CHAPTER 5

CONCLUSION, RECOMMENDATION AND LIMITEDNESS OF THE RESEARCH

A. CONCLUSION

This research aimed to analyze interdisciplinary thinking skill of upper secondary students with STEM-based instruction application on plant reproduction topic. Based on the the result, analysis, and discussion, it can be concluded that there is *significant* different of *interdisciplinary thinking skill* among students after STEM-based instruction implemented. Normalized-gain value that acquired is 0.78, it is in 'high' category n-gain. Specifically, interdisciplinary thinking skill components that comprises of disciplinary grounding, advancement through integration and critical awarenees will be explained as follow. There is a *significant* different of *disciplinary grounding* in *total* among students. N-gain 'middle category in biology and mathematics grounding are achieved. Based on the result of statistical test on disciplinary grounding, there are also *significant* different of *biology* and *mathematics* groundings among students after STEM-based instruction implemented. In line with the second and third indicators of interdisciplinary thinking skill is known that there are *significant* different of *advancement through integration* and *critical awareness* among students. All components of interdisciplinary thinking skill is showed the 'middle' category n-gain.

Based on the research findings, upper secondary students' argumentation were in level 2, level 3 and level 4. In constructing an argument, students use warrant in their explanation, although most of them omit backings for their warrants. There is an improvement tendency on the complexity of students' argumentation after STEM-based learning conducted.

Correlative analysis shows that there is a significant correlation between biology grounding with students' argumentation. From regression test, it is known

that 13% of students' argumentation skill is influenced by their insight of biology grounding.

According to anaylsis on students' argumentation structure and quality, students are started to be able to construct a complex explanation. It indicates that most students are in the level of awareness of other discipline and few students are in early interdisciplinary thinking. From this research, it can be concluded that STEM-based instruction contribute to the improvement students' thinking and communication skill.

B. RECOMMENDATION

This findings show that students can improve thinking and communication skills level through STEM-based instruction. Classroom activities that emphasize on 21st century skill is needed and should be accustomed. In order to stimulate students to convey their own thinking, the teacher should stimulate and pose the critical question in contextual and interesting ways, so that students are trained to generate claim accompanies by relevan data which they acquired in the previous learning. Because, science education is not only aims to produce stduents who are competent in the aspect of knowledge, but also competent in some skill, especially 21st century skill such as thinking skill and communication skill.

Students' thinking and communication skill are improved during learning and they can produce a good STEM-based product in various forms. So that, in upper secondary curriculum there is no engineering subject, but it is important for them to survive in this century. This research shows that the engineering design process is important. Besides, it is acquired the worksheet form which contain engineering design challanges with the budget limitation to make students realize toward the money utilization. In order to plan STEM-based instruction, the teacher should consider the engineering design challenge components: 1) conditions: the setting, situation or context of the problem; 2) challenge: a clearly written challenge or problem statement that clarifies what students are required to do; 3) criteria and constraints: criteria relate to the challenge presented and are those things that must be followed or satisfied when completing the challenge, while constraints are

typically limits related to the challenge or problem that must be followed; 4) resources: the material, tools, or equipment that is provided or can be used to help solve the problem or complete the challenge; and 5) evaluation: how the solution to the problem will be assessed and evaluated. Another sugession is STEM-based learning can be applied in extracurricular activity such as make a STEM club or STEM team The explanation above are the recommendation for the teacher related with the findings in this research.

C. LIMITEDNESS OF THE RESEARCH

Meanwhile, there are some limitedness of this study as follow.

1. According to the result of posttest, few students could not complete the test in mathematics and essay questions. Besides, the spoken test used to know students' argumentation skill applied only to some students who belonged to high, middle, and low category n-gain. Both of these were indicated that during posttest the students were in rush because the school was conducting drama musical preparation.
2. The students' categorization into high, middle and low categories were only based on n-gain level. Because the logical thinking test which aimed to know students' logical thingking level was not conducted yet. So that, in this research is still unkown the changes of logical thinking level before and after STEM-based learning conducted.
3. Related with students' mathematics achievement was still lower than minimum achievement. That is because the mathematical concepts is limited of the theme that related with the plant reproduction topic, which is only about linear programming. So students needs to expossure to contextual learning in every single mathematics lesson.