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20 YEARS OF SPACE SCHOOL: A LONGITUDINAL STUDY OF THE INFLUENCE OF AN EXTRACURRICULAR SPACE EDUCATION PROGRAM ON AUSTRALIAN SECONDARY SCHOOL STUDENTS' STUDY AND CAREER CHOICES

Dr Kimberley Clayfield[a]*, Dr Olivia Samardzic[b], Mr Mike Roach[c]

[a] *South Australian Space School*, kimberley@spaceschool.com
[b] *South Australian Space School*, olivia@spaceschool.com
[c] *South Australian Space School*, mike@spaceschool.com
* Corresponding Author

Abstract

The South Australian Space School (SASS) is an extracurricular residential 3-day education program for South Australian secondary school students in Year 10. It has been held annually since 1997. The program is operated on a volunteer basis by a team of secondary school teachers and Science, Technology, Engineering and Mathematics (STEM) professionals. In 2004 the Space School team also established the 4-day National Space Camp program for Year 11 students. The Space School programs aim to provide a stimulating and rewarding educational experience for secondary school students to focus them on a career in Science, Technology, Engineering, Mathematics and Medicine (STEMM) by using space as an exciting application. Activities are run to give the students contextual information about space sciences but also provide enough examples and career information to highlight the benefits of choosing a STEMM career. Students are selected to attend Space School based on a written application and a recommendation from their school. Space School activities typically include: guest lectures by space professionals to demonstrate the exciting range of real-world activities and careers relating to space, particularly in Australia but also internationally; an astronaut visit and personal interaction with students; hands-on activities such as physics experiments, building and launching model rockets, and contextual science exercises; site visits including Government research facilities and university laboratories; and information talks about university courses and STEMM careers. In February 2017 an online survey was undertaken of Space School graduates from 1997 to 2016 to evaluate whether attending Space School influenced graduates' subsequent school subject choices and/or university study and career choices. The survey also assessed which aspects of the Space School programs students found most influential; the development of peer relationships during the programs was found to be particularly valuable. This paper provides an overview of the survey results, which demonstrate a significant empirical causality between Space School participation and future study and career choices.

Keywords: extracurricular space camp influence STEM careers

Acronyms/Abbreviations

Centre for Australian Space Education (CASE)
Defence Science and Technology Group (DST Group), previously DSTO (DST Organisation)
National Space Camp (NSC)
Science, Technology, Engineering and Mathematics (STEM)
Science, Technology, Engineering, Mathematics and Medicine (STEMM)
South Australian Space School (SASS)
Victorian Space Science Education Centre (VSSEC)

1. Introduction

The Australian Government Chief Scientist noted in his report "Science, Technology, Engineering and Mathematics: Australia's Future" [1] that STEM underpins the capabilities required for creating new jobs, boosting productivity, building a differentiated and globally competitive economy, and growing national prosperity. Education, both formal and informal, is key to preparing a skilled and dynamic STEM workforce and building STEM literacy within the community. However, recent research by Engineers Australia [2] shows an ongoing decline in the number of Australian secondary school students taking up Science, Technology, Engineering and Mathematics (STEM), leading to a shortage of locally trained engineers and creating challenges in developing an innovative, technology-based economy. Anecdotal evidence indicates that space is an effective topic for inspiring and engaging students in STEM, including a 2009 survey by the journal *Nature* which found that 50% of the internationally renowned scientists who published in the journal during the previous three years had been inspired by NASA's Apollo program to become scientists [3]; the continued pursuit of STEM studies is critical not only to develop the skills and capabilities needed to grow the Australian space industry, but to the Australian economy as a whole.

The South Australian Space School (SASS) is an extracurricular residential 3-day education program for

South Australian secondary school students in Year 10. It has been held annually since 1997. The program is organised and staffed on a volunteer basis by a team of secondary school teachers and STEM professionals, and is operated by the Centre for Australian Space Education (CASE) Pty Ltd.

In 2004 the Space School team also established the 4-day National Space Camp program for Year 11 students, which has since run annually. This program was held in Woomera, South Australia, 2004–2006 and 2008–2010, in Canberra, ACT, in 2007 (under the name Australian International Space School), and at the Victorian Space Science Education Centre (VSSEC) 2011–2016. In this paper, the term "Space School" includes any of these programs.

Approximately 880 students have participated in one or more of the Space School programs over the 20 years since its establishment.

The Space School programs aim to provide a stimulating and rewarding educational experience for secondary school students to focus them on a career in STEMM (Science, Technology, Engineering, Mathematics and Medicine) by using space as an exciting application. Activities are run to give the students contextual information about space sciences but also provide enough examples and career information to highlight the benefits of choosing a STEMM career. Students are selected to attend Space School based on a written application and a recommendation from their school.

Space School activities typically include: guest lectures by space professionals to demonstrate the exciting range of real-world activities and careers relating to space, particularly in Australia but also internationally; an astronaut visit and personal interaction with students; hands-on activities such as physics experiments, building and launching model rockets, and contextual science exercises; site visits including Government research facilities and university laboratories; and information talks about university courses and STEMM careers.

In 2017 the South Australian Space School celebrates its 20th anniversary. This milestone offers a timely opportunity to undertake a quantitative study of the influence Space School participation has had on graduates of the Space School programs.

2. Survey Methodology

A survey to assess the influence of Space School participation on graduates' study and career choices was developed in consultation with an education specialist at the University of New South Wales. It consisted of 27 questions, including 4 identification/demographic questions, 18 multiple-choice questions of which 16 were Likert scale questions, and 5 open-ended questions. All questions except the identification questions were optional. The survey was hosted online via the University of New South Wales, and was open over February – March 2017.

Graduates were sent invitations to participate in the online survey via email, and via the public Space School Facebook page [4] (which at the time of writing is followed by approximately 450 people, not all of whom are Space School graduates) and the Space School website [5]. Of approximately 880 Space School graduates, valid email addresses were available for approximately 280 graduates (32%).

3. Survey Results and Discussion

71 graduates responded to the survey, which is a response rate of approximately 25% of graduates successfully emailed. This does not take into account graduates who may have found out about the survey via other sources, such as the Space School Facebook page or website, or being forwarded the invitation by friends, so the total number of graduates who were aware of the survey may be higher, and the percentage response rate effectively lower. This number of responses represents approximately 8% of all Space School graduates. The following results have been presented as a percentage of the survey respondents.

3.1 Respondent demographics

Of the survey respondents, 42% were female and 58% were male; the long-term gender balance of all Space School graduates is approximately 47% female and 53% male.

Just over half of the respondents were aged 21 or under (see Fig. 1), reflecting the difficulty of maintaining contact with graduates of programs from more than five years ago.

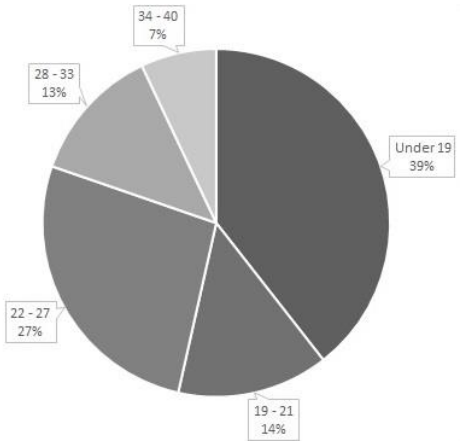

Fig. 1. Age bracket of survey respondents

The majority of respondents were graduates of the SASS program, with just under half of respondents having only attended SASS (Fig. 2). 41% of respondents had attended both SASS and one other NSC program

(Woomera or VSSEC), while 11% of respondents had only attended NSC Woomera or Australian International Space School Canberra. Respondents included two participants from the very first SASS program held in 1997.

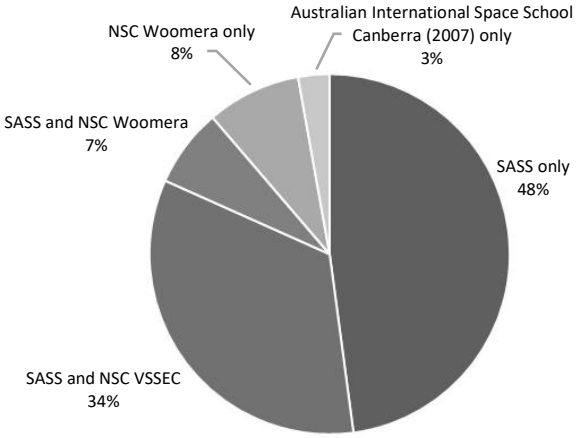

Fig. 2. Space School program(s) attended by survey respondents

3.2 The influence of Space School participation on study and career choices.

At least three quarters of respondents indicated that participating in Space School had influenced their secondary school subject choices (Fig. 3) and/or their tertiary study or career choices (Fig. 4).

Of the graduates who indicated that Space School participation had not influenced their study or career choices, the reasons for this cannot be unambiguously identified from the survey results; however, correlating the responses to the questions shown in Fig. 3 and Fig. 4 with the open-ended questions regarding graduates' career paths, it appears that a substantial number of the survey respondents who disagreed with the survey statements may have answered this way not because Space School dissuaded them from pursuing a STEMM course of study but because they had already decided on such choices before attending Space School. This is reflected in the high percentage of respondents who have undertaken tertiary study in at least one STEMM field.

Graduates were asked whether they had taken university/college courses in all or any of the following fields: science, technology, engineering, mathematics, or medicine. Excluding the respondents who were yet to finish secondary schooling (9 respondents), 84% of respondents indicated that they had undertaken tertiary-level study in at least one STEMM field.

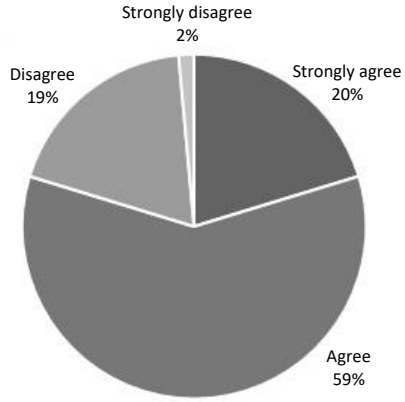

Fig. 3. Attending Space School influenced my subject choice in either or both Years 11 and 12

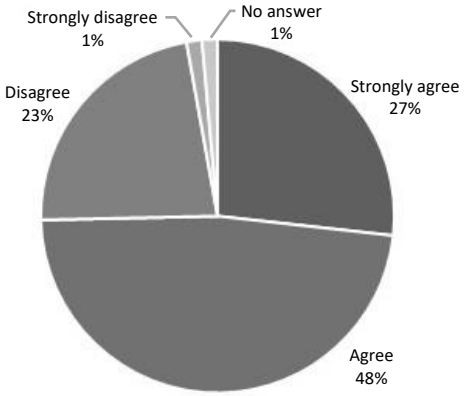

Fig. 4. Attending Space School influenced my study or career choice after finishing school

3.3 Social outcomes of Space School participation

An interesting finding of the survey was the strong positive influence of the social aspect of Space School participation.

Almost 70% of respondents indicated that they have stayed in touch with friends made during the Space School programs (Fig. 5), which is particularly notable given that the students selected for each Space School program come from a wide range of schools; where possible, it is preferred that there are no more than two students from any one school per Space School program.

An open-ended survey question invited graduates to share their best memories of Space School. While expecting that this question would generate feedback on the most popular activities of the Space School programs, at least 30% of respondents explicitly identified meeting like-minded people and making new friends as one of their best memories. This aspect of participation appeared to have particular impact for graduates who had attended rural/regional high schools.

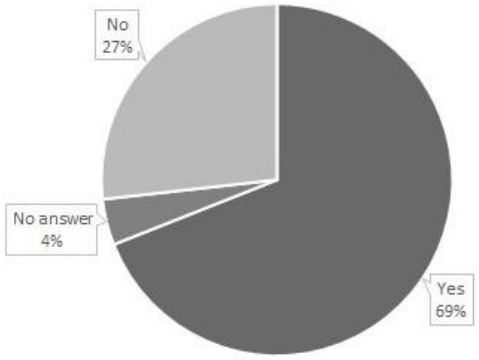

Fig. 5. I have stayed in touch with friends I made at Space School

3.4 General feedback on Space School programs

Some of the general feedback on the Space School programs received from graduates included the following statements:

"It was great to be around like-minded people who were passionate about space - both research into space, and space exploration. The educational component was very interesting. I really enjoyed the live-in aspect of it and making friends (the social atmosphere). And lastly, I loved meeting an astronaut!"

"I had never been exposed to the things we learned. I had never felt so included. This experience changed my life in the most positive way. You don't get this opportunity anywhere else and I consider myself extremely lucky."

"Space School brought science to life for me. I enjoyed seeing the practical application of the science we were being taught, and the visits by the astronaut and to DST were fantastic."

"The RAAF base trip was by far the best experience. It gave me a special insight into one of my potential careers and excited me. We got to do so many things that I would never have been able to do without space school and for that I am very grateful."

"Building model rockets and then launching them during Space School is one of the most memorable moments for me of the whole experience, as it was something fun to do towards the end of the experience and also a learning opportunity. Visiting the DST Group and the RAAF base was also very exciting, as it opened my eyes to various opportunities and career pathways that I had not been previously aware of."

"Spending intensive time with peers who also loved science, space and tech was amazing and very different to how my peers at school felt about those subjects. It was thrilling to finally meet other people who loved that stuff as much as I did! Also adored meeting [NASA astronaut] Scott Parazynski."

"I really enjoyed the DST Group visit, it persuaded me want to pursue a job within the DST Group. The people I met and the places we went were awesome and I would do it again if I could."

"The whole program was amazing, being able to meet like-minded individuals and promoting the passion of space. It was great to meet other students as well as lecturers and professionals and the organisers as well. The trip to Woomera was an amazing experience, a once in a lifetime opportunity for which I am very grateful. I particularly enjoyed the Woomera test range visit, and the model rocket launch."

"The Mars astronaut simulation done at the VSSEC Mission to Mars experience is one of my best memories of any of the space school activities. The entire activity, from communication with the mission control room to tasks done within the Mars simulation were amazing."

"The enduring personal impact of Space school is a fundamental passion for empirical analysis and research, regardless of the field of application. I capitalised on the social networks introduced at Space School to gain work experience at the DST Group and will forever be grateful for the incredible formative experience that exposure provided. My time there was so immersive and enjoyable, I returned multiple times to explore further research areas and participate in the Summer Vacation Scholarship Program."

4. Limitations of this study

The authors acknowledge the following key limitations to this study:

- Valid email contact details were only available for approximately 32% of Space School graduates (with current details more likely to be on record for more recent graduates).
- The method via which respondents found out about the survey was not recorded, and there is no way to track how many graduates found out about the survey via methods other than direct email (e.g. Facebook, email forwarded from friends).
- It can be assumed that the significant majority of Space School participants came into Space School already having an interest in space. Nevertheless, comments received from the survey reflect that Space School probably reinforced that interest, provided additional information and broadened students' awareness, and influenced students' further study or career choices in STEMM fields.

5. Conclusions

An online survey of 71 Space School graduates (8% of all Space School participants) found that at least 75% of survey respondents agreed that participating in Space School had influenced their secondary school subject choices and/or their tertiary study or career choices. The aim of the Space School programs, i.e. to interest and engage students in STEMM careers, is successful, with 84% of respondents who had completed secondary

school having undertaken tertiary-level study in at least one STEMM field.

Furthermore, a significant social benefit to Space School participation was identified, with almost 70% of survey respondents maintaining contact with friends they made at Space School, and at least 30% of respondents explicitly identifying meeting like-minded people and making new friends as one of their best memories. This aspect of participation appeared to have particular impact for graduates who had attended rural/regional high schools.

Acknowledgements

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The authors also thank the Space School graduates who provided input to this survey.

References

[1] Office of the Chief Scientist, *Science, Technology, Engineering and Mathematics: Australia's Future*, Australian Government, Canberra, 2014.

[2] A. Kaspura, *Engineers Make Things Happen*, Institution of Engineers Australia, Canberra, 2017.

[3] R. Monastersky, *Shooting for the Moon*, Nature, 460 (2009) 314-315. Published online 15 July 2009, http://www.nature.com/news/202009/090715/full/460314a.html (accessed 05.09.17).

[4] South Australian Space School Facebook page http://www.facebook.com/saspaceschool (accessed 05.09.17).

[5] South Australian Space School website www.spaceschool.com (accessed 05.09.17).