Action Research

Making wind turbines in specialized skill-set groups to develop autonomy in Grade 9 boys

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Shore School

- Non selective day and boarding school for boys in Sydney Australia

Technology & Applied Studies (TAS)

- The Shore TAS faculty teaches courses in:
- Yr 7 – 8 Mandatory Technology
- Yr 9 – 10 Industrial Tech (Timber)
  Design and Technology
  Graphics Technology
- Yr 11 – 12 Industrial Tech (Timber)
  Design and Technology
  Engineering Studies

Action Research Question

- How can designing and making prototypes in ***specialized skill-set teams*** enable Yr 9 boys to be more *autonomous* makers?

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- My motivation to answer this question:
  - In industry, design is often done collaboratively, so students should learn how to collaborate.
  - “Maker learning” is a student centered approach; “Less us, more them.” Students will be more engaged if they are empowered to take responsibility for their learning (autonomous).
  - Students learn through solving problems, yet too frequently they expect to be told the answers before they think for themselves.
  - Complex problems can be solved when different skills and experience are combined.

The Design Challenge

Working in teams comprising students from Yr 9 Design and Tech, Industrial Tech and Graphics Tech classes, students had 5 x 45 min lessons to design and make a working wind turbine.

The teams were in competition to design the most efficient turbine (measured by it's output of electrical energy in volts and amps).

Why wind turbines?

- The problem of energy production is a real world challenge, fundamental to the sustainability of mankind and the natural world in which we live.
- Renewable energy is of particular significance to Australians. We arguably trail other developed countries in addressing this challenge.
- There is a need to engage the designers of the future in learning about engineering for sustainable production of energy.

Getting started

- Teams pre-selected by teachers.
- Challenge presented prior to commencement of activity. Teams given a chance to do some prior research.
- Teams given suggested information and material resources. Teacher gave brief presentation on the basic design factors and variables influencing wind turbine design.
- Teams then set to work, their first milestone being to have a first prototype ready in 2 lessons' time.

Design Development

- Clearly defined roles and leadership quickly emerged within the teams. However, boys expressed dissatisfaction in the effectiveness of communication between team members.
- Teams were given a limit on the number of questions that they could ask staff (3/lesson). Questions and answers were displayed for all teams to refer to. Teams rarely asked questions, they seemed to accept this as part of the challenge.
- Teams worked mainly through trial and error rather than research to develop their designs. This was probably due to time constraints.
- Teams could use any workshop equipment or scrap materials that they liked. Limited only by their practical “know how” and creativity.

Design Development

- The skills that the teams applied were impressive.
- What was disappointing was the choice of process and design that they followed. This again was probably influenced by time constraints.
- Teams clearly didn’t research and plan but experimented and improvised.
- Each boy kept a journal of activity undertaken, activity planned, and their individual thoughts about their team’s progress. The journals were less detailed and revealing than I had hoped.
- Boys’ comments suggested their teams weren’t communicating effectively; sub-groups within teams focused on their own path and were unaware of what others were doing.

Testing of Prototypes

- Teams tested their prototypes at any time using a test rig comprised of a fan (wind source), switchboard with LED lights and water pump outputs, and multi-meters (to measure voltage and amperage generated).
- The winning team won due to the individual contribution of one boy who worked in isolation and then presented his product to his team at the end. Interesting to note that collaboration was not necessarily suited to some personalities.

Conclusions

- The project was a great way to get boys working collaboratively across different subjects.
- The challenge of designing wind turbines was appropriate as it allowed teams to quickly go through cycles of designing, testing and redesigning prototypes.
- The competitive element promoted the engagement level of boys.
- More time was required for effective collaboration, research and team planning.
- With a longer time frame, team collaboration could be scaffolded and assessed by teachers, and teams could self- and peer-assess their own performance.
- Teams struggled to successfully realise working prototypes, however they learnt valuable lessons as they journeyed through thinking, making and improving their prototypes.
- With a longer timeframe, teachers would also be able to demonstrate the application of specific materials and processes to better inform students' designing and making decisions.

Thank You