementation of scaffolding strategies in learning. With scaffolding, students are able to solve problems that exceed their ability. In principle, scaffolding means dividing the main problem into several sub-problems, each of which is easier to be solved. When all of the sub-problems are solved, it means the main problem has been solved.

With respect to scaffolding, Rokhmat (2013) and Rokhmat, Marzki, Hikmawati, and Verawati (2017a, 2017b, & 2017c) developed a strategy to use in physics learning called the causalitik thinking approach (CTA). The scaffolding was implemented on seven subjects, i.e. kinematics, Newton's law of motion, work and energy, impulse and momentum, gravity, rigid equilibrium, and thermodynamics. The approach facilitated pre-service teachers to develop their ability in causalitic thinking.

Since 2016, some instruments of physics learning based on CTA also have been developed to increase the PSAs of senior high school (SHS) students regarding fluid, heat, electric, optics, and rigid body equilibrium in which also uses the scaffolding. They also introduced nine patterns of instrument design in physics learning with CTA, with one of them in standard form and the other eight in scaffolding.

Nurmadiah, Rokhmat, and Ayup (2018) proved that two of the eight forms of scaffoldings were effective in increasing the SHS students' PSAs on optics. They named the scaffoldings as Type 2a and 2b. In the two types of scaffolding, we present the causal model, number of all causes and effects, and some of the causes and effects. In Type 2b, we also present an example of an argument for explaining why an effect occurs, which is not included in Type 2a. We conducted further research to investigate the influence of the use of scaffolding on the SHS students' PSA; for example, Tamami (2017) implemented Type 2a scaffolding on fluids, and Helmi (2017) implemented Type 2b scaffolding on fluids. The results showed that both types of scaffoldings were effective in increasing the PSA.

Prayogi, Yuanita, and Wasis (2018) used scaffolding that included investigative activities, formulating problems, making hypotheses, and planning experiments to facilitate students' learning. In addition, they used scaffolding to facilitate students in analyzing experimental data. Özmen and Yildirim (2005) stated that learning tools in the form of student worksheets are more effective than traditional learning methods and tools. Worksheets make students more active in learning.

The idea behind designing instrument of scaffolding patterns is in line with Joyce, Weil, and Calhoun (2011 and 2016) assertion that a learning model has to provide some assistance stages (scaffolding) to promote a strong understanding and capability to solve a problem. In general, patterns of scaffolding have been developed related to: 1) the causality table which is suitable for a particular phenomenon; 2) the number of causes and/or effects; 3) one or more examples of the causes, and/or effects; and 4) one or more examples of reasons of the conditions of each cause that need to be present to bring about an effect, or why the effect occurs (Rokhmat, 2013; Rokhmat, Marzuki, Hikmawati, & Verawati, 2015, 2017a, 2017b, 2017c).

This paper will provide an example of a scaffolding approach (CTA) and discuss its impact on the PSA of students. Finally, this study aims to answer two questions: 1) How far the scaffolding is effective in increasing the PSA of students, and 2) How the strategy to develop scaffolding in physics learning with a causalitic-thinking approach (CTA).

AIMS

This research aims to investigate the effectiveness of the scaffolding strategy developed in physics learning with Causalitic-thinking Approach (CTA) in increasing the Problem-solving Ability (PSA) of students, investigate the sort of scaffolding possible to be developed and to present some examples of them.

METHODS

This research is primarily oriented to design a physics learning instrument with a CTA in scaffolding form, and to investigate how effective the implementation of the scaffolding is. PSAs of students were identified with high and low. The design of the current study is a mixed method of embedded experimental design with two phases, quantitative (main phase) and qualitative (secondary phase). The study included four main activities: analyzing subject matter, designing instruments, validating instruments (expert and empirical), and analyzing data and interpreting its results. The analysis of the subject matter, development of the instruments, expert validation, and interpretation of results constituted the qualitative phases the empirical validation and analysis of the data constituted the quantitative phase (Creswell & Clark, 2007) (Figure 1).

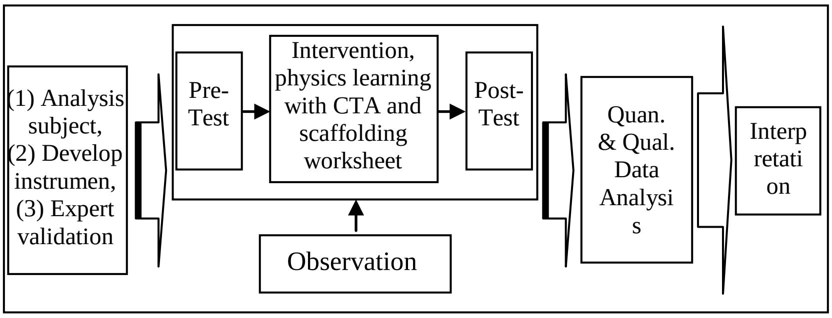

Figure 1: The research phase modified from the essence of two-phase experimental embedded design (Creswell & Clark, 2007: 68).

Qualitative data were gathered from four activities of the research, i.e. analyzing subject matter, developing instruments, and validation by experts, also observation and interpreting the results of the research. Quantitative data were found from two activities, pre-test and post-test, which be held, respectively, before and after intervention (physics-learning with the causalitic-thinking approach in scaffolding form). The tests were used for empirical validation of the instruments and for testing the hypothesis of this research. A qualitative approach was used to characterize the requirements needed to develop the learning instrument with CTA in scaffolding pattern.

The participants were 33 second-year students (females=21; males=12) in one class of a senior high school (SHS) in Mataram, Indonesia in the 2016/2017 school year. Data relating to PSA were obtained using five multi-effect-problems.

In learning, the students were divided into eight groups based on the results of a grouping test about a physics concept which was held at the beginning of the current study. Seven groups consisted of four members and the last one consisted of five members. To analyze the PSA, the students were divided into three groups, group one consisted of students with rank 1 to 9, group two with rank 10 to 24, and the last group with rank 25 to 33. In the second grouping, the first and the third groups respectively were named as the high (Hi) and low (Lo) groups which were needed to analyze the increase of PSA. To analyze the increase in PSA of groups Hi and Lo, and its difference between the two groups, Wilcoxon Signed Rank Test was used (Minium, King, & Bear, 1993)

FINDINGS

The Problem-Solving Ability (PSA)

The problem-solving ability (PSA) is obtained from pre- and post-tests. A score of the PSA is also counted for each of the six indicators of the PSA (IPSA). The indicators include understanding (IPSA-1), selecting (IPSA-2), differentiating (IPSA-3), determining (IPSA-4), applying (IPSA-5), and identifying (IPSA-6). The significance of PSA in increasing the student PSA and the significance of N-gain difference between students of group low (Lo) and high (Hi) were determined by values of the asymp. Sig. (2-tailed) as a result of the analysis using the SPSS application. We reject the null hypothesis if the asymp. Sig. (2-tailed) is less or equal to 0.05. For this analysis, we used the IBM SPSS application statistics version 23.

The results of the analysis are presented in Tables 1 to Table 4. Table 1 shows that the implementation of the causalitic-thinking approach (CTA) in a high and low group of students experienced a significantly increased problem-solving ability (PSA). Table 2 shows that as the implementation of this CTA in high group students, all PSA indicators (IPSA-1 to 6) experienced a significant increase. While Table 3 shows that the implementation of CTA in low-group students significantly only increased four of the six PSA indicators, namely IPSA-1 to IPSA-4 while IPSA-5 and IPSA-6 did not experience a significant increase (indicated by asymp. Sig. (2 tailed) is greater than 0.05, i.e. 0.180 and 0.317). Finally, Table 4 shows that the gain of CTA implementation results for students in the high and low groups is generally no different. Of all the PSA indicators (IPSA-1 to 6) only IPSA-5 (17%) differed significantly (indicated by an asymp. Sig. (2-tailed) value of less than 0.05, ie 0.014, while the asymp value. sig. (2-tailed) other more than 0.05).

Table 1 Result of Wilcoxon Signed Ranks Test Based on Negative Ranks[b] for the PSA of Student of High (Hi) and Low (Lo) Groups

	Post – Pre PSA of Hi	Post – Pre PSA of Low
Z	-2.670[b]	-2.675[b]
Asymp. Sig. (2-tailed)	.008	.007

Table 2 Result of Wilcoxon Signed Ranks Test Based on Negative Ranks[b] for the IPSA of Student of High (Hi)

	Post test – Pre test					
	IPSA-1	IPSA-2	IPSA-3	IPSA-4	IPSA-5	IPSA-6
Z	-2.333[b]	-2.598[b]	-2.588[b]	-2.558[b]	-2.558[b]	-2.121[b]
Asymp. Sig. (2-tailed)	.020	.009	.010	.011	.011	.034

Table 3 Result of Wilcoxon Signed Ranks Test Based on Negative Ranks[b] for the IPSA of Student of Low (Lo)

	Post test – Pre test					
	IPSA-1	IPSA-2	IPSA-3	IPSA-4	IPSA-5	IPSA-6
Z	-2.701[b]	-2.232[b]	-2.699[b]	-2.646[b]	-1.342[b]	-1.000[b]
Asymp. Sig. (2-tailed)	.007	.036	.007	.008	.180	.317

Table 4 Result of Wilcoxon Signed Ranks Test Based on Negative Ranks[b] for the Difference between IPSA Gain of High (Hi) and Low (Lo) Students

	Gain of Hi PSA – Gain of Lo PSA					
	IPSA-1	IPSA-2	IPSA-3	IPSA-4	IPSA-5	IPSA-6
Z	-0.424[b]	-1.334[b]	-1.476[b]	-1.951[b]	-2.456[b]	-1.890[b]
Asymp. Sig. (2-tailed)	.671	.182	.140	.051	.014	.059

The Example of Strategy Developing Scaffolding on the Learning with CTA

Strategy of developing scaffolding in this study were closely related to the compilation of the phenomenon and student worksheet which is equipped by its causality table and space for writing arguments. The scaffoldings are presented in the students' worksheet. In principle, with respect to the causalitic-thinking approach (CTA), it is recommended to compile phenomenon with more than one answer (multi-effect phenomenon) and design students' worksheet with the level of scaffolding being appropriate with the ability of students.

To compile the phenomenon, we design one or more causes as the factors of an effect as variable or have more than one condition. In general, the combination of conditions of each cause will result in only one effect. When one or more causes are designed as variable, they will result in more than one combination of the conditions which as will also result in more than one effect. In general, the number of effects is exactly the same as the number of combinations above, an exception if we confine the effect with specific point of review, the number of effects will be less or the same as number of the combinations or in another word that the number of combinations indicates the maximum number of its effects. Without restriction, the phenomenon can cause too many possible effects (answers) so very difficult for a student to solve it. One of the ways to limit the possible effects is that the question on the phenomenon is restricted, such as making a specific point of review as mentioned above.

Examples of phenomena in student worksheets and key answers (on electrics)

Suppose a closed electric circuit involves three identical bulbs, A, B, and C (be ably combined in series, parallel, or combination of them), also one battery ε. The ends of the combination are connected to the battery ε. Determine all possibilities of the brightness of each bulb. Explain how your answers occur and mention concept, principle, theory, and or the law of physics related to your explanation.

To answer the question, it is provided a table of causality in which students have to fill all elements of causes and effects. They also have to explain the conditions of each cause so result in each effect. At this phenomenon, the number of causes is possible to be three, i.e. (1) the bulbs A, B, and C are identical, (2) the bulbs be combined in series, parallel, or combination of the series and parallel, and (3) the two ends of the circuit are connected to the battery. While, the possible effects is two, i.e. (1) all of the bulbs are light on with the same brightness or (2) one of the bulbs is light on brighter than the two other which are light on with the same brightness.

The first effect can be explained as follow: All of the bulbs be combined in two ways, series or parallel. Each of the ways of combination causes in each bulb will flow the same electric current that results in each bulb light on with the same electric power so causes each of the bulbs is also light on with the same brightness. However, in a parallel combination, the bulb is light on with nine times brighter than that of in series combination. The second effect is also possible to occur in two conditions. The first condition is when two bulbs are combined in series then combined in parallel with the third bulb. At this combination, the third bulb is light on brighter than the two others that have the same brightness. The second condition is when two bulbs are combined in parallel then combined in series with the third bulb. At this combination, the third bulb is also light on brighter than the two others that also have the same brightness. However, these two conditions result in the same effect that the third bulb lights four times brighter than the two other.

The strategy to design scaffolding at this tasks be able as follow: 1) provide its appropriate table of causality, 2) inform the number of all causes and/or all effects, and 3) inform part examples of the causes and/or the effects, also 4) give part of explanations. As a comparison, without scaffolding, the student has to do all of the tasks above.

In this research, scaffolding is defined as what and how far assistance stages are put in learning activities (with causalitic thinking approach, CTA), in instruments or in its implementation strategy. The CTA introduces several things, such as patterns of the causal model (Rokhmat, Marzuki, Hikmawati, and Verawati, 2017b), designing multi-effects phenomenon, determining the causes, predict all possible effects, and compiling arguments in which conditions of each cause are explained why they result in every effect.

It has been developed 8 groups of strategy to develop scaffolding in instruments of physics learning. The strategy is such as inform: 1) table of causality that is appropriate with its causal model (group 1), 2) number of all causes (group 2), 3) number of all effects (group 3), 4) number of all causes and effects (group 4), 5) some examples of the causes (group 5), 6) some examples of the effects (group 6), 7) some examples of the causes and effects (group 7), and inform one or some examples of the arguments (group 8) (Rokhmat, 2013). However, the strategy can also be compiled as a combination of two or more among the groups above. Thus, with respect to the strategy, the scaffolding that is possible be developed is about the pattern of causality table (causal model), the number and its example of causes and effects, and the example of arguments relating conditions all of the causes and each effect. Note:

When the form of causality table of each phenomenon is given, students only need to write all elements of causes and effects in each of its cell.

DISCUSSION and CONCLUSION

Discussion

The results of this study revealed that For an indicator of PSA, at students of Hi group, all indicators (IPSA-1 to 6) are significantly increased (Table 2) while at students of the Lo group only four indicators (IPSA-1 to 4) that significantly increased (Table 3). The opposite situation occurs at the difference of gain (GD) between the PSA for students of Lo and Hi groups, only the fifth indicator (IPSA-5) that significantly increased (Table 4).

The facts above indicates that implementation of the Causalitic-thinking Approach (CTA) is effective in increasing abilities of student including the ability to understand problem, select causes and effects, differentiate which of the causes as the factor of each effect, determine which of the concept, principle, theory, and/or law of physics related to the problem, and ability to apply those concept, principle, theory, and/or law of physics when arranging an argument. On the other hand, increasing the ability of students to compile the argument is not effective. In general, these means that implementation of the CTA is effective to increase problem-solving ability (PSA) which is in line with Rokhmat (2013) and Rokhmat, et al (2017a, 2017b, & 2017c).

Meanwhile, in general, the CTA gave the same impact on both, PSA on the students of Lo and Hi groups which can be interpreted that the instruments used in learning provide the same advantage on all students including the students of the moderate group. This finding is also in line with Rokhmat (2013) and Rokhmat, et al (2017a, 2017b, & 2017c).

Although implementation of the CTA significantly increased the PSA of students, some of its final achievement remains low. Two indicators (IPSA-1 and IPSA-3, on Hi group) achieved quite a high score (91.1 and 82.2), two indicators (IPSA-2 on Hi group and IPSA-1 on Lo group) achieved moderate score (75.6 and 73.3) but the eight other (IPSA-2 to IPSA-6 on Lo group and IPSA-4 to IPSA-6 on Hi group), the scores achieved are very low (55.6 down to 2.2) (Table 5).

Table 5 Average of Final Score of Problem-solving Ability

Data Attribute	Indicators of Problem Solving Ability (IPSA)					
	IPSA-1	IPSA-2	IPSA-3	IPSA-4	IPSA-5	IPSA-6
Lo	73.3	53.3	55.6	17.8	8.9	2.2
Hi	91.1	75.6	82.2	37.8	31.1	13.3

The score of each IPSA above is related to the level of its difficulty. Each indicator of PSA, from IPSA-1 to IPSA-6 respectively represents more and more difficult ability. Ability in IPSA-1 represents that student understands what he has to do with the problem. In IPSA-2, the student needs to select which part of the problem as causes, then using their knowledge he predicts what effect being possible occurred. Having decided which causes as the factor of each predicted effect, in IPSA-3 the student has to differentiate which causes as the factor of each predicted effect which means that the change of the causes will change the possibility of the effect to occur. In IPSA-4, the student needs to analyze the problem and determine whether there is a concept, principle, theory, and/or law of physics in it. To do so of course the student has to have knowledge about those. In IPSA-5, the student needs to apply the concept, principle, theory, and/or law when compiling an argument. Finally, in IPSA-6, the student has to compile the argument or explanation in what conditions the causes will result in each predicted effect. This last IPSA represents the most difficult ability because the student has to use his knowledge comprehensively to correlate the causes with the possibility of happening of each effect (Rokhmat, 2013 & Rokhmat, et al, 2015, 2017a, 2017b, 2017c).

The low final achievement of IPSA score, especially on IPSA-4, IPSA-5, and IPSA-6, is also related to the structure of scaffolding used. In this study, the scaffolding used was: (1) provided appropriate table of causality, (2) informed the number of all causes, (3) informed the number of all effects, (4) gave part examples of causes, (5) gave part examples of effects, and (6) gave part examples of arguments which as the basis of the scoring on the last four IPSAs above. Note: The stage number (2) up to (5) is written in the causality table of number (1) above.

With nine students in each group (Lo or Hi) and five problems that students have to solve, there are 45 arguments per group possible be compiled. However, students only compiled 26 (58%) arguments (for Lo group) and 38 (84%) arguments (for Hi group) which also indicate the possible maximum scores of the IPSA-3, IPSA-4, IPSA-5, and IPSA-6.

Explanation of the paragraph above is that from the arguments we can investigate: (1) the causes which be the factor for the effect the student has predicted (IPSA-3); (2) whether the student states concept, principle, theory, and/or law related to the problems (IPSA-4); (3) if any the concept, principle, theory, and/or law that student states, we can investigate whether the student capable to apply them in the arguments (IPSA-5); and (4) finally, whether the student has compiled a reasonable explanation in the arguments that clearly relate conditions of all causes to each has predicted effect (IPSA-6). This description implicitly also explained why the IPSA-6 has never achieved a higher score than that of IPSA-5 which is also never achieved a higher score than that of IPSA-4. The three indicators are related to each other through the concept, principle, theory, and/or law. This last statement is in line with Table 5 and Table 6.

Table 6 Average of Initial Score of Problem-solving Ability

Data Attribute	Indicators of Problem Solving Ability (IPSA)					
	IPSA-1	IPSA-2	IPSA-3	IPSA-4	IPSA-5	IPSA-6
Lo	35.6	31.1	4.4	2.2	2.2	0.0
Hi	75.6	51.1	26.7	6.7	0.0	0.0

Based on student works in the worksheet, the number of arguments that students compiled is quite high, 58% (Lo group) and 84% (Hi group). However, based on Table 5, the average score of IPSA-3 (55.6 and 82.2) is much higher than those average score of IPSA-4 to IPSA-6 (17.8 down to 2.2 for Lo group and 37.8 down to 13.3 for Hi group). The fact occurs because in the arguments students only explained the causes assumed as the factor without mentioned at least one of concept, principle, theory, and law related to the problem. In addition, the explanation compiled does not clearly relate the causes to the effect he has predicted.

Characteristics of the example of the phenomenon used

In the example of the phenomenon of electric, there are some characteristics. As the causes in the phenomenon include: (1) there are three bulbs A, B, and C, which are identical, (2) the bulbs are compiled in series, parallel, or its combination, and (3) two ends of the compilation are connected to the battery. In this case, the cause of number (1) and (3) are fixed but the cause of number (2) is set as a variable which has three possibilities of conditions (all bulbs are compiled in series (2a), parallel (2b), or in its combination (2c).

However, the combination of series and parallel of the three bulbs (combination 2c) has two possibilities, i.e. one bulb is compiled in series with the two bulbs that are in parallel combination (2c-1) and the other one is one bulb is combined in parallel with the other two bulbs that are in series combination (2c-2). This means that combinations the cause of number (2) actually consists of four possibilities, namely cause-2a, cause-2b, cause2c-1, and cause 2c-2. As the results, the phenomenon has four possible combinations of the cause conditions, i.e.

cause (1)-cause (2a)-cause-3 (combination-1), cause (1)-cause (2b)-cause-3 (combination-2), cause (1)-cause (2c-1)-cause-3 (combination-3), and cause (1)-cause (2c-2)-cause-3 (combination-4).

The possible effects due to the combinations of causes

In the example, the possible effects of the phenomenon could be about the brightness, the electric current flowing, the electric power, the electric energy used, the durable of the bulb, etc. In other words, the effects being possible occurred could be infinite. Therefore, we need to confine by selecting a determined point of view. In the example, the effect is determined with respect to the brightness of each bulb. With this determining, it is only two effects, i.e. all of the bulbs light on with the same brightness and the one another is one bulb light on brighter than the two others that have the same brightness.

Restrictiveness: The unsatisfying achievement of PSA in the research is caused by some restrictiveness such as: (1) the students unused to yet learning physics conceptually, (2) from interview, students need more than 80 minutes to solve two problems, and (3) the problem, in general, is written with long description, also (4) students spend part of their time to explore concept needed before solving problem. This restrictiveness is in line with Rokhmat (2013) and Rokhmat, et al (2017a, 2017b, and 2017c) in his research with the subject of undergraduate students of Physics education program.

To reduce the restrictiveness it is considerable that in learning with CTA needs to give a pre-task (given before learning in class), the student worksheet only has one problem (phenomenon) for learning 80 minutes, develop the problem (phenomenon) with description as simple as possible, and provide a special textbook with respect to learning with the CTA for students. Finally, it is recommended that this learning is applied since basic education.

Conclusion

Physics learning with causalitic-thinking approach (CTA) in scaffolding form is significantly effective to increase problem solving ability (PSA) of students of Low (Lo) and High (Hi) groups on the electric matter. In addition, the increase of PSA on Lo and Hi groups are not different. These means that the scaffolding developed in this learning gave the same advantage for the two groups of the students that also meant effective in increasing the PSA of all students.

Scaffolding which has been developed in the Physics learning with the CTA as follow: 1) The appropriate table of causality is provided, 2) The number of all causes and effects is informed, 3) some of the causes and effects be given, and 4) Example of its arguments is also informed. With this scaffolding, what students have to do are complementing the other causes and effects and compile the other arguments. This scaffolding as an example of the strategies of scaffolding development for guiding students to solve the phenomenon they are facing by compiling tasks sequentially and some of the tasks solved as an example. This development strategy of scaffolding is presented in the student worksheet.

Finally, in general, there are some ways to develop scaffolding in learning activities. First, decipher the main task into some sub-tasks. Second, the sub-tasks are translated into sub-actions that students have to do. The last, the sub-actions are translated into sub-guides then are presented in learning instrument, such as student worksheet.

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