AIP ASTROFEST 09: PROMOTING PHYSICS CAREERS THROUGH ASTRONOMY

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ABSTRACT

We organised an astronomy-based outreach event (known as AIP AstroFest) for year-9 students in South Australia in 2009, as a part of the International Year of Astronomy. The event sessions were aimed at stimulating students' interest in physics and science in order to combat declining enrolments in these vital areas of study. This event consisted of a lecture 'The Milky Way in a Different Light', followed by a number of astronomy-related activities including Q&A sessions with university students and a group discussion session on an astronomy/space topic. The feedback we have received from the participating students and teachers has been overwhelmingly positive, with between 56% and 78% of responding students broadly indicating their interest in physics and science has increased. We seek to describe in this paper details of AIP AstroFest 09 and the feedback from it on the day of the event.

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INTRODUCTION

In recent years there has been a substantial decline in physics enrolments at senior secondary level. For Australia, the Committee for the Review of Teaching and Teacher Education (2003) reports a declining proportion of students who complete Year 12 studies in physics, chemistry, biology and advanced mathematics. The report also states that even when students do perform well in the sciences and mathematics in Year 12, they are not attracted to careers in science and mathematics. Over the last two decades the utility value of physics and chemistry has become less (Dekkers & de Laeter, 2001). Whereas either or both of these subjects were once considered prerequisites for entry to most undergraduate science programs, it is now more common to see these subjects listed on university web pages as 'assumed knowledge' or 'recommended studies'. Dobson (2007) reported a twenty percent decline in Physics enrolments in Australia, while the overall University enrolments more than doubled between 1989 and 2007. This study also highlights that during that time, the number of students enrolling in biological sciences rose by 74%, while the enrolments in chemistry fell by 5.3%. For a earlier period, from the late 1970s to 2002, Australia's overall national pattern for the enrolments in science showed a steady decline in all three traditional science subjects chemistry, physics and biology (Fullarton et al., 2003).

The key research findings of Lyons and Quinn (2009) in the national study, *Choosing Science*, emphasises that the principal factor for the decreasing enrolments in senior school physics was is students' responses to the greater array of options available in Year 11. (Lyons, 2004; Stewart, 1998) found in a large sample survey that students' experiences with school science; and their knowledge and awareness of the range of study and science career options are important in students' choice to continue or not to continue with science. Bolstad and Hipkins (2005) also state that students' knowledge (or lack of knowledge) about the range of science-related study and career options plays a vital role in their decisions about continuing to study senior secondary science. Lyons and Quinn (2009), in assessing influences on Year 10 students' decisions about taking science subjects in Year 11, suggested a range of reasons, including:

- Around two thirds of Year 10 students choosing no senior science made this decision principally because they could not picture themselves as scientists.
- The failure of school science to engage a wider range of students.
- Only 35% of students considered that school science had opened their eyes to new and exciting jobs.
- Around 67% of science teachers believe that declines in science are due to students' tendency to choose less academically challenging subjects from the broad curriculum available.

- 47% of science teachers in this study considered the enrolment declines to be due to students' lack of knowledge about the wide range of science careers available.

Lyons and Quinn (2009) contend that;

> The most common reason endorsed by students for not choosing science was that they were unable to picture themselves as scientists. One interpretation of this finding is that students are knowledgeable about science careers, but do not see a fit with their own aspirations. Alternatively, students may not have sufficiently well developed - or sufficiently authentic - images of scientists and science careers to use as reference points when attempting to picture themselves in various careers. (p. 130)

This study also found that around 80% of Year 10 students believed their most recent experiences (years 9 and 10) had the greatest influence on their decisions about taking senior science classes. Cleaves (2005) also suggests that an interest in science, or encouragement to continue in science, matters more than specific career aspirations - at least in students' initial decisions to enrol in tertiary-level science. Establishing links with real scientists would motivate students to choose senior science subjects. Danaia (2007) attests that astronomy-based activities can have a significant impact on students' perceptions of science and their knowledge outcomes. This study revealed that there were significant differences in relation to junior secondary school students' perceptions of science at school after their involvement with a practical astronomy program.

Astronomy is a broad discipline that draws on a wide range of physics, chemistry and biology concepts. Importantly though, astronomy is one of the most publicly accessible pure research disciplines by virtual of its ease of access - *one only needs to look up into the sky to become an astronomer.* Such accessibility means that astronomy can be used to introduce to students a wide variety of science concepts and how they influence the universe and our local environment.

METHODOLOGY

We organised an astronomy festival for the Australian Institute of Physics-South Australia branch, and called it the AIP AstroFest. The target audience was year 9 students in South Australia in 2009, as a part of the International Year of Astronomy. The festival was held at Flinders University, and was organised by the authors. Sessions were given by the second author, colleagues and astrophysics PhD students from the University of Adelaide. The website for this event can be found at http://www.physics.adelaide.edu.au/aip-sa/astrofest.html.

In South Australia, students choose their Stage 1 and Stage 2 Higher Education Selection Subjects (HESS) by the end of their year 10 study. There is therefore a need to motivate year 9 and 10 students to become more interested in science by providing insight to science careers through engaging learning experiences. Our challenge was to make students' experience with science worthwhile. The key focus of the event was to make students aware that physics can be enjoyable and engaging through astronomical themes that they would find interesting.

We obtained the funding support from the Australian Institute of Physics SA Branch, the Faculty of Science and Engineering, the School of Chemical and Physical Sciences of Flinders University, the Faculty of Sciences and the School of Chemistry and Physics of the University of Adelaide. We designed astronomy-related activities including question and answer sessions with university students. Invitation letters (paper as well as e-mail) were sent to every high school in the state. Student selection was done at the school level and a total of 157 students registered for the event. Half of the students were selected randomly at some schools and half of the students were selected based on their performance in science (either chemistry, biology or physics) at their schools. Student selection was carried out by the individual schools. The AstroFest ran from 9:30 am to 2:30pm at the Flinders University campus on November 25, 2009.

All participant students received a welcome package which also included a T-shirt on arrival. Students were divided into group of three for the parallel activity sessions just after the plenary lecture on 'The Milky Way in Different Light.' This plenary lecture 'The Milky Way in a Different Light' provided students with a overall view of the different wavebands available to astronomers, and how vastly different the Milky Way (the plane of our galaxy) can appear in these wavebands spanning the full electromagnetic spectrum from radio to gamma-ray 'light' and also cosmic-ray particles. The three following parallel activity sessions were:- 1. 'A mission to Mars: Can we do it?' 2. 'The Universe:

How Big is it?' 3. 'Patterns in the Sky'. The first parallel activity 'Mission to Mars' consisted of a presentation addressing the wide range of scientific, engineering, biological, and ethical issues involved in sending humans to Mars. The second parallel activity 'The Universe: How Big is it?' (led by astrophysics PhD students) led students on a tour of the incredible differences in size scale the universe represents from our planet Earth, to the most distant galaxies. The third parallel session (delivered by a research associate with a PhD in astronomy), highlighted the various patterns in the sky that stars make and how these patterns have been used throughout history in for example, navigation and agriculture. All of the parallel sessions included time for discussion with students.

We arranged a food break after the first activity and a sandwich lunch served after the second activity. Each student got the chance to participate in three activities as we repeated them each three times for groups about 50 students each time. The participants completed a survey before the closing ceremony and gained a chance to win one of two iPod Shuffles, purchased with our sponsor funding.

The survey questionnaire outlined below contained nine questions and space for further comments:

Q1. After participating in the AstroFest my interest in Astronomy has increased.
Q2. After participating in the AstroFest my interest in Physics has increased.
Q3. Do you think it is possible to understand Astronomy without a knowledge of Physics?
Q4. The AstroFest was enjoyable.
Q5. The AstroFest stimulated my interest in Science.
Q6. I would like to participate in a similar workshop devoted to other exciting areas of Physics for example, the weird works of Quantum Mechanics.
Q7. I like to read popular science books and articles (including science fiction).
Q8. What career or area of work are you most interested in?
Q9. What is your favourite subject at school?

Questions 1 to 7 required students to choose a response from 1 (fully disagree) to 7 (fully agree), whereas questions 8 and 9 were open-ended.

FINDINGS AND DISCUSSION

We received overwhelmingly positive feedback in the open-ended comments from students about how the AstroFest day had provided them with a fun and comfortable environment, and how it made them feel confident about science careers. Comments from students include 'This has increased my interest in astronomy and now I'm considering it as a possible career path', 'I really enjoyed the expo & it has really broadened my mind about possible careers I might enjoy', 'I enjoyed Astrofest a lot, it was a great experience and I learned a lot. I hope I can come again very soon', 'Easy to move from work place to work place. Looked well organised and rehearsed', 'It was an enjoyable experience from which I gained a lot of knowledge', 'AstroFest is my HERO!!', 'Astrofest Rules!!!', 'Cheers for the T-shirt", 'I had fun today and speeches got me thinking about a way to live in Mars', 'This workshop was a good idea and thank you and it was good to be taught by Uni students'. Many participant students wrote comments consistent with 'I liked all the presentations but I liked the one with the Uni students the best' and 'Looking at the stars and galaxies was cool'.

Figure 1 shows the results from the survey concerning questions 1 to 7. 118 participants completed the survey as some of the participants had to leave before 3:00pm on that day. For question 1, which asked students if AstroFest increaseded their interest in astronomy, 78% of the students rated it between 5 and 7, where such a range of scores defines broad agreement. We note that 17% of the students gave a rating of 7 out of 7 to this first question. On question 2, 56% of students agreed that AstroFest increased their interest in physics with ratings between 5 and 7. For question 3 we received a range of responses, with 62% even rating it between 1 to 4, indicating that the students are confident that they can learn astronomy without knowledge of physics. Concerning question 4, 81% of students responded that AstroFest was an enjoyable experience and rated it between 5 to 7.

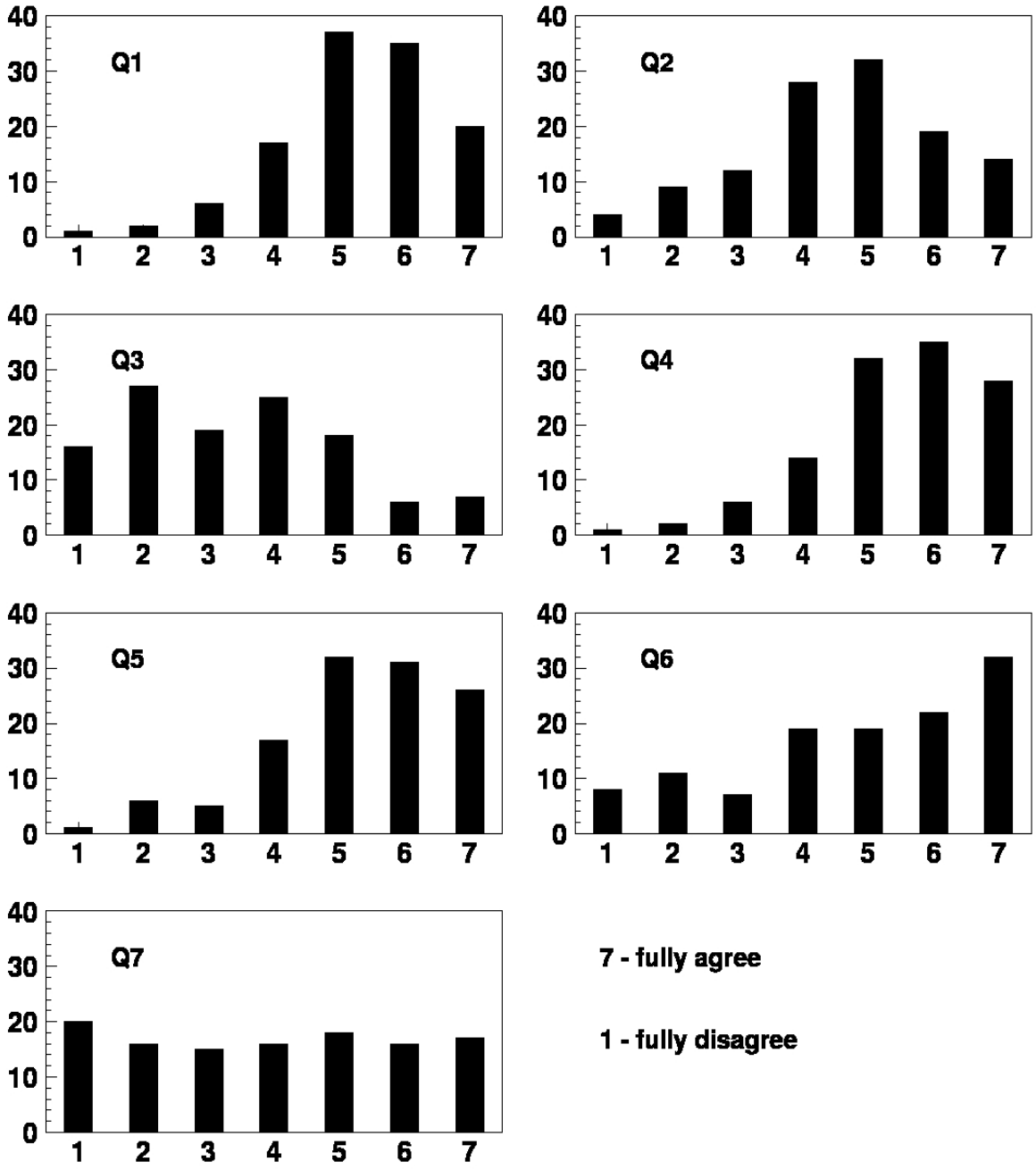

Figure 1: Survey response to questions 1 to 7.

The analysis of the responses to question 5 “The AstroFest stimulated my interest in Science” is of particular interest to us, since it tested the effectiveness of astronomical concepts to stimulate amongst the students a broader thinking about science. 92 students out of 118 or 8% of students agreed (with a rating from 5 to 7) that the AstroFest had increased their interest in science. 51% of the students rated this question between 6 and 7. We regard these results as evidence that an event such as AstroFest for year 9 and 10 students can significantly influence their decisions to choose science careers. The responses to question 6 clearly show that they will be interested in participating in such events in future with 61% of students giving it a ranting between 5 to 7. Question 7 was somewhat removed from the central issues addressed by AstroFest, but nevertheless it showed that these students, who all had a prior interest in science, did not necessarily have a similar interest in reading popular science magazines and/or science fiction.

Figure 2 shows the responses to the open-ended question 'What is your favourite subject at school?' Even though 46% of the students agreed that maths and science are their favourite subjects, we can

see that there was a tendency among students to choose less academically challenging subjects like physical education (PE) , 3D-art, music, drama, photography, volleyball, and 28% of students listed PE, 3D-art and music as their favourite subjects. Evidence from our study also supports the findings of *Choosing Science* (Lyons and Quinn, 2009). Overall, our work is in agreement with the reasons noted by Lyon &Quinn for the declining enrolments in science.

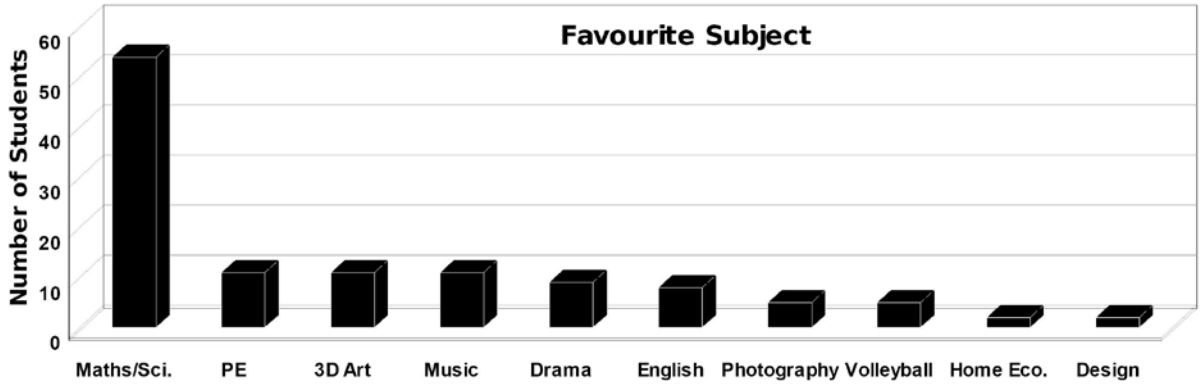

Figure 2: Response distribution to open ended question 9

CONCLUSIONS

The AstroFest event could be seen as successful in engaging students with astronomical themes and stimulating their interest in science. It allowed an opportunity for school students at year 9 level to gain an appreciation for astronomy and how it crosses over into other areas of science. The feedback from the students clearly shows that astronomy can be a way to increase students' interest in science. Some of our survey results are in agreement with (Lyons, 2004; Stewart, 1998; Bolstad & Hipkins, 2005; Lyons & Quinn, 2009). A follow up study by checking the physics enrolments at both Flinders University and the University of Adelaide in 2013 will be useful in attempting to measure the longer term impact of this event. The results from our study underline a need to create greater awareness among year 9/10 students of the variety and scope of physics-related careers. AstroFest was organised as a one-off event in 2009. However, its success would indicate one should consider such an event on an ongoing basis.

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