

CHAPTER V

CONCLUSION, IMPLICATION AND RECCOMENDATION

A. Conclusion

The research in developing STEM based module on earth's structure and its dynamics topic has been conducted following the stage of Design Development Research to capture student's STEM literacy. According to research result and analysis, it acquired some conclusions as follows:

1. The development of STEM based module based on the needs of developing STEM based module which are fulfilling the criteria of good module and fulfilling characteristics of great STEM learning materials to enhance student's STEM literacy. As it is found that existing science modules cannot fully meet those criteria. Therefore, in developing STEM based module, this research follows outline criteria to fulfil the needs of developing great STEM learning material. Developed STEM based module consists of two parts. The first part is the content of earth's structures and its dynamics topic which is developed based on 8 steps of science and engineering practices based on Bybee (2011). In the first part, each page of STEM based module has different focus namely science, science-engineering, science-mathematics, science-technology-mathematics, technology-engineering and technology-engineering-mathematics. Moreover the second part of the module is student's science activity. In developing this part, the outline follows engineering design process stages from English and King (2015).
2. Validation of STEM based module is assessed by three experts to assess content, layout and lexical aspect of the module. Moreover, teacher and student's response towards STEM based module about module's content, layout and utility aspect is also captured. Readability of STEM based module is gain through questionnaire given to students about three aspect of text comprehension, formulating main ideas and quizzes comprehension. According to the result, STEM based module is valid to be used and implemented in learning science on earth's structure and its dynamics topic.
3. The implementation of STEM based module on earth's structure and its dynamics topic is capable to improve student's STEM literacy on knowledge

aspect. It can be proven by student's normalized gain $\langle g \rangle$ score which is 0,35 categorized as moderate enhancement and index effect size of 1,32 in strong category (large effect). Therefore, the implementation of STEM based module gives strong influence towards student's knowledge enhancement.

4. Student's attitude towards STEM is categorized as having good attitude with average score of 76.67. Students are having good attitude towards interest of science and technology as well as environmental awareness aspect.
5. Student's group performance is measured through engineering design process to capture student's profile on STEM process when constructing earthquake proof building. Student's profile is captured starting from their first activity when conducting research background until creating earthquake proof building, in total there are 19 aspects that were measured. Outstanding group is the one who completed the task and fulfil the requirements, while the other groups who received low score cannot complete the task because the mostly skip design process and miss mathematical calculation.
6. Student's response towards STEM based learning is positive mostly in all indicators; interest towards science learning, clarity in delivering task, perception towards benefit of science activity, team work activity is the highest positive response and integration of technology, engineering and mathematics in learning science receives the lowest positive response.

B. Implication

The development of STEM based module on earth's structure and its dynamics topic is valid to be used to in STEM based learning process for 7th grade students in Junior High School. This STEM based module has been proved to be able to enhance student's STEM literacy on knowledge aspect and on student's attitude towards STEM. This module also captures student's profile on STEM process receives positive response from students who have been using this module in learning earth's structure and its dynamics topic.

Developed STEM based module has been validated by expert lecturers in STEM education and instructional material, 4 science teacher and 30 9th grade students and being revised based on suggestion and test result. This developed

STEM based module can be referred as a framework of STEM based module for another science and mathematics concept.

C. Recommendation

According to the findings of this research, there are some recommendations that necessary to be conveyed by other researchers, teachers and students as follow:

1. In developing STEM based module, the first thing which is important is making the outline of the module clearly and explicitly. Researcher should follow basic and core competence of the curriculum to achieve learning goals and refer several characteristics of STEM based module.
2. STEM based module on earth's structure and its dynamics topic can be used by teachers and students as learning materials to help understanding science concept. Moreover, this module can also be referred as STEM based module framework in delivering another science and mathematics concept at schools.
3. Before implementing STEM based module, teacher should know student's characteristics, school curriculum, subject appropriateness, learning objective, school environment and facilities so STEM activity can run smoothly.
4. In measuring STEM literacy on knowledge aspect, it is better to create the instrument to measure STEM literacy as a whole not divide it by science, technology-engineering and mathematics literacy.
5. Realizing that implementing STEM based learning requires sufficient time, teacher should be able to manage the time appropriately especially in engineering design process, students mostly need longer time to finish the task.
6. It is essential to deliver real life example of science concept on the module or in learning process which will help them understanding the concept easily.
7. In STEM activity part when students do engineering process design, teacher should make sure that the entire students are participating and work together in a group to finish the task.
8. At the end of the lesson, it is essential for students to present their work to other students. Thus, other students can find out other group's problem that they encountered during finishing STEM task.

9. When students do their STEM activity, teacher can approach students and ask several questions orally to make sure that students understand the concept. Teacher should also act as a facilitator and should guide the students in the whole STEM learning.
10. To other researchers who interest in developing STEM based module and STEM based learning, it is recommended to implement the module and conduct STEM learning in wider range of students who are involved in the study. Moreover, it is also recommended to add more science and mathematics concept in developing the module. On the other hand, another researcher can develop another instructional module and compare it with STEM based module to check its effectiveness of student's accomplishment.
11. One thing that makes STEM based module different with another instructional module is that the STEM activity provided inside the module. Teacher can use STEM activity to measure student's ability in understanding the concept.