



MATHEMATICS EDUCATION IN RURAL AUSTRALIA: Issues for Equity and Success

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Abstract

In writing this paper, we have taken a somewhat different approach to the usual research paper. This is intentional as we recognise the great diversity of what constitutes ‘rural’ mathematics education internationally. Australia has been known as the ‘lucky country’ and this is very true when it is considered in terms of what constitutes rural education in this country in comparison with what is called “rural education” in other countries, and what is called “field education” in Brazil. As such, our first intent is to provide a description of rural education in Australia. Despite this appearance of being lucky in terms of education provision, we also note that students living in rural areas are less likely than their urban peers to do well in mathematics. Drawing on national testing data, which is our empirical data, we illuminate this status quo and this forms the basis for the remainder of the paper. In order to understand the differential success between urban and rural students in mathematics, we draw on the relevant literature as a means to explain the phenomenon. To do this, we offer a theoretical model to frame the differences in mathematics outcomes between urban and rural students. We do this as we want to make a unique contribution to understanding the situation within Australia, ponder the reasons for the inequity in outcomes for rural learners.

Keywords: rural education, national testing, practices, teachers, students.

EDUCAÇÃO MATEMÁTICA NA AUSTRÁLIA RURAL: questões para equidade e sucesso

Resumo

Ao escrever este artigo, nós desenvolvemos uma abordagem um pouco diferente daquelas mais convencionais para um artigo de pesquisa. Isso foi intencional, pois reconhecemos a grande diversidade do que constitui em termos internacionais a Educação Matemática em contextos 'rurais'. Austrália tem sido conhecida como o "país de sorte" e isso é verdade quando considera-se o que constitui a educação rural no nosso país, em comparação com o que é chamado "educação rural" em outros países e, particularmente, o que é chamado de "Educação do Campo" no Brasil. Assim, a nossa primeira intenção é fornecer uma descrição da educação rural na Austrália. Apesar dessa aparência de ser de sorte em termos de oferta de escolarização, notamos também que os alunos australianos de áreas rurais têm menos probabilidade de terem bom desempenho em Matemática do que aqueles que vivem em áreas urbanas. Baseando-se em dados de testes aplicados nacionalmente, os quais compõem os nossos dados empíricos, nós esclarecemos esse status quo, sendo essa discussão a base para o restante do artigo. Para entender a diferença de sucesso entre alunos de áreas urbanas e rurais em Matemática, abordamos aspectos da literatura relacionada como um meio de explicar o fenômeno. Para fazer isso, oferecemos um modelo teórico para enquadrar as diferenças de resultados em matemática entre os alunos urbanos e rurais. Fazemos isso porque queremos contribuir especificamente para compreender a situação na Austrália: ponderar as razões da desigualdade nos resultados para os aprendizes de áreas rurais.

Palavras-Chave: Educação do Campo, avaliação nacional larga escala, práticas, professor, estudante.

CONTEXUALISING RURAL EDUCATION IN AUSTRALIA

To give some sense of the "average Australian", the Australian Bureau of Statistics– ABS (2013) provides some details about the spread of people across the nation. In considering these figures it is also important to consider the area of Australia. In area, the country is 7.69 square kilometres which is comparable to the size of the USA and greater than Europe. It is a vast country with fertile coastline but an extensive desolate interior. This makes for the dispersal of the population to be concentrated in particular areas. More than 85% of Australians live within 50kms of the coast. In considering where people live in terms of urban and rural areas, the ABS indicate that 60% live in a capital city with 35% living in Melbourne or Sydney. When other major cities are included in these demographics, 69% of Australians live in a major city. 90% of Australians live in an urban setting with a further 3% live in smaller

towns. According to the 2011 census, 1.8 million people lived in rural settings, making approximately 8% of the population.

As Australian education is governed by the states and territories, the figures for expenditure for education provision for each state/jurisdiction will vary considerably. The area of the states varies, as do the populations, making for unique contexts in each location. However, the governments spend considerable funds on education provision in the nation. Between 2006-2007, the proportion of GDP spent on education was 5.3% (or \$64B) but this rose to \$94B in 2010-2011 (or 7.1%) due to a large capital works program initiated by the Federal government (Building the Education Revolution) to stimulate the economy in the face of the Global Financial Crisis. Rural schools benefitted from this increase in expenditure, as did urban schools. While we have been unable to ascertain the amount of funding specifically earmarked for rural education it is noted as being reasonable. There are targeted programs aimed at rural education, including the recent Rural Education Program (REP) that was established in 2002 to support rural families suffering from the extended drought that swept most of the nation. There are also philanthropic organizations (such as the Foundation for Rural and Regional Renewal) which specifically support rural and regional communities. Their Rural Education Australian Program – REAPingRewards was a national program that supported locally driven initiatives to benefit school aged children. Schools could bid for grants to \$10K to support initiatives at the school level. A similar program was also implemented for early years. These types of funding are in addition to those offered by the state and federal government and are reliant on the entrepreneurial skills of the principal or some other person at the school. Many of the students considered to be attending rural schools will come from either farming families or be based in local towns that service the rural communities. Rural schools are often small and may have one or two teachers with a teaching principal if located in sites away from the larger service towns. In the towns, the schools may be larger but in comparison with their urban counterparts may still be quite small.

The government also offers targeted programs and perhaps the most well-known of these in mathematics education has been the SIMMER project operating under the guidance of Professor John Pegg from the University of New England. This hub

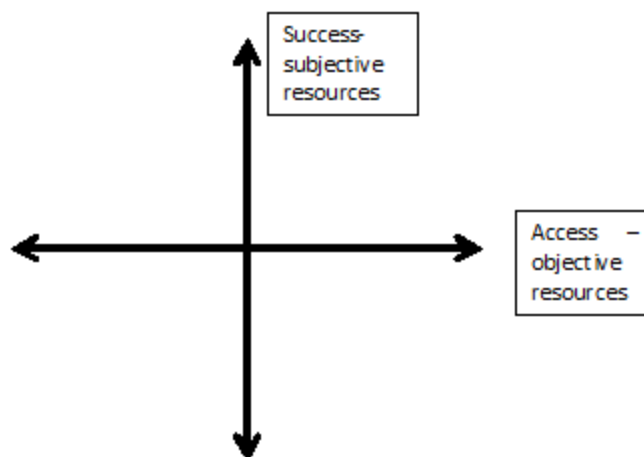
approach across numerous states offered a range of programs to support mathematics (and science) learning and professional support for rural schools across the nation.

Most of the states have issues with staffing schools in non-urban settings so offer incentives for teachers to work in rural/remote settings that may include higher salaries with loading for the rural/remote locations, flights to return to home cities in major school breaks, and points that can be accumulated and traded for positions in urban settings. These systems enable teachers to work in rural and remote settings knowing that they can return to urban settings at some point in their career. However, it is also noted in some studies, that often young graduates (usually women) may take up a position in a rural area, marry into the area and remain in community. One Australian university, Charles Sturt, actively promote themselves as rural university with the explicit intent of educating graduates in various fields (such as education, veterinary science, dentistry) to remain in rural settings.

In comparison to many rural schools in other countries, rural education in Australia is not dissimilar to the provision of resources for urban settings. Governments often have differing funding for rural education in recognition of the challenges that confront rural schools. When considering issues of equity and inclusion there are two main dimensions that need are important for framing any analysis. Resource allocation, which, in Figure 1, we label as our horizontal axis, are those which the governments provide to schools to ensure that schools are in sites that area accessible to rural families, and the facilities within those locations meet the standards set by the government. But as we will explore in this paper, there is more to rural education provision than resources. We refer to this as our vertical access, and it is this axis that we see is most important in the provision of equity and equality for rural students in their study of mathematics.

In writing this paper we draw on a model we have been developing for conceptualizing equity, inclusion and success for marginalized learners. We acknowledge two very different sets of mediating dimensions in education that impact on learning, learners and success.

Figure1 - Model for conceptualising equity, inclusion and success for marginalised learners



In this model, we argue that on the horizontal axis, we need to ensure that adequate resources are given to schools to enable quality education provision. In the Australian case, governments do provide good resourcing to schools – buildings, teachers, equipment and so forth. Yet despite this resourcing the vertical axis – success for rural students – remains different from those of their urban peers. Coming to understand the interactions of these axes becomes important in order to understand how rural education provides different outcomes. Some of these outcomes are on the background of the students. As Hattie’s (2008) comprehensive work on school effectiveness has shown, two key factors in student achievement are the background of the student (which teachers/schools have little control over) and the teacher. In considering our model, access to teachers is part of the horizontal axis – teacher numbers are provided to the school. But what becomes important in considering the success axis is the quality of those teachers to teach in a rural context. So the two axes need to be considered in tandem. The basic infrastructure (horizontal) may be provided but what becomes critical in achieving success are those factors on the vertical axis. Similarly, if one considers this diagram in relation to the provision of rural education in other contexts, the basic infrastructure may be poor (poor building, poor resources) but the quality of the teachers (vertical axis) may be instrumental in bringing about success.

RURAL STUDENTS AND ACHIEVEMENT IN MATHEMATICS

In order to establish if there is a relationship between rurality and success in mathematics education, we have drawn on the national testing data for Australia. This is publicly accessible data (via www.myschool.edu.au). There was a strong relationship between community size and mathematics scores where the larger the community, the greater the achievement score. Welch, Helm and Lamb (2007) et al, also analysed the 2005 data on national tests and found that the further away from urban settings, there was a corresponding decline in mathematics achievement scores, but more alarmingly, that this gap increased the longer students remained in school. More recently, there have been more “positive” signs that the gap between metropolitan and non-metropolitan students has at least stabilised across the school grades. Nevertheless, there is still a substantial performance difference between these groups of students (see Table 1). Approximately 5% of all metropolitan students are deemed to be not at the minimum national standards, whereas, for non-metropolitan students range from 20% (in Year 5) to approximately 17% across other grades in the national testing schedule. Proportionally, the rate of underachievement is 3 times greater in non-metropolitan areas.

Table 1 - Geolocation data for 2012 NAPLAN results representing percentage of students at or above minimum national standards.

	Year 3	Year 5	Year 7	Year 9
Very Remote	56.7	48.6	58.8	60.6
Remote	84.6	82.9	86	85.4
Provincial	92.6	92.3	92.8	92.6
Metro	95.1	94.5	94.8	94.5
Non-metropolitan	82.3	79.6	83.1	83.3

Data sourced from Australian Curriculum, Assessment and Reporting Authority (2012).

EXPLORING THE VERTICAL DOMAIN OF RURAL EDUCATION

The data show that living in a rural context does impact on student achievement (AUSTRALIA HUMAN RIGHTS AND EQUAL OPPORTUNITY COMMISSION, 2000). Coming to understand this dimension is the focus on the remainder of this paper. To undertake this exploration, we draw on the literature in the field and also suggest further areas of exploration.

Geographical isolation is a catalyst for many of the issues on the vertical dimension. Given that only a small part of the population lives in non-urban settings, and the physical location of these sites is often some distance from an urban setting, various factors impact on the provision of education when geography is considered.

TEACHERS AND TEACHING

As Hattie (2008) pointed out, it is the teacher who accounts for most of the effect difference so it is recognized that attracting and retaining quality teachers to rural education is a key to success. However, there are many factors that impact on the potential of quality teachers in rural education. In this section, we consider some of the key influences in the quality of teachers in rural education.

Teaching out of field

Many rural schools have problems with staffing, particularly in the areas of mathematics and science (LYONS et al., 2006). Acquiring suitably qualified teachers in these areas is becoming increasingly problematic for systems and schools, but the problem is exacerbated by the geographical isolation of rural schools. To ensure that students are able to access mathematics in these areas, teachers are often forced to teach outside their teaching areas, particularly in the junior secondary area (HOBBS, 2012). In following this work, Hobbs (2013) studied rural school teachers who taught outside their field (and into mathematics) had to contend with issues around support and their personal resources (i.e. mathematical backgrounds) in making the successful transition to being a mathematics teacher in a rural school.

Professional Development

Perhaps some of the biggest challenges for rural education in a vast country such as Australia is the geographical isolation. With this isolation, the provision of many of the resources commonly accessible to urban teachers is either absent or hard to source. In his work with teachers who had left the profession Buchanan (2012) found that the

lack for professional development and support were most salient reasons for in teacher attrition.

Use of ICTS and technology were also impacted upon where it was found the access to professional development for urban teachers was more readily accessible than for their rural peers (BENNISON; GOOS, 2010). These authors suggest that this impacts considerably on the capacity of rural teachers to use effectively ICTs to support mathematics learning. Further access to professional development is closely linked to teachers' sense of identity and professional, and can impact on their longevity in rural communities. This concern is aptly summed up by authors when they argue that "Access to professional learning is critical and isolation from colleagues, professional associations and support structures can affect the retention of teachers and in turn affect the sustainability of rural communities" (BROADLEY, 2010, p.63).

Distance Education

For many students, the lack of qualified teachers, or even access to schools, requires them to undertake alternative means of education. This is usually provided through a range of media offered through distance education units. These can include the traditional correspondence of resources but increasingly there is a reliance on new technologies that may be synchronous or asynchronous (LOWRIE; JORGENSEN, 2012). In this work, we found the capacity of the teachers to work with different media for distance education influenced the modes of delivery as well as the quality of the delivery. What was also found was that what is often cutting edge technologies when originally established, distance mode education is significantly influenced by the objectively structuring practices – namely the resources that are available in distance education – and the teachers' capacity to deal with these resources.

Preservice Teachers

There is an increasing recognition of the need to prepare teachers to work in rural locations. With the oversupply of teachers, it is almost impossible for new graduates to secure employment in urban settings, particularly for primary and junior secondary teachers. As such, many graduates need to seek employment in rural areas

but they are unprepared for the demands of these settings, so there is an emergence on research into the needs for preservice teacher education to prepare graduates for these contexts, including early childhood (GREEN; NOLAN, 2011). There is a need for preservice teachers to experience rural education as part of their practicum experience so that attitudes towards rural education may be enhanced (HUDSON; HUDSON, 2008).

Curriculum, Pedagogy and Assessment in Rural Education

While we could not find any research that specifically targeted rural education curriculum, pedagogy and assessment, we were able to find a comprehensive literature that acknowledged the impact of living in remote areas. This research drew on the cultural knowledges of Indigenous Australians, and firmly acknowledged the importance of the intersection of non-dominant cultures and school education. With large numbers of Indigenous Australians living in rural areas, creating learning environments and assessment practices that meet the needs of rural/remote Indigenous learners has been the focus of considerable research. Creating culturally relevant pedagogy and assessment has been one approach (KLENOWSKI et al., 2010) to seeking to engage rural Indigenous learners in mathematics education. We contend, that while the culture of Indigenous learners is often remarkably different from that represented in and through schooling, the same could be argued for rural students. Their life worlds are remarkably different from those of urban students. Case study observations of students living in remote areas have revealed that applications of mathematics knowledge are considerably different to that of students living in metropolitan areas (LOWRIE, 2006). These students are often required to support their family's economic needs (e.g., helping on the family farm) rather than being involved in cultural or sporting activities as could be the case with their peers in metropolitan areas. Although these non-metropolitan students are more likely to struggle in the mathematics classroom, they are involved in real-life mathematics engagement as they participate in their home responsibilities (e.g., helping to maintain fencing on properties, working out ratio and proportions of chemicals, navigating and following directions across large areas of land, buying or selling of livestock and farm produce). Nevertheless, it has been reported that these

relatively sophisticated mathematical ideas, applied in contextual situations, never appear to have strong links to what is taught and “valued” in the school-based mathematics curriculum (LOWRIE, 2007). Consequently, the applications of mathematics do not reinforce or consolidate the narrow views of mathematics learning.

Students

A further challenge for rural education is the needs of the families. Often students may miss periods of school due to farm demands, particularly as the students get older and are better able to help with farm chores. The retention of rural students in the post-compulsory years at least ten percentage points below their urban peers and for remote students it is even greater. As Lamb et al. (2004) have shown, the further students are located away from major urban centres, their retention to Year 12 drops according to the distances from those centres. With low retention, and low numbers, and the need for teachers to teach outside their teaching areas, questions about the quality of higher levels of mathematics being offered in rural areas also becomes a challenge for students wishing to enrol in these subjects. They are most likely to enrol in distance education courses if they are to be able to complete senior levels of mathematics.

In a study of ICT use in schools (LOONG; DOIG; GROVES, 2011), it was found that there was little reported difference between urban and rural students’ perceptions of ICT use. Where there were differences, these were in favour of more frequent use by rural children. Similarly in their work with young rural children’s use of computers in the pre-school setting (ZEVENBERGEN; LOGAN, 2008) work, they found that children were accessing computers in very constructive and educational ways. Such studies suggest that there is a propensity for rural students to access and use computers. But as the research cited earlier in this paper showed, there was a challenge for offering quality professional development to teachers to enable them to use computers and other digital tools in educative ways.

Lowrie and Jorgensen (2011) compared and contrasted the types of games metropolitan and non-metropolitan students engage with in a digital form. They found interaction effects between students’ geographic location and their gender. Not

surprisingly, non-metropolitan male students preferred playing games that involved navigation and mapping. However, they were less likely to engage with games that required the interpretation of graphs and tables when compared to their metropolitan male counterparts. By contrast, metropolitan female students were more likely to engage with mapping games when compared to males in metropolitan areas and preferred playing problem-solving type games (including games with logic) than that of females in non-metropolitan areas. Other studies have found there are quite distinct difference in the way metropolitan and non-metropolitan students interpret and process mapping tasks. The metropolitan students tend to construct maps within scaled boundaries and represent information in a linear and directional manner. By contrast, the non-metropolitan students rely on landmarks and compass points to locate and arrange spatial information (LOWRIE;FRANCIS;ROGERS, 2000).

CONCLUSION

What we have sought to undertake in this paper is an overview of the research in rural education in mathematics education for Australian schooling. We have framed our work using a model drawn from Bourdieu's notions of objective and subjective structuring practices. In this paper, we have acknowledged that governments may allocate considerable economic support for rural education in Australia (horizontal domain), but the subjective structuring practices (or the vertical domain) is influential in shaping the learning opportunities for mathematics education. There are numerous factors that influence the quality of education provision when the vertical domain is considered. To address structural inequality for rural students, the vertical domain of education must be considered in concert with the horizontal domain.

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