

# **Australia in Space: a strategic plan for Australian space science Education, Training and Careers Working Group Report**

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## **Vision Statement**

It's 2030 and every school in Australia knows where students, parents and teachers can find information about current and future space careers and opportunities. The Australian Space Agency has been operating for over 10 years, met their goal to create 20,000 jobs in the Australian space industry, and the space economy continues growing past the \$12 billion goal recently achieved. Key skills widely utilised across many space industries have been mapped and outlined within vocational, university and combination pathways for students of all ages including micro-credentialing for rapid and highly technical upskilling. Case studies and profiles of Australian 'Space Science Stars' linked to all educational disciplines are easily accessible and updated regularly as new industries and jobs are created and developed. Public events, research conferences and societal space activities are promoted both to the public and in regular updates to registered participants of a database managed, updated and compliant with cyber-security requirements and Australian Privacy Principles through a Commonwealth agency across all Australian states.

Space education links to the Australian curriculum and senior Science, Technology, Engineering and Mathematics (STEM) subjects across states are regularly reviewed by Early Childhood, Primary and Secondary Educators in collaboration with research & industry space experts to provide endorsed relevant and current teaching resources available through widely used and publicly funded platforms. These teaching resources are available for all Australian and international teachers to easily access, with associated professional development available face to face and online remotely for a range of levels of experience to maximise the impact of these classroom resources.

A position has been created within the Australian Space Agency to allow access to and develop opportunities that arise for students, schools and tertiary institutions to engage with 'real' space research and developing materials to be utilised for data collection or tested in space allowing access to 'Moonshot Missions' for students at all levels.

## **Background**

The mention of anything to do with space captures attention from students to science experts and across the general public. Space science and education has never been more important to society as

space technology integrates into every part of our daily lives and becomes increasingly important in the future.

With the announcement of the formation of the Australian Space Agency in 2017 and the ongoing implementation of Agency nodes across Australia, students can now visualise a pathway to working in space industry and/or space research with a career in Australia rather than needing to travel and work overseas. Evidence from students who recently completed a placement through the South Australian Space Industry Centre/Advanced Technology Program with startup space industries at Lot 14 in Adelaide and in university research institutions shows they first became interested in space in primary school, between 8 and 10 years of age. Building on this early fascination with space and attracting more students into pathways enabling access to a future space career is the principal goal for the Space Education, Training and Careers Working Group. However, with enrolments declining in senior STEM subjects across Australia (Education Council, 2019), this situation needs to be rapidly reversed for the Australian Space Agency to reach a goal of 20,000 space industry jobs by 2030.

Many Australian schools across all educational sectors have a strong focus on literacy and numeracy skills. Given this, space provides a rich context for students to improve their skill levels to enable straightforward access and subsequent success in content-rich and technical senior STEM subjects, and presents an engaging context and great opportunity to develop student engagement with easy to access information and resources. To succeed in a future space-aligned career, students also need to develop competency in problem solving, data analysis, technology, communication, teamwork, tenacity and resilience.

The Victorian Space Science Education Centre (VSSEC) uses space as a vector to engage students in STEM education. It has had visits from over 120,000 students participating in one or more of their STEM programs since the Centre first accepted students in 2006. The programs teach students to solve problems via data acquisition, analysis techniques and by teamwork using effective communication between team members, which are all essential skills for current and future space careers (Pakakis, 2020). VSSEC's signature Mission to Mars program is now also being taught at Hamilton Secondary College in South Australia (Mike Roach Space Education Centre) where over 2,000 students have visited since the opening in September, 2017 (Kourbelis, 2020). Longitudinal studies published at the 68<sup>th</sup> International Astronautical Congress (IAC) from students attending the South Australian Space School camp over the last 20 years showed many of the Year 10 student attendees are now working in space industries. Furthermore, research across the world has found the shared experiences on camp produced strong friendships and ongoing supportive peer relationships, particularly for rural students (Clayfield, Samardzic, & Roach, 2017). The impact of these shared experiences demonstrate how important the development of networks for students, teachers and parents are for influencing and engaging students in a space career pathway.

When asking students about their interest in space, many immediately start talking about astronauts and rockets. While such aspirations are important for niche sectors of the space industry, there exists a great diversity of space science-related careers and professions. This breadth is evidenced through the Australian Space Agency's 7 national civil space priorities: position, navigation and timing; Earth observation; communications technologies and services; space situational awareness and debris monitoring; leapfrog R&D; robotics and automation, and access to space (Australian Space Agency, 2019). The SmartSat Cooperative Research Centre has over 100 partners from research and industry participating in a \$245 million R&D program focused on technologies in advanced communications and IoT connectivity and intelligent satellite systems. In particular the Earth Observation next generation data services aims to '*spawn new businesses, create export economic value and generate new high-tech jobs for all Australians*' (SmartSAT CRC, 2020). Australian states are also releasing their own space strategies aligned with the ASA priorities. For example, Queensland has a focus on launch activities, ground systems, Earth observation, niche

manufacturing, robotics and automation for space (Department of State Development, Manufacturing, Infrastructure and Planning, 2020).

Mapping the skills gap in the space sector is currently being undertaken by a joint venture between the SmartSat CRC and the Australian Space Agency (Koronios, A.; James, A.; Sasanelli, N., 2020). This will be developed in the SmartSat CRC to identify the pathways needed for careers in the three SmartSat CRC areas. However, it is critical that this is extended for all of the ASA focus areas and that information be easily available for all students, teachers and parents.

These career vocational, university and combination pathway resources and links could be shared through the new Australian Space Discovery Centre. This will open in early-mid 2021 and be a public place to inspire, educate and engage anyone who aspires to a career in space (Department of Industry, 2020). A public database linked to the Centre (compliant with Australian privacy principles) could provide regular updates on space education and career information, with feedback from database members informing this process. Longitudinal studies with volunteer surveys of members could also collate information about the most useful type of information, resources and events for influencing student and parental career choices in space.

As a result of the recent need to develop online school teaching during the 2020 Covid-19 pandemic, many Australian teachers have relied on space education resources from NASA and other international space agencies. This does not provide an Australian context. Although there are some excellent Australian resources available they are often aligned to one state or need updating due to curriculum changes. For example, the CSIRO Astrophysics for Senior Physics (Hollow, 2002) is currently out of date for the NSW Science senior science curriculum but contains useful information for students interested in astronomy, cosmology and nuclear physics.

Therefore it is proposed that funding for a panel composed both of teachers across all states and space industry/research experts is needed to regularly review and quality endorse curriculum aligned with the national Australian Curriculum and specialist senior subjects. This curriculum would then be easily accessible to teachers through national Commonwealth funded platforms under the 'Inspiring all Australians in Digital Literacy and STEM' measure of the National Innovation and Science Agenda (Commonwealth Department of Education, 2020).

Several recent decadal plans and science/technology strategies include individual Education and Outreach programs, e.g. the National STEM School Education Strategy (Education Council, 2015); the Women in STEM Decadal Plan (Academy of Science, 2019), A vision for Space Science and technology in Australia (Academy of Science, 2017). Recognising current gaps in STEM education, the Department of Defence developed its own strategic plan: 'Moving towards a high-tech future for defence: Workforce Strategic Vision underpinned by Science, Technology, Engineering and Mathematics' which has a key action to reinforce and harmonise objectives and goals from both their own strategic vision and broader strategies and plans (Australian Government, 2019).

It would be sensible to promote national education and career programs which coordinate information, recommendations and strategies identified in such various plans to reduce duplication of effort and resources, reinforce messages, and maximise government funding outcomes, for space related education, training, and the development of our future workforce.

## Issues Table

Insight	Aspiration	Actions	Impacts	Metrics
Lack of understanding of wide range of skills and careers within space science research and industry	Detailed mapping of workforce skills and vocational, university and combination career pathways needed for current and future space research and work	Align with current mapping by ASA and SmartSAT to understand the current and future skills needed  Provide skills and career mapping results on national website such as Australian Space Discovery Centre and Academy of Science Website	Parents, teachers and students can easily find out and will have a greater understanding of what skills need to be developed and how school subjects/STEM programs/activities can also develop these skills	Improvement in recognised space and STEM skills in students entering tertiary studies and workforce, especially space sector
Difficult for students to visualise and understand current and future Space Careers outside of astronauts and rocket launching	Real examples of Space careers, professions and relevant skills are easily accessible by students, parents and teachers	Videos, case studies, recorded panel webinars are available through national STEM Associations, Academy of Science and Space Discovery Centre career section and STEM media free to schools (such as 'Careers in STEM')	Online and face to face resources are easily available for students to find role models for careers in Space Industry and Research.	Students, parents and teachers will have a greater understanding of the range of careers and diversity of people involved – feedback can be invited from students to understand which types of examples are most appreciated/understood by students and influence future choices
Lack of easily accessible quality endorsed Space education resources for teachers linked to Australian curriculum, especially in Science, Mathematics and Technologies	Expert panel of educators and Space Industry Personnel/ Researchers endorse quality Space aligned curriculum links and resources	A panel is funded with educators (across Early Childhood, Primary and Secondary) from all states and Space experts to meet every 3 years (Year 1, 4 and 7) over decadal plan to endorse Curriculum which is then linked to Commonwealth funded sites and through National Science/Maths Associations	Teachers are able to easily access quality endorsed Australian based Curriculum and links to engage and inspire students to enrol in subjects enabling them to proceed along a Space career pathway	Metrics are kept of how often educators are accessing sites, pre and post surveys are used to see how educators are utilising curriculum resources and feedback for improvements on the next cycle

<p>Many current STEM activities and competitions develop skills that are used in Space research and Industry but students/teachers participating are unaware of this</p>	<p>Expert panel of educators and Space Industry Personnel/ Researchers endorse and showcase how skills developed in STEM competitions and activities (such as VEX robotics) are useful for a career in Space</p>	<p>A panel is funded with educators (across Early Childhood, Primary and Secondary) from all states and Space experts to meet every 3 years (Yr 1, 4 and 7) over decadal plan to endorse how skills developed through current and future STEM activities are utilised in Space research/work. These endorsements are added to promotion of the STEM competitions and activities through current promotions such as on the STARPortal</p>	<p>STEM activities and programs that teachers are already involved in and are linking to current STEM curriculum will be easily able be linked to a career and pathway for Space for students</p>	<p>Metrics are kept of how often educators are accessing links, volunteer pre and post surveys are used to see how students and teachers understanding of how skills developed link to Space careers</p>
<p>Quality teacher PD is needed to be linked to endorsed Space Education resources and easily available (and credited) for all Australian teachers</p>	<p>Professional development should be available at Beginner, Intermediate and Expert levels – easily accessible and provide accredited certificates across all states.</p>	<p>Teacher PD is developed to run face to face or online individually or in groups based on quality endorsed curriculum and links and is able to be certified in all states by educational jurisdictions/sector bodies which includes the academic Space Education panel.</p>	<p>Teachers at all levels are able to access and increase their knowledge about linking Space Education to current Australian Curriculum (and some Senior courses which may differ from state to state)</p>	<p>Pre and post surveys are used to see how PD has benefited teachers and changed pedagogy in the classroom as well as accessed metrics.</p>
<p>Many Space related activities and events are happening all over Australia, difficult for students, teachers and parents to access unless they are members of particular groups</p>	<p>Students, parents and teachers are able to find out about Space related activities and programs in all Australian states from joining one database</p>	<p>A position is created within the Australia Space Agency Discovery Centre to maintain a database (from students, parents and teachers who access the Discovery centre in person or online) and email out regularly (at least once per quarter) about activities</p>	<p>More students, parents and teacher will be able to easily access public and paid events about Space Science research and careers which will lessen a current high volume of queries for Space Industry and Researchers</p>	<p>Numbers are kept of those accessing events and a reduction is seen in queries for Space Industry and Researchers.</p>

		happening state and Australia wide.		
Space Conferences and Forums are not easily accessible by teachers to 'self-link' curriculum and Space research/ industry	Teachers, parents and students are able to access at least one 'open' session of all conferences and forums in Australia to talk to researchers and industry directly	Similar to the IAC 2017 in Adelaide where the general exhibition hall was free to the general public and educators, free ticketed access is made available for part of all Conferences and forums with a relevant Space section.	This will enable 'open discussions' between teachers and Space Industry/researcher which can help provide 'real world context' to STEM subjects and curriculum already being taught.	Free ticketed access will allow documentation of numbers attending and post survey questions would allow information to be collected about the most popular links made which could feed back to the Space Expert Curriculum and Skills Panel
Difficult for students and schools to access 'Space (Moonshot) Missions' and for these missions to be funded and run to completion with outcomes	Students and schools may be able to engage more easily with 'real' space research and material development for data collection/Space testing	A position is funded for the Australian Space Agency that allows access to and development of opportunities that arise from Industry and Research to link directly with interested schools and teachers (an Education Space broker)	Students and schools are able to be involved with real space Missions without huge costs and time impacts on teachers and industry for a major Australia/State wide 'Space Mission. Small groups of professional scientists and engineers provide motivation and expertise for students to continue on these long - often 3-5 yr missions	Documentation of successful partnerships can be publicised and lead to more Industry/School partnerships and 'mini-missions'  Students can be interviewed and followed to see the impact these missions have made on their study and career choices

## Recommendations

The Academy of Science should call upon the government and government funded agencies to provide support for the Academy to conduct and/or help coordinate the following activities:

1. Work with other agencies for mapping of workforce skills and tertiary education career pathways (include a range of VET, Uni and combination courses) needed for current and future space-related jobs
  - a. This should be aligned with related (ASA and SmartSat CRC) projects
  - b. Mapping results to be available via a national website, e.g. ASA Space Discovery Centre or Academy of Science
2. Establish national responsibilities for provision of space-related careers information and opportunities
  - a. The Australian Space Discovery Centre should have a position created to develop and maintain a database of space-related activities and programs in all states
  - b. Careers information incorporating case studies, webinars, should be available to national STEM associations, STEM resources provided to schools, Academy of Science and the general public
  - c. The Australian Space Agency should have a position created to develop linkages between students, teachers and relevant industry and R&D ( including 'Moonshot') projects
3. Establish a national panel of stakeholders to support curriculum and careers development
  - a. National panel of K-12 educators and space workers (industry and research) to endorse curriculum and STEM skills development in the space context.
  - b. Curriculum information is linked to relevant Commonwealth-funded and teachers' association sites and regularly reviewed (every 3 years)
  - c. STEM information linked to panel-endorsed relevant STEM activities including STARPortal
4. Establish a program for development of quality-endorsed space-related teacher PD (multi-level) material linked to relevant curricula
  - a. Space conferences and forums in Australia have at least one "no-cost" 'open session or stand' where educators and space workers can visit, network and share the latest space updates and curriculum/pedagogy advances

These recommendations should link with recommendations from other Decadal plans and long-term strategies to strengthen and consolidate government funding in order to improve space-related skills and jobs in Australia, space-related education, and participation of traditionally underrepresented groups where appropriate.

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