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STEM BUILD PROGRAM: AN INITIATIVE TOWARDS PROMOTING STUDENTS THINKING AND COMMUNICATIVE SKILLS

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The goal of STEM education is to provide students with skills necessary for success in today's workforce. These skills are defined as real world problem solving, inquiry, and creative and critical thinking. This can be achieved by moving towards student-centered teaching. This paper will describe a STEM intervention Program for 60 primary school students which employed an engineering design process as its instructional design. This paper will also discuss on the outcome of the program on the student thinking and communicative skills. Students were engaged in designing a prototype to solve a world challenge by applying science and mathematics concept in the project. The process of designing the prototype was found able to give autonomy to the students to think, plan create and test their ideas and improve on it. During the process their thinking skills and communicative skills were put into practice. Teachers were given training on how to execute this program which sees them as the facilitator and students as the active learner. The advantage of this program is that it provides students with informal practice creatively solving problems long before they need to decide on a course of study for college. The opportunity to practice and understand engineering skills opens up a world of possibilities for the students to experience and gained knowledge as to what their careers may be like. Using engineering design principles to complete hands-on, problem-based projects also deepens the student's understanding of scientific processes and emphasizes on the 21st Century Skill.

Keywords: STEM Build, engineering design process, thinking and communicative skills

INTRODUCTION

STEM education is much talked about all over the world. STEM education practice

is often in the form of accelerated or enriched science and mathematics education rather than integration (Johnson, Peters-Burton & Moore, 2015). Learning concepts to pass test should not be the main aim but learning what it is like to think like a STEM professional and develop the requisite STEM habits of mind. STEM workforce must have strong thinking and communicating skills. Thinking skills help STEM workforce in problem solving to detect mistakes, gather relevant information and understand how different parts or systems interact with each other. Thinking skills are needed to develop innovative, cost-effective solutions (Bureau of Labor Statistic, 2015). STEM Build program was developed specially to cultivate and nurture students' thinking and communicative skills.

STEM Build Program

It was developed for elementary level. Children in this age level needs to build connections and foundation in science and mathematics so that they are able to comprehend as they go further into secondary level. This is a crucial stage to inculcate interest in science and retain the interest by giving opportunity for them to engage as they proceed further in school. This program was developed based on three STEM principle; a) Integration of STEM with the School Science Curriculum; b) continuous involvement of the community and industry; and c) connection with secondary science education. Projects in the module were developed based on three themes in the primary science curriculum; life science, physical science, and technology and sustainable living. Projects in the module are all engineering based. In every module, it follows four instructional constructs; a) theory and concept; b) activity; c) project design and develop (engineering design process); and d) showcase. 20 teachers were given training using the modules in three phases in which teachers was asked to carry out at least one activity from the module to their students and the program was finalize with a one day STEM camp with 60 elementary school children.

THINKING SKILLS AND COMMUNICATIVE SKILLS

Thinking skills comprise of creative and critical thinking skills. Creative thinking is cognitive process that provides means to identify the problem and give rise to the generation of multiple alternatives on solving a problem (Allen & Gerras, 2009). Through critical thinking, alternatives are analysed and judged for effectiveness and appropriateness in solving the problem. Communicative skills are the ability of the students to convey their ideas and convince others to select their ideas or discuss on how to combine ideas to produce the best idea.

WHEN DO THE THINKING AND COMMUNICATIVE SKILLS OCCUR?

The instructional design of the module employed the engineering design process;

imagine, design, create, test and improve. The start of the projects, teachers will pose a problem and students are required to come up with a prototype to solve the problem. Students will be facilitated using the 5 stages in the engineering design process to solve the problem. During these 5 stages of the process, children have to use their thinking and communicative skills to brainstorm (imagine), come up with a design and select the best design (design), based on the selected design they develop/built their prototype (create). The students have to plan what to test on their prototype (test) and lastly decide on what and how to improve (improve). Teachers act as facilitators giving them the problem to solve using the 5 stages of the engineering design process. Students in each of the stages showed interest and were engaged in the activity. They were discussing and explaining their solutions and design with each other. 60 students were divided into 4 big groups and 8 projects were carried out with teachers as facilitators. Students were observed in all the 5 stages of process and field notes were taken. Students carry out the activities within the 4 big groups in smaller groups of 2-3 person. Projects were carry out in groups to ensure discussions and collaborations happen and this also encourage teamwork and tolerance between members.

The findings showed that students for the first project were quite reserve and there was not much discussion but just accept ideas from the first person who offered it. But as they moved on to the next project until the eighth projects students showed a remarkable change in offering to give ideas and defending their ideas when discussion to select the best one. Teachers facilitated the discussion for them to follow all 5 stages of the engineering design process. When students understand the process the flow of the doing the projects were more efficient and engaging. Students showed confidence and able to come up with design and plan to test by themselves and manage to give reflections on the results of the test for improvement. Creativity and critical thinking skills were based on their discussion throughout the process of doing the projects and also on their artifact. The discussion was audio taped. This was then transcribed and analysed based upon Allen & Gerras (2009) definition on creative (identifying problem and generation of multiple solutions) and critical thinking (students analyse solutions and justify the specific characteristic of the solutions in terms of effectiveness and appropriateness). These solutions were in the form of products/prototypes.

CONCLUSION

STEM Build Program using the engineering design process was found to be able encourage and encourage thinking and communicative skills by creating the learning environment for them to be creative and critical in order to solve a given problem. The approach though quite alien to them but they manage to adjust and embrace it and manage to do the projects

successfully. Even though students that were involve in the program came from 20 different schools but at the end of the program they became friends and are able to communicate freely with one another. They also showed they were engage in the activities, enjoyed the programs with the spirit to win the challenge given and most importantly they were happy learning science.

Reference

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