From Clay to CAD to MP3

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Introduction

In recent years design industries have witnessed an ever increasing demand for rapid prototype manufacturing technologies. The use of equipment such as Laser cutters, 3D printers, computer controlled milling machines and lathes has seen a change in the skills required by employers not only at the production stage but more importantly at design conception and pre-production processing. The necessity of producing designs via ***Computer Aided Design (CAD)*** software packages requires ***designers and makers*** to be capable of working in a digital environment. ***Middleton (2005) highlighted in his paper Creative Thinking, Values and Design and Technology Education in the International Journal of Technology and Design Education*** that the 21st Century thinking skills of creativity, critical thinking and problem solving are highly regarded by industry and therefore imperative that as ***Maker Learners*** are prepared for life after school they must be ready and able to immerse themselves within this paradigm.

The Research Question

"How can utilising physical prototyping when teaching CAD skills enhance creativity in Grade 8 Makers?" This study seeks to investigate two issues.

Firstly, investigate if student creativity is being stifled by the requirement to produce virtual products prior to manufacture,

Secondly, determine the effectiveness of directly linking physical prototypes to the CAD processes when students generate designs ideas.

Research Context

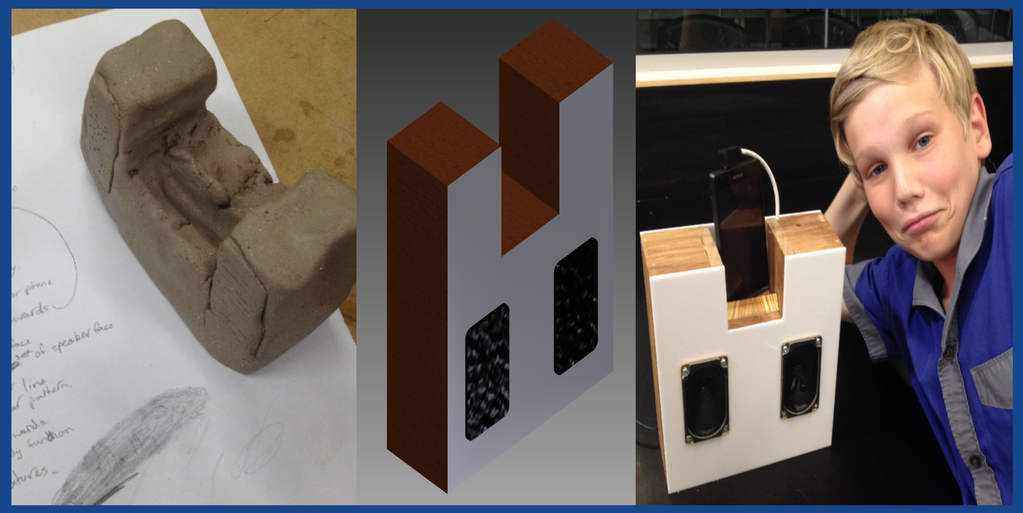
The Anglican Church Grammar School, known locally as Churchie, is a school of 1810 students from Prep to Year 12, including 170 boarding students. The school is located close to the Brisbane CBD with a local, interstate and international student body.

Participants

A group of ***16 Year 8 Maker Learners*** were the subjects of this action research project as the sequencing of their project coincided with the scheduling requirements of the action research project. Student's came to this course with CAD skills ranging from no experience to novice capabilities. ***These boys were required to undertake conceptual development of an MP3 player utilising sketching and CAD modelling to document their designs.*** Their designs were then manufactured using a variety of techniques, selection of which was by student preference.

The Research Action

Churchie students engage in ***Maker Learning*** using a process of research, ideation, concept selection, CAD modelling, manufacture and finally evaluation. It was proposed that between the concept selection and CAD documentation stages *a* ***clay prototype would be made by all students*****.** On completion of the prototype ***students analysed the prototype to determine its appropriateness and the most efficient way to develop their design into a CAD model.*** They then developed a sequence for producing their CAD model and documentation.



Data Collection

Data for this project were collected by a variety of methods, including:

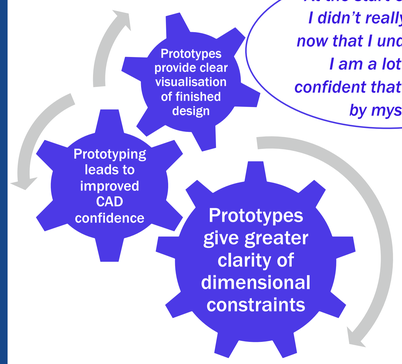
- ***Individual interviews*** recording the significance of the prototyping task.
- ***Direct observations*** of students during the activity and photos of student work.
- A ***research journal*** was kept throughout the action research project.
- Student ***pre and post activity questionnaires***.

Data Analysis

Qualitative data from ***student interviews, researcher journal and images*** of the activity were subjected to ***thematic analysis***. Underlying themes from student responses and other evidence were used to determine the effect of the research action. The ***pre and post activity questionnaires*** were compared and statistical variations using Cohen's d effect size scores were analysed were considered with the thematic analysis. The questionnaires were also scrutinised for common themes in student responses.

Key Findings and Discussion

Based on the results from this study ***there is evidence to support the use of prototypes prior to the development of CAD models.***



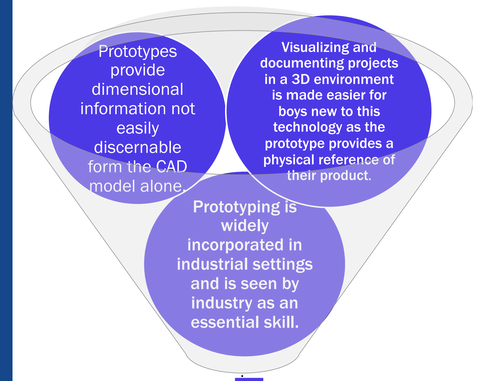
"At the start of the year I didn't really like it ... now that I understand it I am a lot more confident that I can do it by myself.

"The clay prototype helped me to understand modelling the shape on CAD ... redesigning the front face and the back to get a clear picture of what it was going to look like, I could easily copy what the design was like onto the computer."

"It allowed us to easily see what the final design could look like with elaborate processes, as well as knowing how to make it on the computer"

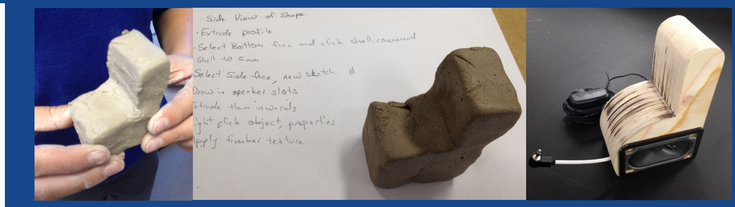
In the questionnaire responses and in student observation, creativity was improved by the prototyping task, and some boys indicated in interviews that creativity may have been enhanced during this project. The improvement, however, was not statistically significant enough to confidently report improvement.

Conclusions



There was some evidence indicating positive trends in student responses regarding creativity, however, it was not significant and is recommended that further research regarding this issue be undertaken.

Following this project and discussion with Design and Technology faculty members it has been decided that all classes from Grades 7 to 12 will undertake prototyping as part of the design process prior to the development of the selected CAD designs.



Key Readings

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Further Information

This poster and further information is available at http://www.theibsc.org/.

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