Student insights, trajectories and equity considerations: using the LSAY to examine demographic predictors of participation in senior secondary science

Grant Cooper, RMIT

The analysis in this chapter draws on a 2018 journal article by G Cooper, A Berry and J Baglin, 'Demographic predictors of students' science participation over the age of 16: an Australian case study', Research in Science Education, *DOI: 10.1007/s11165-018-9692-0.*

Background

Science, technology, engineering and maths (STEM) literacies are viewed by governments, industry and others as crucial to growth, fostering innovation and promoting global competitiveness. There are, however, concerns about disparities between supply and demand in the so-called STEM-labour pipeline (Hobbs, Clark & Plant 2018). As part of the response, education reform has been viewed as one way of addressing the predicted mismatch between STEM labour market demand and domestic supply. Reliable and representative student data are an important 'resource' as stakeholders try to address some of the challenges and/or barriers associated with STEM education in Australia and, indeed, globally. The policy and initiatives focusing on the improvement of STEM-education outcomes and participation need to be evidence-based. Data that offer insights into students' educational and career trajectories, especially longitudinal studies, are an important resource for stakeholders as they implement change. The dataset of interest in this publication is the Longitudinal Surveys of Australian Youth (LSAY). Analysing students' science participation in senior secondary science, this brief chapter draws on an analysis by Cooper, Berry and Baglin (2018). In this piece of work, Cooper and colleagues used the LSAY data to examine whether, and to what extent, demographic factors predict students' participation in science over the age of 16 years (post-16). Subject selection during this stage in students' lives is crucial, given that such choices may have a profound impact on their future pathways.

While there is a lack of space to examine in detail the Cooper, Berry and Baglin (2018) study, the reader is encouraged to access this paper for a more complete discussion on the various components of the study, particularly if they are interested in reading more about science participation in Australia. Here, the findings of the Cooper, Berry and Baglin study are used to demonstrate the potential for LSAY to offer valuable insights into students' educational and career pathways.

The last two decades have seen considerable declines in the proportion of high school students choosing senior science courses in many post-industrial countries, including Australia (Kennedy, Lyons & Quinn 2014). Commonly, learners perceive that science and science education offer little relevance both to themselves and to the society in which they live (Dillon 2009). Adding to concerns about falling participation rates in science education are the student groups who have traditionally been underrepresented in science, particularly as the year level increases (UNESCO 2017). Such groups include those from low-socioeconomic status (SES) backgrounds (Fullarton et al. 2003; Gorard & See 2009), Indigenous Australians (Dreise & Thomson 2014), and females in the physical sciences (Higgins 2018). Ancestry backgrounds have been associated with a disadvantage in academic achievement in countries such as the USA and parts of Europe, while an immigrant advantage has been observed in countries with selective immigration policies, including Australia and Canada (Akther & Robinson 2014). Cooper, Berry and Baglin (2018) examined four demographic predictors of science participation, including SES, Indigenous status, gender and ancestry/background. The results below are drawn from the 2009 cohort of the LSAY survey (Y09). Y09 was selected because it was the latest publicly available LSAY dataset that aligned with the aim of the study when the project started.

Results

As shown in table 2, approximately 57% of the study participants were female, while nearly 43% were male. Indigenous students comprised just over 5% of the sample, which is higher than the estimate in the total Australian population (approximately 3%). About 58% of the sample were categorised as Australian-born, nearly one-third were first-generation individuals and the remainder had foreign-born ancestry. Over 7000 students were included in the analysis; the relatively large sample size, which includes participants from across Australia, is a clear strength of the LSAY datasets.

Table 2 Descriptive statistics

	Frequency	Percentage (%)
Gender		
Female	4 065	57.44
Male	3 013	42.56
Indigenous status		
Non-Indigenous	6 716	94.88
Indigenous	362	5.12
Ancestry/background		
Australian-born	4 151	58.64
First generation	2 274	32.13
Foreign-born	6 53	9.23
Self-reported participation in Science		
Yes	4 150	58.63
No	2 928	41.37

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Multiple logistic regression was the technique used for analysis. Odds ratios (OR) are reported in table 3 and measure the degree of association between each predictor and the outcome. This model was statistically significant ($X^2(5) = 269.79$, $p < .001$). The predictors explained 5% (Nagelkerke R^2) of the variance in students' post-16 science participation and correctly classified 60.9% of cases (relative to 58.6% when no independent variables were added).

The results indicated that SES was a significant predictor of students' post-16 science participation (OR = 1.51). Also, Indigenous students were significantly less likely than non-Indigenous students to report post-16 participation in a science subject (OR = .53). There was however a non-significant difference in the odds of females (compared with males) reporting participation in a science subject (OR = 1.03). Compared with Australian-background students, first-generation students were more likely to report participation in a science subject (OR = 1.35). Furthermore, foreign-background students were also significantly more likely to report participation in a science subject than those from an Australian background (OR = 1.68).

Table 3 Results of logistic regression predicting students' participation in a science subject

	B	SE	Likelihood ratio χ2	df	p	95% CI		
						OR	LB	UB
SES	.42	.03	147.06	1	<.001**	1.51	1.41	1.62
Indigenous	-.63	.11	31.70	1	<.001**	.53	.42	.66
Gender[1]	.04	.05	.50	1	.47	1.03	.94	1.14
Aus-bkg[2]	-	-	52.76	2	<.001**	-	-	-
Firstgen-bkg	.30	.05	-	1	<.001**	1.35	1.21	1.50
Foreign-bkg	.52	.09	-	1	<.001**	1.68	1.40	2.01

SE standard error, *CI* confidence interval, *OR* odds ratio, *LB* lower bound, *UB* upper bound, *Aus-bkg* Australian background, *Firstgen-bkg* First-generation background, *Foreign-bkg* Foreign background

**Significant p< .001

1 Female category (relative to male)

2 Reference category.

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The analysis of the LSAY data indicated that being Indigenous was the strongest negative predictor of post-16 science participation in this study. Additionally, as students' SES status increased, so too did the likelihood of students' post-16 participation in a science subject. An interesting finding of this study was the non-significant difference in the odds of either gender reporting participation in a science subject. This is a limitation of the study, as the variables used in the model did not allow the researchers to differentiate between different types of science subjects within schools (for example, physics or biology). In subsequent analysis of the Y15 cohort, gender was identified as a significant predictor of science participation at the domain level (Cooper & Berry 2020). For instance, in biology, females are over-represented while in physics, they are under-represented. Similarly, other studies report female underrepresentation in physics subject participation at the senior secondary level (Fullarton et al. 2003; Higgins 2018) and more broadly in other STEM-related subjects (for example, engineering). Differences in ancestry background and science participation were also noted, possibly highlighting the effect of skilled-migration policy, the cultural valuing of science in Australia and/or influences on students' science participation.

The value of the LSAY?

The dataset is a secondary data source (that is, the authors did not collect the data in the course of their research) and has what may be viewed as advantages and disadvantages within the context of its use. In relation to the Cooper, Berry and Baglin (2018) study, there were several advantages in using this data set, including its representative scope, the potential to generate new insights, relative ease of access and its free access. Broadly speaking however, it is important to be mindful that stakeholders should be cautious with secondary data source analysis because the data are likely to have been originally collected for different research aims, the data set may be relatively old and there may be limited control over data quality (Cheng & Phillips 2014). None of these were relevant concerns in relation to use of the LSAY dataset.

While a thorough discussion of the results can be found in Cooper, Berry and Baglin (2018), a key message in this chapter is the considerable value of the LSAY initiative. While demographics cannot be changed, the narratives within the LSAY data, together with careful analysis, show a variety of student insights and trajectories. This evidence base is of value to a variety of stakeholders, who may use these data to justify funding decisions, policy changes and/or curriculum initiatives. Consequently, it could be argued that the LSAY initiative has significant potential to promote notions of fairness and inclusion in schools, important elements worth advancing in our education system and beyond.

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