

AEG5216 Teaching Mathematics 2

Assignment 1: Inquiry into senior secondary mathematics teaching and learning

Topic: Addressing equity issues in senior secondary maths

Equity, and its close companion equality, are incredibly problematic concepts in society as a whole, and particularly in the field of education. Indeed, many people struggle to understand the difference between the two and whilst they might believe they are providing for equality in their classrooms and schools they are in truth disadvantaging many students by not understanding the true meaning of equity. Equality is defined as “the state of being equal, especially in status, rights, or opportunities” (Oxford Dictionaries, 2011), while equity is “the quality of being fair and impartial” (Oxford Dictionaries, 2011). The two terms have been observed to be used interchangeably, even though their meanings are quite different. In order to provide all students with equal opportunities one must understand what it is to be equitable; this may involve privileging some students above others in order to compensate for underlying disadvantage that affects students. The most widely researched and acknowledged area of inequality is gender differences. There are many other groups of students who are impacted by factors of equity and equality: students from lower socio-economically robust areas, students who belong to non-dominant cultures, Aboriginal students, migrants and students with English as a second language, students with disabilities, GLBTI students and high-achieving and gifted students. The challenge for teaching professionals arises in trying to navigate these issues of equity – teachers should be mindful of developing an inclusive classroom and choosing resources and activities that promote genuine equality of students.

Investigation of the academic research into and literature about equity concerns in secondary mathematics yields a huge amount of material, both recent and older. The focus of much of this published research deals with equity issues relating to gender and socio-economic status of students, and it is not specifically targeted at senior secondary level - however many of the equity issues faced are similar throughout secondary school life, and these studies can be extrapolated where necessary to enhance understanding at senior level. Approaches to equity and equality are an ongoing challenge for educators. Goos, Stillman and Vale (2007) list three fundamental aspects of educational equality: equal opportunity, equal treatment and equal outcomes. They further note that equitable practice is necessary to facilitate this equality. Thomas (2009) highlights the declining trend of Australian university students graduating with a mathematics major, implying that there are fewer students completing post-compulsory mathematics subjects, and attributing this to inequity. The National Report on Schooling in Australia, published in 1997, discusses several key equity initiatives which were undertaken in Australian schools. These included measures for promoting equity for students of non-English speaking backgrounds, students with disabilities, geographically isolated students, students from low socio-economic backgrounds, gifted and talented students, and gender equity

initiatives. While it is clear that the government has strategies in place to promote and endorse equity, there is still a need for further work on this issue.

Gender equity is invariably one of the foremost areas of research and discussion in an investigation of educational equity. There is no doubt that huge strides have been made in gender equity in mathematics since the early part of the twentieth century. Participation and success in mathematics by girls is widely recognised, and indeed some researchers are questioning whether the advantage has actually been reversed altogether against boys (Leder, 2006). The research completed by Forgasz, Leder and Kloosterman (2004) indicates that amongst Australian students there is far less tendency to view boys as more competent at mathematics than girls. However, other studies have shown that the general public's (Leder and Forgasz, 2010), and indeed a proportion of teachers' and pre-service teachers' (Forgasz, 2005), perception is still that boys are more suited to mathematical studies than girls. Gill (1997) notes that the participation rate in mathematics shows reasonable equality between boys and girls, even through to the first year of senior secondary schooling. In the final senior secondary year some interesting trends have been noted. The overall level of enrolments in advanced mathematics subjects has dropped for both boys and girls. A smaller proportion of those enrolled are girls, however those girls have a higher chance of performing well. Leder and Taylor (2010) also note this trend, but they observe that in test conditions (Australian Mathematics Competition) boys generally perform better. These findings seem contradictory, and this indicates that further research is required, especially in relation to the nature and equity of examination format.

Another widely documented area is how socio-economic status (SES) impacts equity. There are a number of factors that contribute to SES disadvantage, and SES is frequently correlated with socio-cultural differences. Argy (2007) argues that there is a widening gap between students of upper/middle and low SES in terms of funding and performance. Riegle-Crumb and Grodsky (2010) studied American schools but their findings can be applied in similar circumstances in Australia. They argue that not only students from low SES families are disadvantaged, but that the disadvantage is often systemic where a school is located in an economically depressed region, or is populated by a large proportion of students from a cultural minority with low SES. In a similar vein Allexaht-Snider (2006) noted that students whose parents had come from low SES backgrounds and had performed poorly in mathematics were likely to repeat that cycle unless their parents actively participated in their education. Yeoh and Leigh-Lancaster (2010) showed that students from low SES regions were less likely to enrol in more advanced senior secondary mathematics subjects, thereby potentially narrowing their future education and career pathways. Another point of contention for students from low SES or socio-culturally diverse backgrounds is that the contextualisation or

modelling that occurs in the average mathematics classroom can seriously disadvantage these students (Rousseau and Powell, 2005 and Jablonka and Gellert, 2011). Sullivan, Zevenbergen and Mousley (2003) point out that this context is not only relevant to the way problems are presented, but also the overall learning environment.

The increasing use of digital based technologies in mathematical learning has been the subject of much research over the past five years. Forgasz (2006) found that teachers are becoming increasingly comfortable with utilising computers as a tool for mathematical education, but that many teachers perceived that boys were more competent than girls. Other research has found there may be an emerging trend that shows boys are being advantaged when it comes to the use of technology, especially in relation to the use of CAS calculators in examinations (Forgasz, Griffith and Tan, 2006 and Forgasz and Tan, 2010). Vale (2006) raises concerns that technology use may be focusing on and favouring socially advantaged students at the expense of low SES and socio-culturally diverse students. However, Vale (also in 2006) goes on to illustrate a case study of technology being used to great effect in a classroom in a school with a large proportion of low SES, socio-culturally diverse students. Technology can be used to achieve equitable practice, but care must be taken not to disadvantage students further by its use.

There are further groups of students studying mathematics who may be considered disadvantaged or marginalised, although less research seems to be available. Klenowski (2009) discusses the decreasing trend of Aboriginal students completing senior secondary school, with the conclusion that more "culture-fair" assessment needs to be developed in order to support these students. There is some literature discussing students with learning difficulties or disabilities (see Goos et. al., 2007) but little research on the equity regarding students with physical disabilities and their experience. GLBTI students may also be affected by equity concerns. With both of these groups the biggest inequity may be a complete lack of representation in resources, which similar to students from socio-culturally diverse backgrounds can lead to marginalisation and feelings of alienation from the material. Benbow and Stanley (1996) argue that high-potential students could be disadvantaged by the push toward equity, and the supposed lowering of educational standards that is being engendered by this movement.

For this paper two VCE level mathematics textbooks were reviewed, and a survey made of a selection of the questions contained therein. The two books were Evans, Lipson & Wallace's fifth edition (2006) of *Essential Mathematical Methods 1 & 2*, and Nolan, Phillips, Novak, Heames & Iampolsky's second edition (2006) *Maths Quest 12 Further Mathematics*. The questions selected from both were the review questions that appeared at the end of each

chapter. For a full breakdown of question types, please refer to Appendix One, however a brief discussion follows. Both texts included considerably more questions about males than females. At least forty percent of the contextualised questions of both books mentioned males, whereas thirty percent of the *Maths Quest* text mentioned females and only twenty-four percent of the *Essential Mathematical Methods* book mentioned females. The *Maths Quest* text also included almost forty-five percent of contextualised questions relating to money and wealth, of which thirty percent more related to males than females. Both texts included a significant number of questions that referred to sport or physical ability, nineteen percent and thirty percent of contextualised questions. Neither text included many culturally diverse names, a total of seven percent and less than three percent of contextualised questions. Other indicators were negligible, but this in itself is notable. This data leads to the conclusion that text book resources could be an indicator of inequity persisting in senior secondary mathematics. Aside from the obvious conclusions regarding higher representation of males, it is also evident that socio-economically disadvantaged students may be alienated by the presence of so many questions regarding money and wealth (although it must be noted that some chapters in the book were devoted to concepts of loans, investment and financial transactions). Students from non-dominant cultures may feel excluded by a lack of representation, and students with physical disabilities may find the high proportion of sports related questions confronting. Overall twenty-one percent of the *Maths Quest* text and only eleven percent of the *Essential Mathematical Methods* text involved contextualised questions. Given the research showing that providing well-structured context can assist the understanding of disadvantaged students, this in itself shows a possible deficit in terms of equitable practice (Rousseau and Powell, 2005 and Jablonka and Gellert, 2011).

Critical factors that effects equity and equality in education are teacher and societal attitudes. Teachers' expectations of students have been shown to have significant impact on student performance, behaviour and indeed the students' enjoyment of mathematics (Jorgensen and Niesche, 2008). Forgasz (2006) found that some teachers and pre-service teachers are out of touch with students' own perceptions of their mathematical abilities and continue to operate under preconceived, inaccurate, gender stereotyped notions. Leder and Forgasz (2010) noted that there is still a perception in the general community that males have more mathematical aptitude than females. It is imperative that teaching professionals identify and overcome their own misinformed preconceptions and genuinely embrace the concept of student equality so that real equity can be achieved in the classroom.

Several researchers are now advocating the pathway of social justice and ethics in the classroom as a means of attaining equity. Goos et. al. (2007) make the point that "equity and social justice... do not mean equal treatment, but must embrace fairness and mutual respect

in response to difference.” Atweh and Brady (2009) argue that not only should the focus be on improving equity within mathematics education, but that the education itself should advocate student responsibility in the wider context of the world – that by supporting students to be better citizens it will improve students' relationships and also equity within the classroom environment. Boaler (2008) similarly points out that equity is not necessarily to be found within the mathematics curriculum, but that in developing relationships within the classrooms by means of group work and carefully selected contextualised problem solving equity can be achieved. These views indicate that not only should curricula and resources be amended to be as equitable as possible, but that organisation and practices within the classroom can have enormous positive impact. This is not easy to accomplish in a senior secondary mathematics scenario, where the learning is driven by the assessment structure of examinations, but if such practice were to be initiated in earlier year levels the equitable benefits would almost certainly flow through to the senior level.

Investigating the issues that arise in terms of equity in senior secondary mathematics uncovered a wide array of fascinating and enlightening data and information. While it answered some questions, it raised even more, and it is clear that far more research is required, especially as relates specifically to the senior (post-compulsory) years. There is no simple solution to redressing the equity imbalance that plays out in Australian schools. What has been made evident by this research is that a holistic view may be the best approach. Ensuring that the curriculum and supporting resources are as equitable as possible is only one step. Teaching professionals should attempt to recognise any preconceived notions and stereotyping that may impact on their interactions with disadvantaged students. They may also be well advised to consider social justice principles within their lesson plans and organisation and work toward inclusive classrooms for all students.

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