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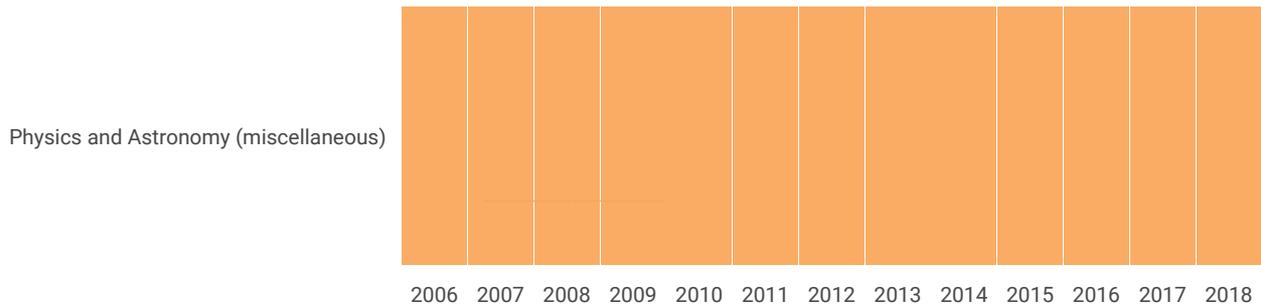
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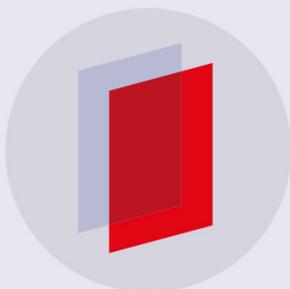
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The profile of students' self-efficacy using virtual chem-lab in hybrid learning

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Abstract. Self-efficacy is one of the affective outcomes that affect students' motivation and learning. This study would like to present the profile of students' self-efficacy who used virtual chem-lab in hybrid learning. Descriptive quantitative method was used in this study. Level of self-efficacy of 74 students were measured using the self-efficacy questionnaire. The students came from three groups named groups A, B and C, with different learning process in each class. The learning process of group A was as usual learning process used hands-on laboratory. The group B used virtual chem-lab as supplement of hands on laboratory integrated into hybrid learning. On the other hand, the group C used virtual chem-lab as replacement of hands-on laboratory which was integrated into hybrid learning. The students' self-efficacy data were analyzed by categorizing the self-efficacy score into ideal rating category. The result of this study showed that students who used virtual chem-lab both as supplement and replacement of hands-on laboratory integrated into hybrid learning had mostly good level of self-efficacy, while students in the group A had lower scores with fair level of self-efficacy. It indicated that the use of virtual chem-lab in hybrid learning have positive influence on students' self-efficacy.

1. Introduction

Self-efficacy refers to beliefs in capabilities to organize and execute the courses of action required to produce given attainments [1]. Self-efficacy beliefs affect the quality of human functioning through cognitive, motivational, affective, and decisional processes [2]. It affects behavior not only directly, but also by its impact on other determinants such as goals and aspirations, outcome expectations, affective proclivities, and perception of impediments and opportunities in the social environment [3].

Self-efficacy affects choice of activity, effort, persistence, [4, 5, 6] learning [4, 6, 7], achievement [4, 7, 8] and strategy oriented [7, 8, 9]. People tend to choose tasks and activities at which they believe they can succeed and avoid those which they think they will fail [10]. Students with low self-efficacy tend to avoid many task, especially those that are difficult and challenging [5, 7], whereas those who belief in their capability are likely approach these tasks [4]. Self-efficacy has strong related to effort and persistence [4]. When facing difficulties, efficacious students work harder and persist longer [4], while low self-efficacy students will put in little effort and give up quickly [10]. Although the ability are same, students with high self-efficacy tend to learn and achieve more than students with low self-efficacy [8]. Self-efficacious students mastered academic task better than students with lower self-efficacy [4]. They also find and use better task strategies to attain the goals [9]. Previous study found that students with high self-efficacy for reading and writing were more likely to adopt a deep strategy-oriented approach to studying, while students with low self-efficacy were more likely to take a surface approach [11, 12].



Previous study found that self-efficacy beliefs have positive influence to students' academic performance in chemistry lesson [13, 14], then effort to improve self-efficacy is necessary to support chemistry learning outcomes. Development of self-efficacy is affected by people's own and other experience on succeed and failure, persuasion from others, and physiological condition [1, 7]. Recent studies were found that educational programmes have possibility to enhance students' self-efficacy [15]. Bautista & Boone [16] also found that the use of virtual laboratory could increase self-efficacy of preservice teacher. The virtual chem-lab can be integrated hybrid learning that combination of face to face and online activity [18]. Many studies proved that it has positive effect in improving the learning outcome [19, 20]. Therefore, this study aimed to reveal the profile of students' self-efficacy who used virtual chem-lab in hybrid learning.

2. Methods

2.1. Participant and Procedure

Descriptive quantitative method was used in this study. This study was conducted on chemical bonding material. A total of 74 students from a public senior high school were participated in this study. The students were from three classes with different learning process. The differences of learning process in all three classes is shown in Table 1. The learning process of group A was as usual learning process used hands on laboratory. The learning process in the group B was by implementing virtual chem-lab as supplement of hands on laboratory integrated into hybrid learning. On the other hand, the group C used virtual chem-lab as replacement of hands on laboratory which was integrated into hybrid learning.

Table 1. Differences in Learning Processes in All Three Classes.

Hybrid Learning Phase	Class		
	A	B	C
1 st , 2 nd			
Face to face	Discussion, presentation, question and answer, Individual task	Discussion, presentation, question and answer	Discussion, presentation, question and answer
Online	-	Individual task, discussion	Individual task, discussion
3 rd , 4 th			
Face to face	Experiment using hands-on lab, Discussion	Experiment using hands-on lab, Discussion	Experiment using virtual chem-lab, Discussion
Online	-	Experiment using virtual chem-lab, question and answer	Discussion, question and answer
5 th			
Face to face	Discussion, question and answer, exercise	Discussion, question and answer, exercise	Discussion, question and answer, exercise
Online	-	Discussion	Discussion

The use of virtual chem-lab was integrated into hybrid learning by combining face to face and online instruction. The online phases were done three times; e. i. in the beginning, in the middle and in the last of learning sessions. The online phase of hybrid learning is used as a supplemental discussion forum with the proportion of online phases being performed that was 30-40% of the face-to-face

phase. As learning management system, smart phone-based Social media of Line was used as discussion media the online phase of supplement and replacement groups.

2.2. Data Collection Instrumen

Self-efficacy questionnaire was used to measure students' self-efficacy level. It was given at the end of the chemical bonding lesson. The questionnaire used a Likert scale modification of 4 points from never to always. The aspects measured in the self-efficacy questionnaire include the choice of activity, effort and persistence, learning and achievement, and strategy oriented. The aspects were synthesized from low and high criteria of self-efficacy [4,5,6,7,8,9]. These aspects were spelled out into 24 point statements. The self-efficacy questionnaire used has passed two validation steps. The first was content validation by two experts covering aspects of content, construct and language. The second stage was empirical validation involving 267 students from two schools to test the questionnaire. The second was empirical validation by 267 students from two schools. The self-efficacy questionnaire was proven to be reliable with Cronbach's alpha value of 0.71.

2.3. Data Analysis

Descriptive quantitative analysis was used to reveal the profile of students' self-efficacy. The self-efficacy scores obtained were converted into interval data scale. Then, the scores were analyzed by categorizing into ideal rating category [21]. The ideal rating category could be seen in Table 2.

Table 2. Ideal Rating Category.

Score Range	Category
$X_i + 1.8 SB_i < \bar{X}$	Very Good
$X_i + 0.6 SB_i < \bar{X} \leq X_i + 1.8 SB_i$	Good
$X_i - 0.6 SB_i < \bar{X} \leq X_i + 0.6 SB_i$	Fair
$X_i - 1.8 SB_i < \bar{X} \leq X_i - 0.6 SB_i$	Poor
$\bar{X} \leq X_i - 1.8 SB_i$	Very Poor

Note: $X_i = \frac{1}{2}$ (ideal max score + ideal min score); $SB_i = \frac{1}{6}$ (ideal max score - ideal min score); \bar{X} = average score of students' self-efficacy.

3. Result and Discussion

To reveal the profile of students' self-efficacy using virtual chem-lab in hybrid learning, students from three groups was measured their self-efficacy level. The statistical descriptive of self-efficacy score obtained by group A, B and C can be seen in Table 3. Based on the ideal rating category, it indicated that students of group B and group C had higher self-efficacy level with good category, whereas group A had fair category. Although the result difference was small, but it shows that the use of virtual chem-lab both as supplement and replacement in hybrid learning have positive effect on students' self-efficacy. These results were similar with finding of Bautista and Boone [16] that the use of virtual laboratory could increase self-efficacy of preservice teacher. Furthermore, the finding of Nurfitriyana, Wiyarsi, and Sugiyarto [17] also showed that the use of hybrid learning can improve students' self-efficacy.

Table 3. Descriptive Statistics of Students' Self-efficacy.

Group	N	Mean	Standard Deviation	Category
A	27	64.37	8.172	Fair
B	22	67.36	8.984	Good
C	25	67.92	9.552	Good

Initially, students in group B was expected to get highest self-efficacy score because of their learning process used both hands-on and virtual lab. However, contrary to the result was observed. Group C was surprisingly got highest self-efficacy though they only used virtual chem-lab as replacement of hands-on lab. One of the reasons observed was the high enthusiasm of students in group C. Previous study found that students who enjoyed web-based learning environments or were curious about web courses had higher self-efficacy [22]. In this study students in both group B and C were interest to use virtual chem-lab, but students in group C were interest more. They have done experiment using virtual chem-lab many times and tried to do it again at home. Students in group C were also actively asked and discussed difficult materials until they clear enough. It was make them more confident to their capability.

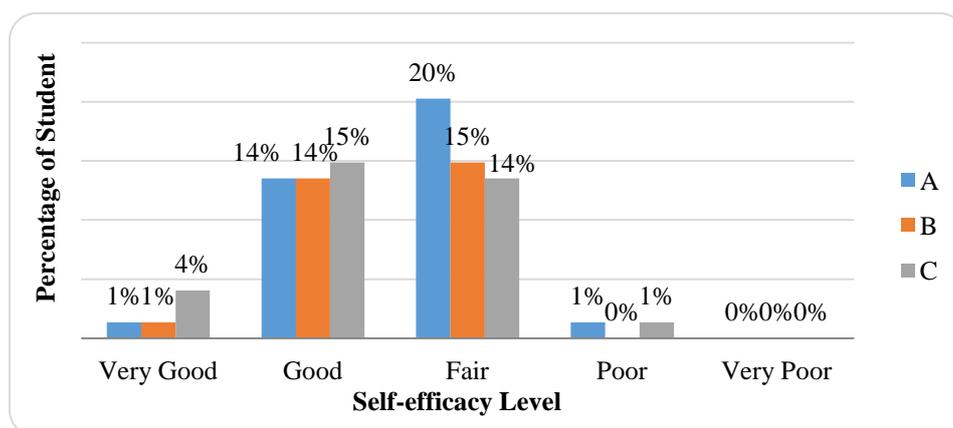


Figure 1. Percentage of self-efficacy level of three groups.

Figure 1 shows the comparison of self-efficacy level percentage of all three groups. In all three groups the students' self-efficacy level is mostly in good and fair category. There were no student had very poor self-efficacy. It means that every student has belief in himself though only a little. Students of group C got highest percentage on very good category of self-efficacy. One of the most striking sign observed was they more likely to approach challenging task. In group A more than half students were in fair category. It may be there was no online phase in learning activity of group A. Therefore, their experience were less than the other two groups. Discussion activity of group A was also not as much as group B and C, so they got less experience to solve problem and explore deeper and broader to the related material. While group B and C were given time in online phase to discuss the difficult material that simulate them to learn broader to the related material. When one of students asked about difficult material then they discussed it, thus all student in online forum could read the discussion and enrich their knowledge. It was indirectly increase their belief of their capability to solve further task.

There were still a small percentage of students who had poor category of self-efficacy. These students observed that they had low self-efficacy belief from the beginning of the lesson. Students' own succeed and failure is strongly affect their self-efficacy [10]. Students feel more belief that they can succeed at a task when they have succeeded in the similar task in the past [1]. These student gained poor score in previous chemistry materials, so they feel that they could not master current material too. Even when they were given an extra time to ask and discuss the material which they did not understand, they refused and did not show more effort to understand it. Succeed and failure of others also affected students' self-efficacy [10]. When student who considered as the smart one failed to solve a task, the other students feel that they certainly will not able to.

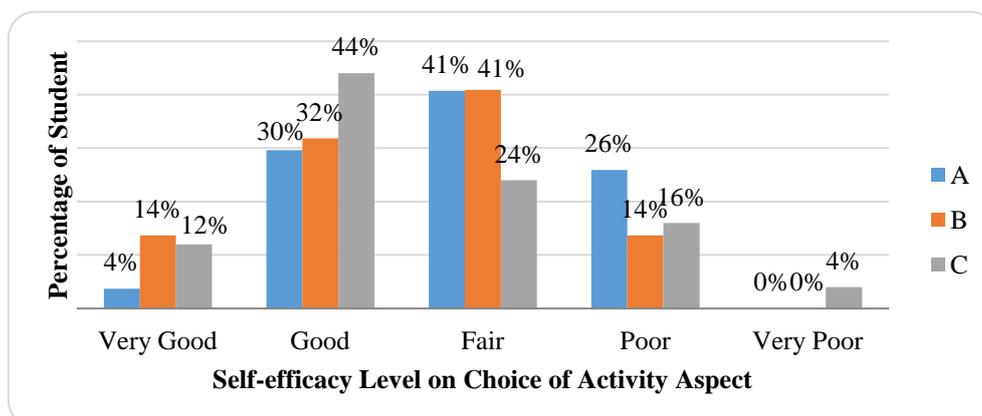


Figure 2. Students' Self-efficacy Profile on Choice of Activity Aspect.

There were six aspect of self-efficacy measured in this study i.e. choice of activity, effort, persistence, learning, achievement, and strategy-oriented. On choice of activity aspect, the average of self-efficacy score of all three groups were in fair category of self-efficacy. It is reasonable because of students are usually avoid difficult task. However, there were students in group B and C confidently undertook the task given. As shown in Figure 2, the very good category of self-efficacy on choice of activity aspect is dominate by students of group B and C, whereas, the good category of self-efficacy was dominated by group C. Many of them actively asked and discussed the difficult material in online phase, so they believe they could solve the task. Actually, some students of group A also had self-belief because they gained good score on previous lesson material. Mastery experience is important source of self-efficacy [1]. Unfortunately, their belief were decreased in the end of lesson because they tough that chemistry materials is difficult.

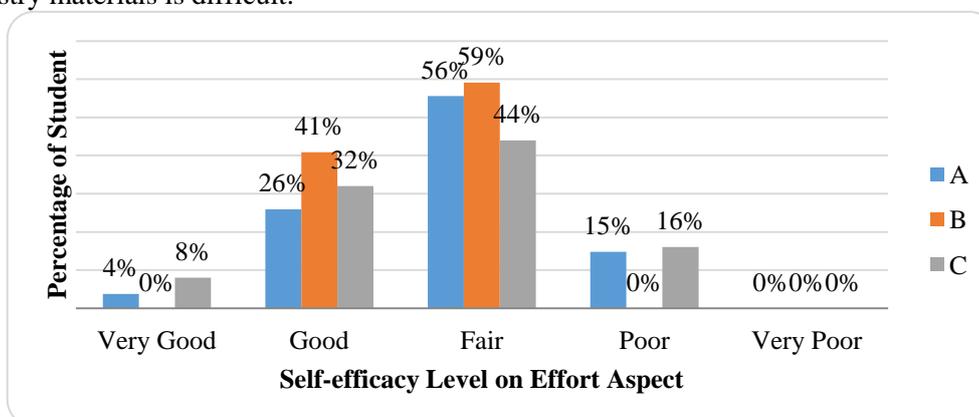


Figure 3. Students' Self-efficacy Profile on Effort Aspect.

Effort and persistence is important aspect of self-efficacy. Students with high self-efficacy give harder effort and persist longer [4], while low self-efficacy students will put in little effort and give up quickly [10]. Students' self-efficacy profile on effort and persistence aspect is shown in figure 3 and figure 4. In average, students' effort of group A and C was in fair category, whereas it was good category in the group B. On persistence aspect, group A had fair category, while group B and C both had good category. Students in group C was dominant in very good category. One study found that high self-efficacy students spent more time doing homework [23]. Many students in group B and C showed much effort to accomplish task and solve problem. They also did not give up easily when facing difficult task. Students in group A showed less effort and persistence than the other two groups. Students in group B showed hardest effort compare to students in group A and C. Effort of students in Group C were not as high as group B, but they did not give-up easily. Students in both group B and C

more likely tried again when they failed in a task or in an experiment activity. Moreover, the online phase of hybrid learning facilitated them to discuss learning problem longer and more flexible.

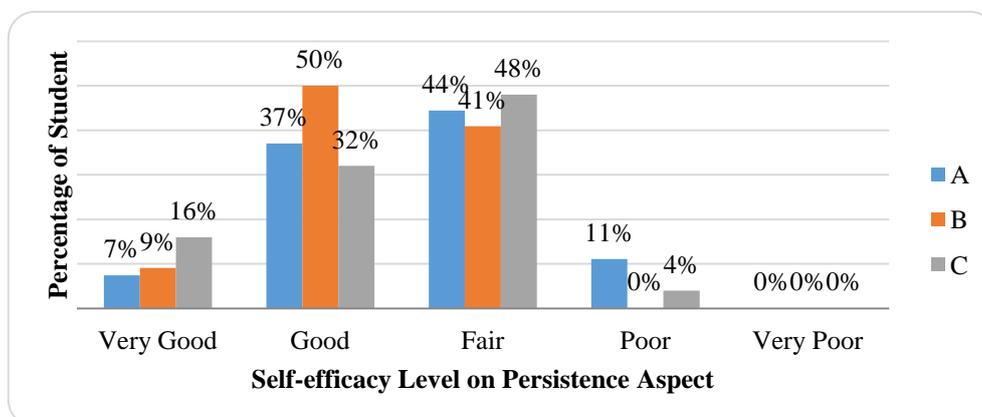


Figure 4. Students' Self-efficacy Profile on Persistence Aspect.

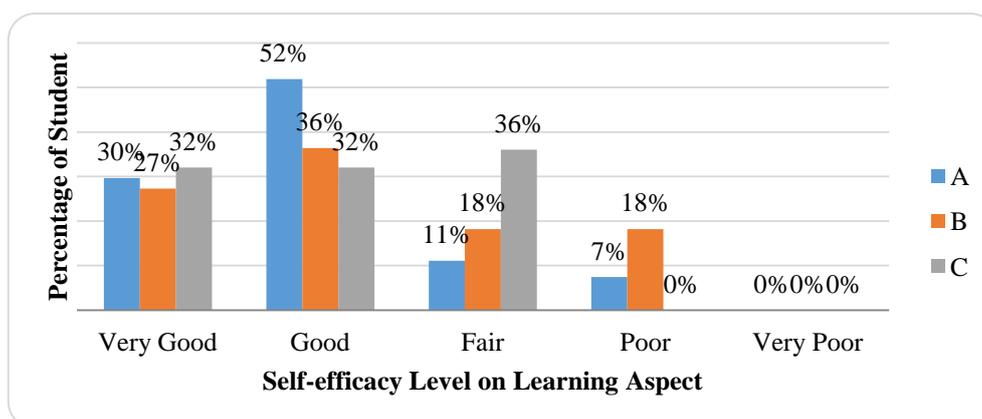


Figure 5. Students' Self-efficacy Profile on Learning Aspect.

Students with higher self-efficacy tend to learn more [1] and were more likely to associate learning activities with optimal experience than students with low self-efficacy [7]. Students' self-efficacy profile on learning aspect is shown in figure 5. In this study, students' self-efficacy score of three groups were dominant in very good and good category. In this aspect there were more students with very good self-efficacy level. It means that they could integrated their previous experience in the current material. In this aspect the self-efficacy level of the three groups was almost the same, even group A been the most dominant in the good category. Previous study found that virtual chem-lab encourage and motivate students to get deeper and broader related knowledge [24]. However, in this study the use of virtual lab integrated hybrid learning had no major effect on this aspect.

Even when students' actual ability level are the same, students with high self-efficacy tend to achieve more than students with low self-efficacy [1]. Figure 6 shows students' self-efficacy profile on achievement aspect. Percentage of student in very good level of self-efficacy was dominated by group B and C. Learning process in group B and C used virtual chem-lab integrated into hybrid learning. Students in both group B and C had more learning experiences and more time to discuss the materials. It is reasonable that they had more belief that they can succeed and got a good score in chemistry especially chemical bonding subject. Goal setting is recognized as a main aspect of achievement [25]. Students of group B and C tend to set higher goal that pushed them to gain higher achievement. Students with high self-efficacy level may achieve at superior level because they engage in cognitive processes that promote learning [4].

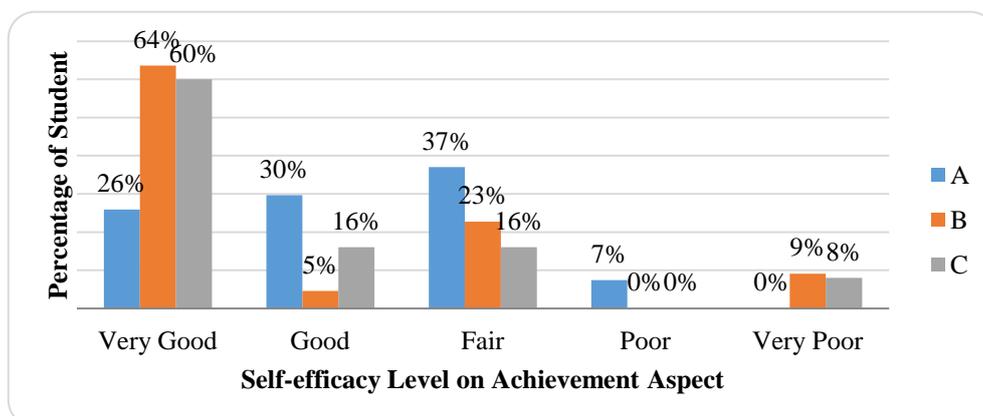


Figure 6. Students' Self-efficacy Profile on Achievement Aspect.

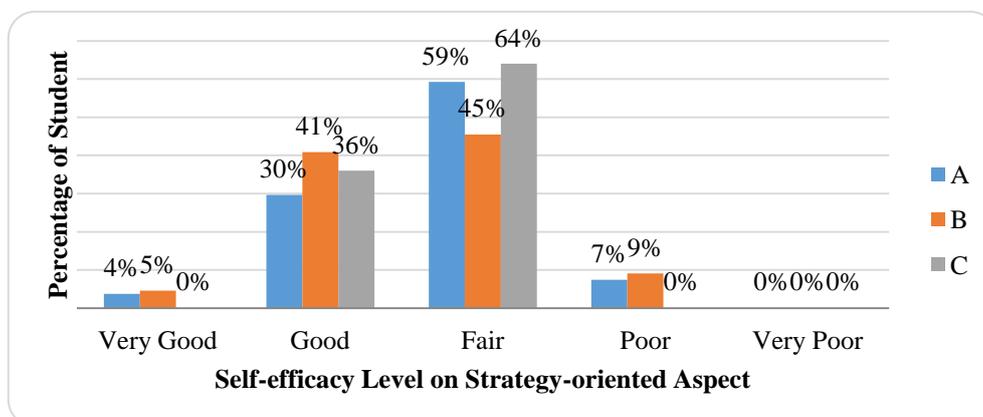


Figure 7. Students' Self-efficacy Profile on Strategy-oriented Aspect.

The last aspect is strategy-oriented. Self-efficacy beliefs motivate students to use learning strategies [5]. Students with high self-efficacy will find and use better task strategies to attain the goals [9]. They prefer use deep learning strategy over surface approach [11]. Students' self-efficacy profile on strategy-oriented aspect can be seen in figure 7. In this case, all students in three groups were generally in fair category. Many students of the three groups did not have effective strategy in learning chemistry. They did the task or homework near the dateline collection. They were also not trying to find new learning strategy if they did not successfully master the material. However, there were students in group A and B who tried to found the best way to solve problem as they had very good self-efficacy level.

4. Conclusion

The result of this study showed that students who used virtual chem-lab both as supplement and replacement of hands-on laboratory integrated into hybrid learning mostly in good level of self-efficacy, while students in the group A had lower scores with fair level of self-efficacy. It indicated that the use of virtual chem-lab in hybrid learning have positive influence on students' self-efficacy. Although there was a small percentage of students who had self-efficacy in poor category, there was no student in very poor category. It means that every student has a self-efficacy belief in himself though only a little.

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