

CHAPTER V CONCLUSION, IMPLICATION, AND RECOMMENDATION

5.1 Conclusion

According to the research questions and the findings that have been revealed, the researcher summed up several conclusion:

First, from the statistical test that has been conducted the result showed that student' involvement in STEM-ESD based learning on renewable energy project has remarkable impacts in students' sustainability action. Students sustainability action measured by the questionnaire encompassed by past, present, and future action also competencies as the indicators. Independent Sample T-Test result indicated significant difference between experimental class that applied STEM-ESD learning and control class that applied regular learning. From the result of action shifting analysis, showed that students in the experimental class experienced more positive shifting from their past, present, and future action. Elaboration of students' mean score for each action indicator also showed the same result where experiment class exhibited higher mean score then control class.

The STEM-ESD learning stages provide opportunities for students to solve real-world problems that occur around them by creating renewable energy projects that match economic, social and environmental values. This allows students to self-reflect on how their actions will affect sustainability. In addition, the implementation of the STEM-ESD learning model exposes students to hands-on learning that emphasizes group collaboration. Learning in this setting facilitates students' ability to influence their environment to act collectively. From this, we can conclude that the positive trend on students' sustainability actions cannot be separated from implementation of STEM-ESD based learning.

Second, the result revealed that mean score of each creativity dimension, all of students groups exhibited highest score in Resolution dimension and lowest score in Novelty dimension. Elaboration of mean score for each group revealed that group 3 with the product of water wheel appeared as the group with highest score. Compared to previous study, the result of students' creativity in this research appeared to be lower except in Resolution dimension.

The results of student creativity showed low numbers in the novelty and elaboration and synthesis dimensions due to the high level of student dependence on projects that are already available on the internet and coupled with the lack of student experience in participating in STEM-ESD learning on renewable energy projects. Although the results on these two dimensions are not satisfactory, STEM-ESD learning facilitates students in creating renewable energy technology products that fit the concept and can be the right solution for energy problems. This encourages students to have high scores on the Resolution dimension.

5.2 Implication

Based on the findings of this research it was proven that STEM-ESD learning on renewable energy project has the positive impact towards students' sustainability action. Learning settings that provided by STEM-ESD based model exposed self-reflection of the impacts of their action to energy issues. The appropriate application of STEM-ESD based learning models is expected to push positive trends in students' sustainability action.

STEM-ESD based learning on renewable energy project has made quite positive impact in students' creativity especially for constructing logical, valuable, useful, and understandable product, but not for the novel and elaborated product. so that STEM-ESD based learning on renewable energy can be applied to increase creativity but with a long enough period of application so that students are familiar with the process of making products.

5.3 Recommendation

Based on the result of this study, recommendations can be made as references for future studies as:

1. Examine the alignment between the results of the student sustainability action questionnaire with the real actions that students take in their daily lives. This is important to examine how far STEM-ESD learning has changed students' energy behavior.
2. Since STEM-ESD based learning on renewable energy project is integrated and holistic learning students and teacher better have initial experience in conducting this kind of learning settings in order to minimize confusion and technical errors in the applications.