HOW RELEVANT ARE AUSTRALIAN SCIENCE CURICULA FOR RURAL AND REMOTE STUDENTS?

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ABSTRACT

This paper reports findings from the Choosing Science study (Lyons & Quinn, 2010) indicating that Australian Year 10 students in small rural or remote areas tend to regard their science lessons as less relevant than do students in larger towns and cities. Specifically, those in small rural or remote schools were significantly more inclined than their city peers to disagree that what they learned in science classes 'helped them make sense of the world'. They were also significantly more likely to strongly agree that they found science lessons boring, and to strongly disagree that science was one of the most interesting subjects. Potential explanations discussed include a mismatch between science curriculum content and the everyday experiences of students in these regions, the relative shortage of experienced specialist science teachers in rural or remote areas and a lack of opportunities to demonstrate the relevance of school science, among others. The paper considers the implications of these findings in relation to the Australian Science Curriculum and whether it is likely to better address the needs of rural and remote students.

INTRODUCTION

A previous paper by the authors published in this journal argued that high school students in small rural and remote towns tend to enjoy their science lessons significantly less than their peers in larger towns and cities (Lyons & Quinn, 2012). This argument was based on evidence from the national *Choosing Science* research project which investigated the influences on Year 10 students' decisions about taking science subjects in Year 11 (Lyons & Quinn, 2010). The paper made the point that this difference was not due simply to a lower level of enjoyment of school in general among rural and remote students, since these students were also significantly less inclined than peers in other locations to enjoy science relative to other subjects.

This paper complements the previous one by narrowing the focus from regional variations in students' overall enjoyment of science classes to variations in their perceptions of the interest and relevance of science curricula. It reports the results of comparisons between students in four geographic regions about whether the content they learned in science classes helped them make sense of the world, and whether they found it interesting. While there is no doubt some overlap between students' views of the relevance of science lessons and their overall enjoyment of these lessons, we argue that the former is a more specific element contributing to the latter in that relevance concerns the applicability of science content and skills to students' personal values and interests.

The paper begins by providing an overview of the research landscape in this field as a context for the study. We then introduce the *Choosing Science* study, describing the relevant research questions, sample characteristics and methodology before presenting and discussing the associated results. We argue that these findings are important in terms of the ongoing debate about how well an Australian Science Curriculum will address the diversity in interests of students in different educational and geographical contexts.

OVERVIEW OF SCIENCE EDUCATION IN RURAL AUSTRALIA

The literature identifies a number of advantages of rural education in Australia. Vinson (2002) found that the sense of community, the level of social capital and the role of the school in maintaining community identity were often more positive than in larger centres. Boylan, Sinclair, Smith, Squires, Edwards, Jacob, O'Malley and Nolan (1993) reported that teachers in rural areas regarded the quieter, safer and healthier lifestyles as very beneficial, particularly among those raising children. More recently, the state and territory case studies presented in the SiMERR National Survey (Lyons, 2006) provided overwhelming support from teachers, parents and students for these arguments.

Nevertheless, there is also evidence that high school students in small rural and remote towns in Australia are subject to a number of educational disadvantages, including a higher rate of teacher turnover, a greater proportion of first year out teachers, a greater chance of being taught by a non-specialist teacher, and less access to non-school resources such as museums (Harris, Jensz, & Baldwin, 2005; Lyons, Cooksey, Panizzon, Parnell, & Pegg, 2006).

In terms of educational outcomes, a succession of PISA science results have shown that students in these schools achieve considerably lower results than those in more populous locations (e.g. Thomson, De Bortoli, Nicholas, Hillman, & Buckley, 2010). Our previous paper in this journal indicated that Year 10 students in these areas also had poorer attitudes towards science classes, a finding consistent with Waldrip and Fisher (1999). Aspects of these attitudes included enjoyment of science lessons, intentions to participate further in science learning and disposition towards scientists and science more generally.

The research on attitudes to science notes both their multidimensional nature and the difficulty of drilling down to identify which sub-components most contribute to the students' overall attitudes. The *Choosing Science* questionnaire included multiple questions on attitudes, including several which investigated students' perceptions of the contribution of science lessons to their understanding of the world and to their personal interests. The personal relevance of science lessons to young people has been a concern in many countries including Australia, with several key reports arguing that students often question the relevance of what they learn and experience in junior high school (e.g. Osborne & Dillon, 2008; OECD, 2007). Darby-Hobbs (2011) rightly highlights the 'relevance imperative' as one of the most important themes to have emerged in the field of science education. Indeed, the 2006 PISA study included additional questions specifically addressing this imperative. That study found that 74 per cent of 15 year old Australian students agreed science helped them understand the things around them, though only 55 per cent agreed that science was very relevant to them (Thomson & De Bortoli, 2008). Unfortunately there was no breakdown of these statistics by geographical location and hence no indication as to whether students learning science in different locations find it equally relevant.

THE *CHOOSING SCIENCE* STUDY

The *Choosing Science* study explored a range of influences on Year 10 (15 - 16 year old) students' decisions about whether to take science subjects in Year 11. This report concerns three items investigating students' views on the relevance and benefit of their science lessons:

- "What I learn in science helps me to make sense of the world"
- "Science lessons bore me"
- "Science is one of the most interesting subjects"

The first item was included in the survey as it was thought to encapsulate the primary purpose of science education – understanding the physical world. The second and third items come from Fraser's (1978) Test of Science Related Attitudes (TOSRA). The principal reason for using the TOSRA instrument was to enable comparisons between the attitudes of contemporary students and those of Fraser's 1977 cohort. Results of this comparison are published elsewhere. TOSRA measured students' agreement with a range of dispositions towards science, including the interest and relevance of school science. The TOSRA scale has been validated many times and shown to be robust (Blalock, Lichtenstein, Owen, Pruski, Marshall, & Topperwein, 2008) with high levels of scale reliability. Students responded to the three items via a five point Likert-type format with the following options: Strongly disagree (1), Disagree (2), Unsure (3), Agree (4) and Strongly agree (5).

Sample Characteristics

The *Choosing Science* cohort comprised Year 10 students intending to progress to Year 11. The final sample of 3759 students attended 200 schools selected for state/territory and sector representation and for geographical location. School locations were allocated to the four categories listed in Table 1.

Table 1: ***Breakdown of Choosing Science respondents by sex and geographical location.***

	Girls		Boys		Total	
Location Category	*count*	*per cent*	*count*	*per cent*	*count*	*per cent*
Capital city	863	23	878	23.4	1741	46.3
Large non-capital city	387	10.3	323	8.6	710	18.9
Rural city/large town	482	12.8	355	9.4	837	22.3
Small rural/remote town	262	7	209	5.6	471	12.5
Total	1994	53	1765	47	**3759**	**100**

Close to half the students attended capital city schools, while about 12.5 per cent were from small rural or remote areas. Around 24 per cent of respondents (N=908) had decided not to take any science in Year 11. Further details of the sample composition can be found in the full *Choosing Science* report (Lyons & Quinn, 2010).

Analysis

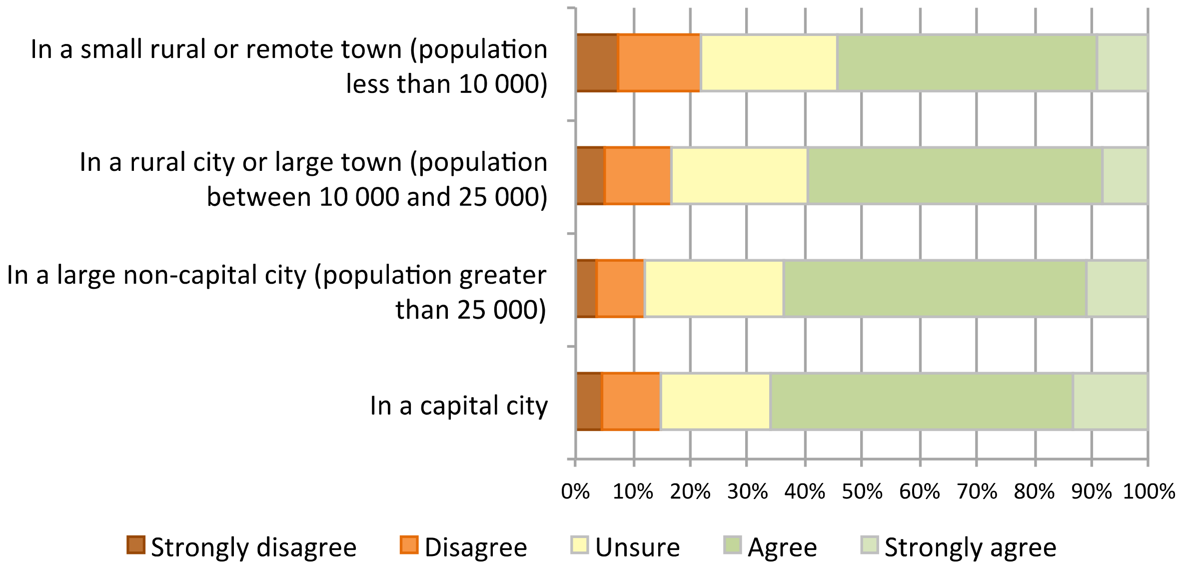
The analyses for this report consisted of chi-square contingency table tests employing a level of significance of $p<0.001$ and a minimum reportable effect size of 0.06. According to Cohen (1988, in Gravetter & Wallnau, 2005) this corresponds to a small effect size in tables where the variable with the smaller number of categories has three degrees of freedom, which is the case for all analyses reported here. Students' agreement responses on each item were cross-tabulated with school location. Patterns of difference were analysed using chi-square contingency table tests. Where significant chi-square relationships were observed, adjusted standardised residuals (ASRs) were used to evaluate the sources of the differences. ASRs greater than +3.30 or less than –3.30 indicate (at 99.9 per cent probability level) that individual cell counts are significantly different to those expected if there was no association between the variables. In this paper significant results will be reported as footnotes showing chi-square statistics, Cramer's V effect sizes and absolute values of the ASRs of unexpected cell counts.

RESULTS

Making Sense of the World

Overall, about 63 per cent of the *Choosing Science* cohort agreed that school science helped them make sense of the world while about 16 per cent did not agree. Boys were significantly more inclined than girls to agree with this statement. Figure 1 compares the ratings of respondents in the four location categories.

Figure 1: *Percentages breakdown of agreement with the statement "What I learn in school science helps me make sense of the world", by respondents in four categories of location.*



Contingency table analysis revealed a significant association between geographic location and agreement with this item[1]. The association was primarily due to significantly more students than expected from small rural and remote towns disagreeing that what they learned helped them make sense of the world, and significantly more than expected students from capital cities strongly agreeing that this was the case. The Effect size of this association was small.

Interest in Science Lessons

Two TOSRA items related to the relevance and interest of science lessons. The first sought students' agreement with the statement 'Science lessons bore me'. Since it was likely that responses to this might be coloured by students' views on school more generally, a second question explored the level of interest relative to other subjects: 'Science is one of the most interesting school subjects'.

Figure 2 compares the ratings on agreement with the first item by students in difference geographical regions. The figure shows that around 45 per cent of students in small rural and remote towns agreed that they were bored by science lessons. This compares to 34 per cent of respondents from rural cities/large towns, and around 30 per cent of respondents from the two most populous regions. Contingency table analysis revealed a significant association between geographic location and agreement with this item[2]. The association was due primarily to significantly fewer students than expected from small rural and remote towns disagreeing that science lessons bored them and significantly more strongly agreeing that this was the case. The Effect size of this association was small.

[1] $\chi 2$ (12) = 48.03; p<0.001; Cramer's V = 0.065, ASR 3.7

[2] $\chi 2$ (12) = 44.34; p<0.001; Cramer's V = 0.063, ASR 3.7

Figure 2: *Percentages breakdown of agreement with the statement "Science lessons bore me", by respondents in four categories of location*

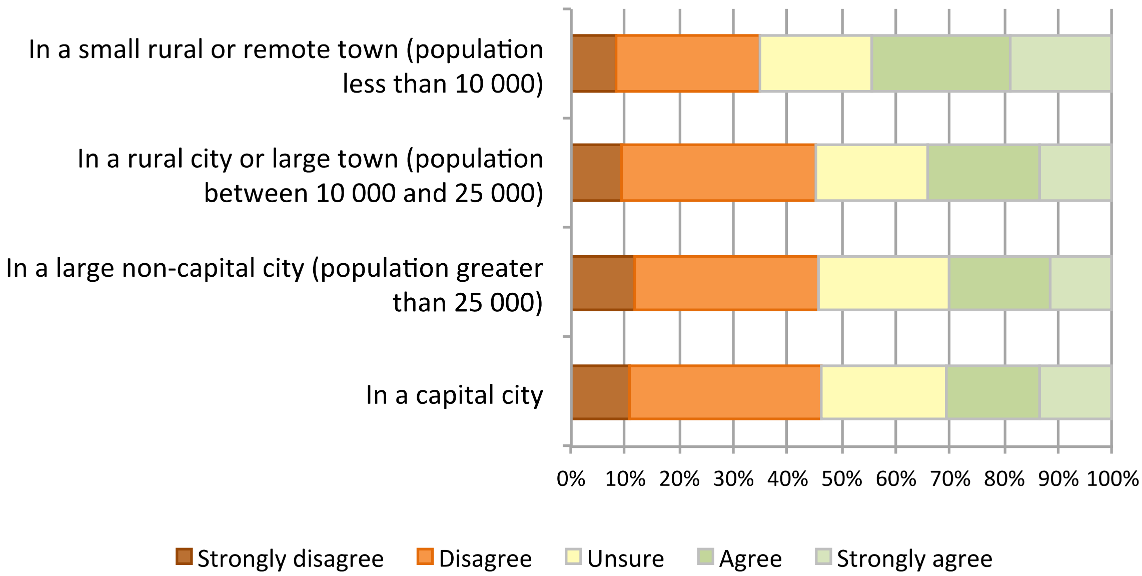
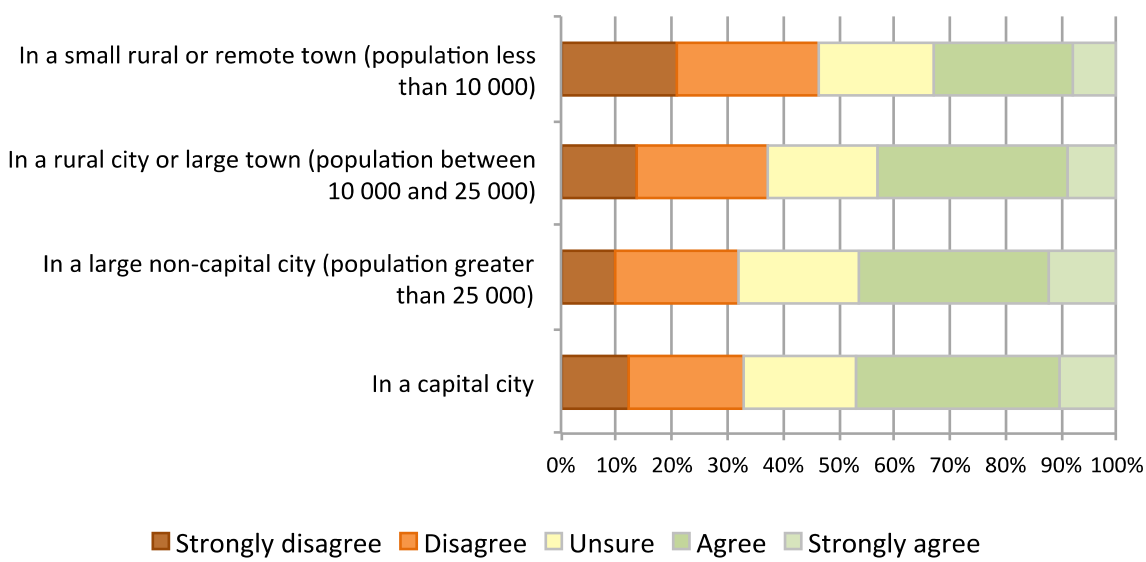


Figure 3 compares the ratings of respondents in different regions on the item "science is one of the most interesting school subjects". The figure shows that only a third of those in small rural and remote towns agreed with this statement, and 46 per cent disagreed. Of these, more than 21 per cent strongly disagreed, about twice the proportion of those in the large cities.

Figure 3: *Percentages breakdown of agreement with the statement "Science is one of the most interesting school subjects", by respondents in four categories of location*



Contingency table analysis revealed a significant association between geographic location and agreement with this item[3]. The association was primarily due to significantly more students than expected from small rural and remote towns strongly disagreeing that science was one of the most interesting subjects, and fewer than expected agreeing that this was the case. In contrast, significantly

[3] $\chi2$ (12) = 55.91; p<0.001; Cramer's V = 0.070, ASR 5.4

more than expected students from capital cities agreed that science was one of the most interesting subjects. The effect size of this association was small.

DISCUSSION

In concert, these results indicate that Year 10 students in small rural and remote schools tend to see less relevance and meaning in their school science lessons than do their city cousins. While the *Choosing Science* study did not explore individual explanations further to determine why this might be the case, the literature in this field offers a number of potential explanations.

The first of these may be the relative lack of qualified and experienced science teachers in small rural and remote schools. Previous studies (Harris et al., 2005; Lyons et al., 2006) reported that the demand for science teachers in such regions is significantly higher than in larger towns and cities, and that teachers are more often required to teach out of field. Hence science is often taught by teachers lacking the requisite discipline background and pedagogical content knowledge. Further, due to the higher rates of teacher attrition in small rural/remote schools, students' experiences of science are more likely to be affected by high turnover and teacher inexperience. Research shows that inexperienced and diffident teachers tend to rely more on textbook-based learning and undertake less practical work, leading to a less engaging and contextualised learning experience (e.g. Roehrig & Luft, 2004; Tobin & Garnett, 1988).

Second, it may be the case that students in small rural and remote schools have less access than their city peers to out-of-school experiences showing the relevance of science, for example, museums and outreach science opportunities. Lyons et al. (2006) found that science teachers in rural and remote areas were significantly more inclined than those in urban schools to perceive an unmet need for their students to visit non-school educational sites. The teachers' qualitative responses identified distance, time required and the lack of substitute teachers to cover other classes as the chief reasons for this lack of opportunity. However the degree to which this contributed to the perceived lack of relevance can only be speculated upon.

A third possibility is the applicability of the typical science syllabus to young people in rural and remote regions. We have argued previously (Lyons & Quinn, 2012) that the more academic nature of Year 10 syllabuses favour students who intend taking science at the senior secondary and university levels. Alloway, Gilbert, Gilbert and Muspratt (2004) argued that many students in small rural and remote schools are less inclined than their city cousins to aspire to university study and hence do not consider the Year 10 curriculum as relevant.

This third possibility has implications for the implementation of the Australian Science Curriculum. Given the centralisation of its development, the uniformity of its design and the focus on content, if adopted without modification by local curriculum authorities there is a real risk that it will not allow the level of flexibility some locally developed state and territory syllabuses have had to cater for student diversity, including the needs and interests of rural and remote students. This was shown by Drummond, Halsey and van Breda (2010, p. 5) to be a concern of rural teachers worried that the content-focused nature of the curriculum would *reduce their capacity to design learning opportunities that are responsive to local issues and interests*. A few education authorities seem to have taken such concerns on board – for example Education Queensland intends to implement the curriculum with reference to that state's Action Plan for Rural and Remote Education 2011-2015. However, this requirement to address geo-social diversity is absent from the *Shape of the Australian Curriculum v.3* (ACARA, 2012) document (indeed the terms rural and remote are not mentioned at all in this document) and so may not find its way into state and territory requirements.

Evidence reported here and in our previous paper reinforces the needs for ACARA and other education authorities to correct this oversight so that teachers are explicitly encouraged to recognise and cater for the interests of rural and remote students the design of science curricula. Further, given the aforementioned teacher supply and attrition problems we also recommend that these bodies recognise the additional needs of teachers in small rural and remote schools for resources, support and professional development to help them better engage their students in learning science.

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