

Mater Christi College STEM Cup evaluation

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FLEET volunteers

- Taylor Christie
- Imogen Stephenson
- Michael Barson
- Alex Tritt
- Grace Causer
- Jason Major

Introduction

Mater Christi College is an all-girls school in Belgrave, Victoria. Each year they hold a STEM Cup that involves a range of fun and challenging science-based activities that enable students to explore and discover new subjects and interests. Their overall objective is to get more students involved in STEM. FLEET participated by conducting three workshops among many others developed by the College and other guests. This included Superstars of STEM, which was a group of invited women in STEM that gave presentations to the students and who made themselves available throughout the days for students to come and chat with them about their careers. Other activities included rockets, robotics and coding.

FLEET's three workshops were the following:

- Catapults
- Graphite circuits
- Optics: colours and diffraction

FLEET Objectives

FLEET had the following objectives for students:

Graphite circuits

- To understand the basics of electricity, conductors, insulators and the structure of the atom
- To understand the features and functions of circuits and how resistance works and affects the efficiency of digital technologies

Catapults

- To understand the basic concept of energy and conservation of energy
- To understand the difference between kinetic and potential energy

Optics

- To have a basic understanding of the nature of light and some knowledge or awareness about the nature of light as a wave and particle
- To be able to communicate ideas, explanations and processes about light using scientific representations

Critical thinking

- To think critically about how we (society) use digital technologies and the implications for energy consumption

Method

Each FLEET activity (Catapults, Graphite circuits and Optics: colours and diffraction) lasted 50 minutes. For the Catapult and Graphite circuit activities there was an element of competition introduced. In the Catapult activity this involved teams testing whose modified catapult could fling a projectile the furthest. In the Graphite circuit activity, the competition included the longest working circuit and most artistic or creative circuit. Worksheets accompanied each activity. The nature of the event meant the worksheets were not compulsory to complete, but were there to help students record their observations and clarify their thoughts. Most students only partially completed the worksheets.

The FLEET workshops were developed for a maximum level of year 10. We were unaware that there were going to be year 11 and 12 students participating in the workshops. Given the volunteers responses noted below, it is likely that these year 11 and 12 students would not have found the FLEET workshops sufficiently engaging or challenging, especially the Catapult and Graphite circuits workshops.

Results

The structure and time frame of the workshops did not enable effective evaluation relevant to FLEET's objectives. To a large extent we intended to rely on data from an evaluation conducted by Mater Christi College to understand the impact of the STEM Cup. Their evaluation, however, consisted of a survey with a flawed design and questions, which meant we were unable to obtain any meaningful data.

The Mater Christi survey asked the following questions:

- How would you rate your activity out of 10?
- Did you learn anything?
- Do you feel more interested in pursuing a career in STEM after attending this event?
- Has the STEM Cup changed your opinion of STEM (science, technology, engineering, and math) education and its importance for students today?

The only survey question I have used data from in this report is the first question that got students to rate the activities they did out of 10. While there are severe limitations to any conclusions that can be drawn from this question alone, we use it only to get a sense of student engagement with each activity. Students also only completed a response to one of their activities, which meant only some of the respondents provided data for FLEET activities. The response rate to this question for FLEET activities (or any activity) is therefore low and exacerbates the issue of a lack of meaningful data.

Further, the FLEET activities were targeted to the years 7-9. The optics was the exception where there was more scope to extend into year 10. As noted above, all secondary year levels participated and this may have affected how older students rated the FLEET workshops, but there is no way of knowing from the survey what year level survey the respondents are in. This is reflected in the volunteer feedback below

Catapults

The average student rating out of 10 for the catapult activity was 5.73 (N= 15 responses). The distribution of how students rated the activity is represented in Figure 1.

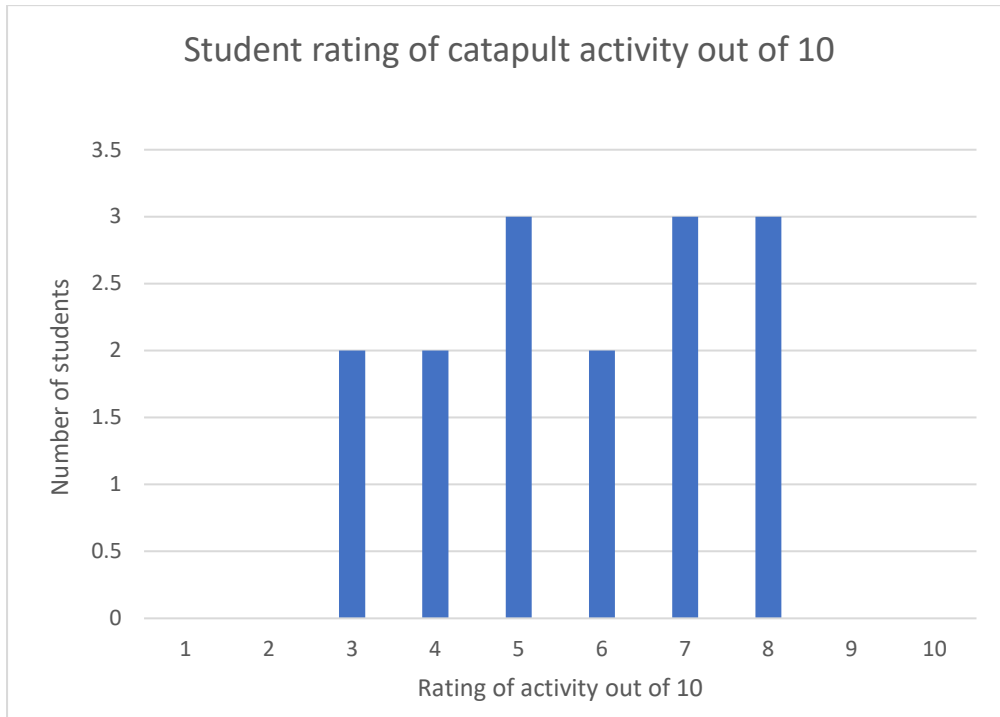


Figure 1. Mater Christi students rating out of 10 for the catapult activity.

Graphite circuits

The average rating out of 10 for the graphite circuit activity was 6.77 (N=14 responses). The distribution of how students rated the activity is represented below in Figure 2.

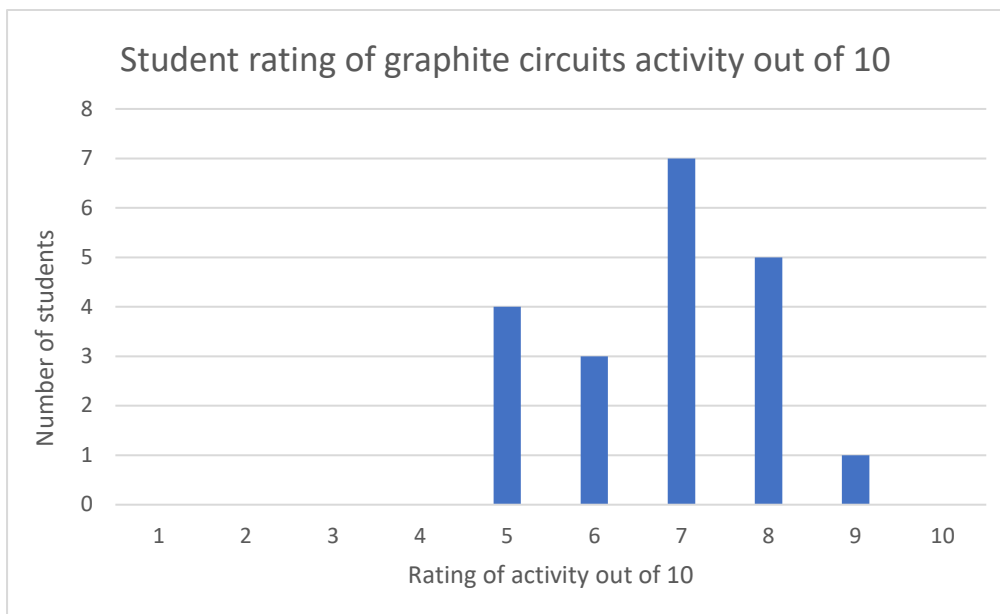


Figure 2. Mater Christi students rating out of 10 for the graphite circuit activity.

Optics

The average rating out of 10 for the graphite circuit activity was 7 (N=7 responses). The distribution of how students rated the activity is represented below in Figure 3.

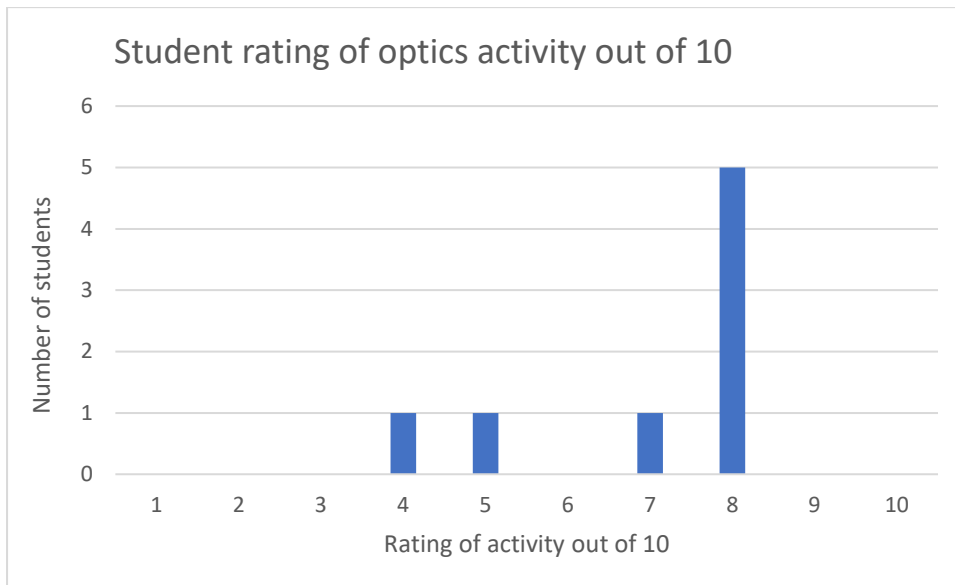


Figure 3. Mater Christi students rating out of 10 for the optics activity.

Comparison of FLEET activities to all STEM Cup activities

The average rating for all STEM Cup activities was 6.7 (N=292 responses). This included the escape rooms and discussions with the STEM Superstars that involved women scientists invited to come and speak with the students about their careers and be available for drop-in chats throughout the day.

As a comparison, probably the most highly rated activity was the Superstars of STEM. It achieved an average student rating of 8.6 (N=10 responses)

FLEET volunteer feedback

Each volunteer was asked to provide feedback about their experience with the STEM Cup workshops. Specifically, volunteers were asked the following questions:

- What did you get from the experience. This includes your thoughts on working and talking with the students about anything from the experiments, your research, etc?
- Can you write a few words about any interesting conversations, observations, or just things some students said that would help FLEET understand what the impact of the workshop was?

There was some valuable feedback about the need to better tailor the circuits and catapult workshop to the different year levels. As noted these two workshops were developed for the year 7-9 levels and as noted needed some changes to make it suitably challenging and engaging for the older year levels.

In addition to the above feedback, there was one broad theme to emerge from the volunteer data and this was student engagement with science and competition. Linked to this engagement is evidence, albeit anecdotal, that students did learn something from the experience.

Theme: Student engagement with the science and competition

Despite observations that some older students did not engage effectively with the catapults and circuits activities, the volunteers did observe that younger year levels up to year 9 enjoyed thinking about and the science that underpinned the activities and trying to apply that to the activity and understand what they were observing. In the process, as noted, there is some evidence of learning. See the volunteer quotes below. The introduction of competition to the activities helped engage the students further.

My favourite quote was from a year 12 who exclaimed, 'I don't even take science, but this is so cool!'... I also showed some students photos/videos from the lab which they found very cool.

It was nice to see those students who initially seemed unengaged and uninterested in the task have fun with it in the end. I think the competitive nature of the challenge (i.e. trying to beat the other groups) really helps to engage the students.

It was fun to see students be curious in response to the incentive of competition. For example, some groups experimented with maintaining continuity over several pages.

My favourite quote from a student was "that was way more interesting than I expected".

The following volunteer observations of students participating in the activities they supervised suggest that linked to the student engagement with the science there some evidence of learning relative to FLEET's objectives.

I remember discussions where the students could independently see the parallel between the diffraction of the coloured lasers/lights and the fact you see rainbow patterns looking at white lights using the goggles.

The demonstration given at the start of the class to introduce the students to the concepts of potential and kinetic energy should definitely be continued in future, as the students did not seem to know what these two types of energies were.

I asked them why this might improve the distance travelled by their projectile. Their answer was that it would add weight to their pom pom which would then allow it to travel further (which is actually correct since kinetic energy is proportional to mass).

Volunteer gratification

Alongside student learning, the following quote also highlights an element of gratification for the volunteer to have helped, indeed inspired, a student to become interested and engaged with science, or potentially at least, to think differently about the value of science.

I had a really nice conversation with one student in particular (year 7/8) who told me she had not considered science as a career as it all seemed too hard for her, but she was excited by what she had achieved and learnt during the class.

Suitability of catapults and graphite circuits for senior students

As noted above, the volunteers observed that some of the older students struggled to engage with catapults and graphite circuit activities

The 11/12s did creative and long circuits, but seemed a little bored (maybe need to increase complexity for that level).

I agree with [FLEET volunteer] that the workshop could be more adapted to different year levels.

Discussion and Limitations

FLEET's workshop achieved a student rating comparable to the average rating for all workshops and activities that were part of the STEM Cup. There is some learning evident, but there is insufficient data to know whether that learning covered all FLEET's objectives for this outreach event.

While the FLEET workshops were not developed for the senior school levels, nor were senior school students expected to be participating, it is noted that these workshops are unsuitable for these students.

Limitations

As noted already the survey data used is limited to one question and from a small number of responses to that question. Data from FLEET volunteer observations were from recollections made about a week after the event and their recollections may therefore be incomplete. FLEET volunteers were also focusing on running a workshop that they had not run before and not putting effort into collecting social data. These limitations severely limit any conclusions we can draw from this data used in this report.