Mechatronics Makers – Real World Engineering

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Introduction

Two classes – one focusing on software development (using iPads) and another focusing on mechatronic engineering (i.e. robotics and circuits) were given the opportunity to create cross-curricular projects.

We were trying to enhance students' perseverance, ability to overcome obstacles and meaningfulness of the project. We thought that engaging in a task we believed would be very motivating would lead to these outcomes.

The Research Question

How might making a self-imagined product encourage Grade 10 boys to show perseverance when faced with technical challenges?

Research Context

Christ Church Grammar School is an Anglican Boys' School in Perth, Western Australia. Our school population is approximately 1500, ranging from Grades K to 12. Our peer schools see us as having an ethnically diverse population. We see ourselves as offering boys a broad range of opportunities to develop in heart, mind and body – it is a school where academic, artistic, or sporting achievement is equally celebrated.

Participants

Sixteen boys aged 15-16 years participated, in four groups:

- Half had recently learnt how to write computer programs for iPads
- Half had recently learnt how to build robots and attach circuitry

The Research Action

- Teams were created consisting of students with different pre-existing skills
- Each team dreamed up an idea for a physical device that interacted with, or was driven by, software
- Teams followed the Maker paradigm in the design, construction and testing of their projects
- Examples of projects included:
  - a computer game with a 'glove' that functioned like a joystick
  - a chessboard which detected when pieces were placed supported by an iPad app which recommended moves
  - an unmanned 4-propeller drone

Data Collection & Analysis

- Informal conversations were held with students throughout the course of the research
- Interviews were conducted with each of the groups at the conclusion of the course
- Interviews were conducted and responses analysed for trends

Key Findings and Discussion

Our students were gifted and proficient learners

- Students who chose to take part in a team could be considered gifted according to Gagné's definitions
- Core students felt that they were not ready for a task of such difficulty

The cross-curricular content was inherently motivating

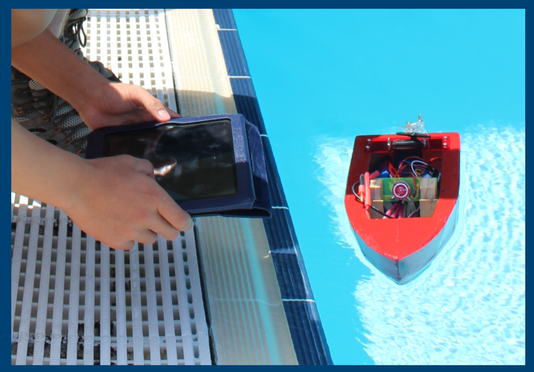
- Students indicated that the broad nature of the project fascinated them
- One student said that the cross-curricular project was not "*just coding*". He had become comfortable with coding and was excited by the fact that he did not "*know for sure*" that he would be successful
- Students enjoyed working with peers who had a greater level of expertise than they did, albeit it in a different field

The project was motivating and developed perseverance in students

- High levels of perseverance were needed to complete the project
- The goals set incorporated a meaningful, real-world end-product
- They knew that they would feel rewarded upon completion
- They knew that the time already invested in the project would be "*wasted*" if they gave up
- The social pressure placed on them by working with their peers helped them to keep on going

Dissatisfaction upon success

- One boy reported feeling a strong sense of anticlimax after each success
- He described completing milestones as "*inspirational but not the real thing. There is still so much more to do.*"
- Syed's (2010) research indicated that the most highly achieving students tend to feel a sense of anticlimax after success, due to a newly illuminated set of incomplete goals



Conclusions

- The cross-curricular Maker-Model project had a very positive effect on student perseverance
- The cross-curricular nature also increased task difficulty for gifted students in a differentiated classroom
- When engaging with core students in a cross-curricular project, the underlying skills should be easier or better established to ensure that are able to approach the project

Key Readings

Delisle, R. (1997). *How to use problem-based learning in the classroom* (1st ed.). Alexandria, Va., USA: ASCD
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Martinez, S., & Stager, G. (2013). *Invent to learn* (1st ed.). Torrance, Calif.: Constructing Modern Knowledge Press
Syed, M. (2010). *Bounce: The myth of talent and the power of practice*. Fourth Estate, Hammersmith, London
Stringer, E. (2014). *Action research* (4th ed.). Los Angeles: Sage Publications
Tough, P. (2012). *How Children Succeed*. First Mariner Books, New York, NY

Further Information

This poster and further information is available at http://www.theibsc.org/
Researchers' emails: mkameron@ccgs.wa.edu.au, plouden@ccgs.wa.edu.au
The project blog is located at http://ccgsmaker.edublogs.org/

"[Completing a milestone] is inspirational but not the real thing. There is still so much more to do"