CHAPTER V
CONCLUSION, IMPLICATION AND RECOMMENDATION

A. Conclusion

This research give information about how does the differences between STEM based instructional material and non-STEM based instructional material in fostering students' conceptual understanding of science, generate engineering design behaviors and teamwork skills. Based on the research findings and the discussion in the previous chapter, the researcher proposes some conclusions regarded to each research question.

Firstly, STEM based instructional material has better effect in promoting students' conceptual understanding of science based on the hypothesis "there is significance difference of students' conceptual understanding improvement between control group and experiment group." that was accepted.

Secondly, STEM based instructional material has better effect in generating and enhancing students' engineering design behavior rather than non-STEM based instructional material. The result of students' engineering design behavior observation revealed that in the first phase both of experimental group and control group were categorized either as beginning designer or emerged designer, but in the second phase students who learnt science through STEM based instructional material performed better engineering design behaviors. The progress of engineering design behavior occurred because STEM based instructional material put engineering design process within the activity.

Thirdly, Students who learn science through STEM based instructional material performed better teamwork skill based on their self-perception, peers' perception

and teacher's perception rather than students who learn science through non-STEM based instructional material. Students' teamwork skills of control group were categorized as medium level, meanwhile students' teamwork skills of experiment group were categorized as high level. Students who enrolled in experiment group tend to rate their teamwork skills equivalent with peer rating and teacher rating which means that STEM based instructional material gave students opportunities to learn how and when to both lead a group and listen to their peers, and demonstrates the value of what they can accomplish when they put their heads together to complete a task.

In summary, STEM based instructional material has better effect in promoting students' conceptual understanding of science, engineering design behavior and teamwork skills rather than non-STEM based instructional material due to the differences of content presentations of integrated science and engineering design activities in lever system topic and the application of lever system in daily that helps students to construct their understanding of science from clearly identifying the problem to creating and developing solutions as an effective approach to support science learning. In others words, it suggests that a cohesive Science, Technology, Engineering and Mathematics (STEM) based instructional material offers increased opportunity for a quality curriculum delivery, meaningful and real life learning, and better real world application by the students of their knowledge following the science course.

B. Implication

Implications are drawn from the research finding. The findings of this research give implication to the students that learning science through STEM based instructional give new experience where students could improve their thinking skill and started to understand the relationship of science concept and technology as product made by humans to meet a want or need. Therefore, it implies the science teachers to apply STEM based instructional material in science instruction because it helps students to construct their understanding of science from clearly identifying the problem to creating and developing solutions as an effective approach to support science learning and offers increased opportunity for a quality curriculum delivery, meaningful and real life learning, and better real world application by the students of their knowledge.

The second result of this research reveals that students who learn science through STEM based instructional material is better than students who learn science through non-STEM based instructional material in generating engineering design behaviors and teamwork skills. It gives implication to the students that they could develop their creative skills along with communication and collaboration skills, this result also gives implication to science teachers that they should be aware of students' behavior in conducting engineering activities. Most of science teachers are very poorly equipped to teach engineering since a traditional science educator would have gone through the typical teacher preparation program in college, it is unlikely that many have had any engineering and technology related experience. On that ground, there is a need for science teacher in this situation to be able to effectively model and explain the work of an engineer in teaching STEM education.

C. Recommendation

Regarding of the research that has been conducted, researcher arrange recommendation for the teacher, STEM based instructional material can be implemented as learning material in science instruction. This instructional material can be implemented to facilitate students' conceptual understanding, engineering design behaviors and acquisition of teamwork skills. For another researcher can develop further study in the area of the development of students' quality of design based on engineering design behavior through the implementation of STEM based instructional material.

Educational policy maker, school and teachers should start to see science in integrated way. In some middle schools, science is introduced as separate subject where science classes and textbooks provide biology, chemistry and physics content. This condition becomes the first challenge in implementing STEM education as well as STEM based instructional material as for teacher education where teacher education programs are discipline-oriented, each in their silos. Subjects such as science and mathematics are taught separately as „silos‟ through a discipline-based approach with limited connection to real life situations. It might be a little bit complicated for teachers to shift from their comfort zones of teaching in the silos and promote for an integrated STEM education learning approach or STEM based instructional material.

Educational policy maker and school should facilitate teacher training related about STEM education. Another challenge in implementing STEM based instructional material is related to inadequate teacher qualifications to teach science, technology, engineering and mathematics in integrated ways. These include teachers' deep content knowledge, strong belief in innovative teaching strategies that has at its core student centered teaching, interdisciplinary learning to building bridges across subjects, and the development of strong teams that are able to create a culture of success in schools through professional communities.