

Creating Equitable Practice in Diverse Classrooms: Developing a Tool to Evaluate Pedagogy

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With Australia performing so poorly in terms of equity in mathematical achievement on the PISA scores, there is an increasing recognition for practices that may stem the inequities in education in this country. This paper explores an approach that has been found to be highly successful in the United States and links it to current issues in Australian education. Practical considerations are made regarding the application and implementation of such reform pedagogy when particular nuances of Australian issues are considered. In particular, the development of a tool to evaluate reform pedagogy is the focus of this paper.

Increasingly classrooms are becoming more diverse and with such change, new forms of pedagogy are needed to enable the greatest likelihood for success for all students but most particularly for those students who traditionally have been most at risk of not succeeding in school mathematics. Alarming, Australia performed well on international comparisons in terms of overall performance but was one of the poorest performing countries in terms of equity (Lokan, Greenwood, & Cresswell, 2001). These authors contend that the outstanding performance of some students overcompensated for the poorer performing students to allow for a good overall outcome. The concern for us is the large gap between those who perform well and those who do not. Such poor performance is not random but strongly aligned with the social, cultural and geographical location of students. In this paper we discuss these highly differentiated performances and propose an alternate pedagogy that has been found to be highly successful in some contexts outside Australia, but with modifications that appear to be more amenable to the unique situations of Australian education. Further, we discuss the difficulties with the implementation of such a model and the challenges to the implementation of such a successful model.

Differential Outcomes in Australian Education: The Case of Most Disadvantage

MCEETYA (2006) reported the results for students in the national testing schemes from 2005. Comparisons of these figures show that for students who come from Indigenous backgrounds and/or live in geographical remote regions are considerably more at risk of performing poorly on standardised tests than their peers in urban or regional areas, or students who are non-Indigenous. Furthermore, it can be hypothesised that some students may have their disadvantage compounded by the multiple disadvantage caused through the combination of factors. For example, Indigenous students who live in remote areas may be at increased risk of performing poorly in mathematics than their peers who are in different social/cultural or geographical locations. The differences in performance by location can be seen in Table One where there are considerable differences between students who live in Urban areas (and perform higher) than their peers who live in very remote areas (and perform lower).

Table 1

Percentage of Students Performing to Benchmark by Geolocation, 2005 (Source: MCEETYA 2005)

State	Metro	Year 3		Metro	Year 5		Metro	Year 7	
		Very remote	diff		Very remote	diff		Very remote	diff
NSW	95.5	86.1	9.4	92.2	74.3	17.9	77.3	61.8	15.5
Vic	95.5	na		95.2	Na		87.3	Na	
Qld	93.2	76.8	16.4	89	63.1	25.9	84.5	54.3	30.2
SA	93.3	78.7	14.6	90	63.1	26.9	87	54.1	32.9
WA	91.9	67	24.9	88.2	57.3	30.9	85.9	57.9	28
Tas	92.4	86.8	5.6	89.8	83.2	6.6	82.3	na	
NT	Na	65.5		na	35.6		na	31.9	
ACT	94.6	NA		93.2	Na		88.1	na	
Aust	94.6	73.2	21.4	91.8	54.5	37.3	83.1	49.4	33.7

These data highlight the significant differences in performance by students according to their geographical location. For us, what is alarming is there is relative consistency in the data for students who live in metropolitan areas and their peers in remote areas regardless of state. Furthermore, the decline in performance of students in remote regions over time is a point for noting (and action).

In the following data, we consider the data on Indigenous students (Table Two below). A similar trend to that noted in Table One can be observed for Indigenous students. These data suggest that as Indigenous transit through formal schooling, the difference in performance with non-Indigenous students increases with duration of time. As with the students from remote areas, the gap in performance increases as students move through formal schooling by approximately 10% for each period. State performance varies which we contend may be a factor related to Table One where those states which have considerable numbers of Indigenous students living in very remote areas may have greater likelihood of poorer performance on the state-wide testing schemes.

Table 2

Percentage of Students Achieving the Numeracy Benchmark by State, 2005 (Source: MCEETYA 2005)

State	Year 3			Year 5			Year 7		
	All	Indig	diff	All	Indig	diff	All	Indig	diff
NSW	95.4	87.6	7.8	91.7	75.4	16.3	75.8	44.5	31.3
Vic	95.5	91.8	3.7	95.4	89.5	5.9	86.9	66.5	20.4
Qld	92.7	78.9	13.8	88.1	65.8	22.3	83.2	54.5	28.7
SA	92.6	74.5	18.1	90.1	69.8	20.3	85.7	55.8	29.9
WA	90.2	64.8	25.4	85.9	51.6	34.3	84.3	46.8	37.5
Tas	91.2	82.4	8.8	89.1	78.7	10.4	80.5	66.4	14.1
NT	86.2	68	18.2	69.6	35.1	34.5	64.8	24.9	39.9
ACT	94.6	92.8	1.8	93.2	81.4	11.8	88.1	62.6	25.5
Aust	94.1	80.4	13.7	90.8	66.5	24.3	81.8	48.8	33

We acknowledge the problematic nature of state-wide tests which have some limitations in what they are able to test, the protocols around the tests, and the limitations imposed by the marking schemes and hence what can be assessed. Such limitations restrict what and how assessment can be developed. However, the tests do alert educators to the considerable differences in performance and the need to redress such performance.

Reform Pedagogy

Drawing heavily on the work of Boaler (2002) who has systematically documented the pedagogy and performance in reform classrooms in the United States over an extended period of time, we take those characteristics that she proposed as instrumental in creating equitable outcomes for students as they come to learn school mathematics. The reform pedagogy that Boaler studied was that of Complex Instruction developed by Cohen and colleagues (Cohen & Latan, 1997). At its basis, it draws on a range of literatures to develop a pedagogy that takes a number of key ideas: group work where students assume responsibility for group learning and action; assigning status to those students who may otherwise be marginalised within a group; complex tasks that are rigorous and foster deep learning; and multidimensionality where students can represent their thinking and processes in ways at suit their unique thinking styles.

Boaler's extensive research in classrooms has highlighted the power of this approach in changing the learning outcomes for students, particularly those students from the most disadvantaged contexts. Her extensive study of Railside has illustrated how the school moved from the poorest performing school in California to 'above state average' over a period of 4 years. This radical transformation was seen to be brought about through the use of the Complex Instruction approach. Boaler (2008) noted that the outcomes of the approach are not limited to cognitive outcomes but also to social outcomes where she found that the students also learned how to resolve social and cultural conflicts outside classrooms as a consequence of their participation in the reform.

Linking Reform Pedagogy with Productive Pedagogies

Boaler's work is overlaid with the extensive research undertaken in Queensland schools through the Productive Pedagogies framework (Education Queensland, 2008). This approach has many of the features of Boaler's reform pedagogy in terms of intellectual quality and supportive learning environments but within a framework for both action and research. We do not intend to expand the Productive Pedagogies Framework in this paper as it has been taken up by most Australian states in some form or another and has been the basis of a considerable number of research papers. There are four dimensions within the framework – Intellectual Quality, Relevance, Supportive School Environment and Recognition of Difference – in which there are a number of pedagogies that are evident of that theme. In total, there are 20 identified pedagogies. These pedagogies have been used as the basis for the Queensland Schools Longitudinal Reform Study (Education Queensland, 2001) where schools across the state were studied in terms of pedagogical quality using the framework. Extensive work was undertaken to break each of the pedagogies into qualitatively different features that explicated the degree of take up so as to form the basis for observational schedules. A scaling system that recognises the degree of implementation for each pedagogy was developed using a 1 to 5 scale that, in simple terms, identified a 1 as being not an integral component of the classroom pedagogy through to 5 which identified the pedagogy being an integral feature of the classroom practice.

The model used within the Productive Pedagogies framework has been a useful tool for analysing mathematics classroom practice (Zevenbergen & Lerman, 2007). It provides a very general framework for deconstructing pedagogy as a whole. However, it also has some limitations. Most particularly for the mathematics classroom, it does not allow for the depth of analysis related to mathematical ideas. We also contend that it does not allow for the depth of analysis that Boaler's equity work has identified specifically as it applies to the teaching and learning of mathematics in diverse classrooms. To this end, we are developing a tool that incorporates the key aspects of the Productive Pedagogies framework and incorporating the aspects identified through Boaler's study of Railside.

Developing a Tool for Analysing Equity in Mathematics Classrooms

In the remainder of this paper we draw on our work where we are seeking to develop a tool for analysing classroom practice in terms of building equitable outcomes for learners. Given the data we highlighted at the commencement of this paper, we see it as critical that pedagogies be explicitly developed to redress these outcomes. To develop a tool, we have combined the work cited above – that is, the equity work of Boaler with the processes and principles used within the Productive Pedagogies framework.

To date, we have been working with a series of video tapes that were part of a previous project and that have been analysed with the Productive Pedagogies framework (Zevenbergen & Lerman, 2006). The videos were

known to the research team and were selected on the basis of their breadth in inclusive practices. Some of the videos were highly inclusive through to videos that were very traditional in their approaches to teaching mathematics. These were correlated with the initial analysis of the data (Lerman & Zevenbergen, 2006)

Using the approach adopted with the Productive Pedagogies Framework, the video data has been explored by at least 3 researchers who have negotiated each of the dimensions that were identified in Boaler's work and extended these to specifically address Australian issues. For example, one of these is the use of home language. For many of Indigenous students the language of school instruction is different from that spoken at home. In many remote communities, Indigenous students come to school speaking a Kriol. For these students negotiating meaning becomes complex when there is high demand for translating between the school and home languages, particularly when the home language is relatively "restricted" in a Bernsteinian (1990) sense and does not have the same patterns of signification found in school language.

In working through these videos, the research team has negotiated their understandings of practice in relation to the key dimensions to establish a scoring system that aligns with that of Productive Pedagogies. We have created 4 overarching categories that are then broken into smaller, more identified items. The negotiation process between the research team has created a rich discussion that has enabled the unpacking of what is meant by each criteria and the progressive adoption of each criteria on a 5 point scale which range from 1-5.

In the following sections we provide the criteria that have developed as a consequence of the video analysis and negotiations among the research team. Preliminary application of these criteria to 5 videos indicates that the scoring rubric tends to work across the settings.

The Scoring Rubric for Equitable Pedagogy

In this section we provide the descriptors and scores for each of the identified pedagogies relevant to equitable pedagogy.

Process

Drawing on the process outlined in the University of Queensland Manual, we provide the following description of the scoring process. When scoring for each lesson, observers should carefully consider the explanations given for each dimension, using the descriptors of the scores from 1-5 for each criteria. If any difficulty is encountered in selecting between two scores, the observers should consider whether the minimum criteria for each score have been met. If these criteria have not been met, the lower score should be used. In determining the scores for each dimension, the observers should only consider the evidence seen during the specific period. The observers should complete the criteria sheet at the end of the observation period.

Equitable Pedagogies

Group Work

The group works collectively in resolving the task. People's input is drawn upon to solve the problem.

1. No group work is evident in the lesson
2. Group work is used for a brief activity over a small portion of the lesson
3. Group work is used over about half of the lesson
4. Group work is evident for almost all of the lesson
5. Group work is an essential component of the lesson in its aims and structure.

Multiple Pathways

The teaching approach and/or activity allows for students to draw on their knowledge to construct different pathways to resolving the task or problem. This may be through drawing on different forms of knowledge and knowing.

1. No multiple pathways offered by the teacher for students to solve the task or problem
2. Students given some minor variations or pathways in which to solve the task or problem

3. Students are given different starting points for the task, and some pathway variations, albeit in a limited fashion
4. Students have either different starting points or multiple pathways and some level of choice in representation
5. Students are able to use a variety of representations, multiple pathways and engage at different starting points. All three must be present.

Multiple Entry Points

The task/problem is designed so that students can draw on different entry points when starting the task/problem.

1. Tasks have only one entry point strictly controlled by the teacher
2. Teacher outlines limited variety of entry points with no student control
3. Students have some control over entry points of the task within set parameters
4. Teacher allows a variety of entry points for differing abilities
5. Teacher allows complete student discretion in the undertaking of an open ended task or problem.

Roles within the Group

The social organisation involves the clear expectations that members of a group will have particular roles within that group. The roles are followed so as to enable each person to be an active and instrumental member of the group.

1. Teacher defines roles of the group with no collective responsibility
2. Students have linked roles that are still teacher directed to complete the task
3. Students work as a collective but with predetermined roles and objectives
4. Teacher has limited responsibility in the setting up of the collective roles and responsibilities
5. All students in the group work collectively and take responsibility for each other with no direction from the teacher

Quality Interactions within the Group

The pedagogy allows for quality interactions among peers where peers can discuss and debate mathematical ideas as part of their pathway to resolving the task/problem.

1. Students are arranged in groups but have little or no interaction
2. Students have limited interaction with each other or for a brief period
3. Students are engaged in mostly low level interactions with each other for a substantial portion of the lesson
4. Students are engaged in high quality interactions for a significant portion of the lesson
5. High quality interactions with high order thinking processes evident between students for almost all the lesson.

Teacher as Facilitator

The role of the teacher is to absolve responsibility for learning to the students. Through the careful development of scaffolding techniques and task selection, the students take responsibility for their own learning and the learning of others within the group. The teachers' role is to check that students remain on task, provide quality tasks, and to provide assessment when appropriate to the group's progress.

1. Teacher takes all responsibility for the learning, task design and assessment
2. Teacher absolves very limited responsibility to the students
3. Students take some responsibility for their learning in terms of the collective learning in the group and staying on task

4. Students take responsibility for their learning with the teacher facilitating students' learning
5. Students take full responsibility for their learning with teacher facilitating students' learning through an appropriate task

Use of Home Language

Students are able to draw on their home language to negotiate meanings. When reporting back, the student/s should use standard Australian English.

1. No use of home language allowed within the classroom. Complete reliance on English
2. Teacher allows limited use of home language between students
3. Students and AEWs (Aboriginal Education Workers) often use home language in the classroom
4. Teacher encourages use of home language and also attempts to learn and communicate using students' home language
5. Teacher, AEWs and students use students' home language on a regular basis to facilitate the students' understanding of mathematical concepts and learning

Multi-Representational

Catering for the diversity among learners, the tasks should foster, and allow for, various methods of representation that cater for the different skills and dispositions that learners bring to the task. Provided that the result is reasonable, the pathway and mode of representation is valued.

1. No options given by the teacher for students to represent their work
2. Some limited forms of representation allowed by the teacher but these are strictly teacher controlled
3. Teacher encourages some variance in task reporting but within guidelines set by the teacher
4. Students are given an open ended task with some brief parameters for representational options
5. Teacher supplies a broad, open ended task that allows students to fully decide on ways of reporting back and representing their work.

A Way Forward

As a tool for exploring practice, we have found the Productive Pedagogies method to be a useful but limited tool when exploring equity in mathematics education. The model that we are building towards draws on the extensive work of Boaler, extended and modified for the Australian context, appears to have application for our work in the area of equity and mathematics education. It is our intention to apply this model to a range of projects with which we are currently involved. Preliminary applications indicate that there is considerable scope for success. We anticipate that as the model is implemented it will be further refined for the particular contexts within which we work.

References

- Bernstein, B. (1996). *Pedagogy, symbolic control and identity: Theory, research and critique*. London: Taylor & Francis.
- Boaler, J. (2002). Learning from teaching: Exploring the relationship between reform curriculum and equity. *Journal for Research in Mathematics Education*, 33(4), 239 – 258.
- Boaler, J. (2008, March). *The relationship between research and practice in mathematics education: International examples of good practice*. Paper presented at the ICMI Century Conference. Working Group 3. Rome: ICMI.
- Cohen, E., & Latan, R. (1997). *Working for equity in heterogeneous classrooms: sociological theory in practice*. New York: Teachers College Press.
- Education Queensland (2001). *The Queensland school longitudinal reform study*. Brisbane: GoPrint.
- Education Queensland (2008). *Productive Pedagogies*. Retrieved March 2008 from the World Wide Web: <http://www.eq.qld.gov.au>.

- Lerman, S., & Zevenbergen, R. (2006). Maths, ICT & Pedagogy: An examination of equitable practice across diverse settings. In J. Novotna, H. Morova, M. Kratka, & N. Stehlikova (Eds.), *Mathematics in the centre* (Proceedings of the 30th annual conference of the International Group for the Psychology of Mathematics Education, Prague, Czech Republic, Vol 4, pp.49-56). Prague, Czech Republic: PME.
- Lokan, J., Greenwood, L., & Cresswell, J. (2001). *How literate are Australia's students? 15-up and counting, reading, writing, reasoning*. Melbourne: ACER.
- MCEETYA (2006). *Results from the Year 3, 5 and 7 Literacy and Numeracy Tests*. Canberra: MCEETYA.
- Zevenbergen, R., & Lerman, S. (2007). Pedagogy and interactive whiteboards: Using an activity theory approach to understand the tensions in practice. In K. Beswick & J. Watson, (Eds.), *Mathematics: essential research, essential practice* (Proceedings of the 30th annual conference of the Mathematics Education Research Group of Australasia, Hobart, CD version). Sydney: MERGA.
- Zevenbergen, R., & Lerman, S. (2006). Maths, ICT and pedagogy: An examination of practice. In P. Grootenboer, R. Zevenbergen, & M. Chinnapan (Eds.), *Identities, cultures and learning spaces* (Proceedings of the 29th annual conference of the Mathematics Education Research Group of Australasia, Canberra, Vol. 2, pp. 591-598). Sydney: MERGA.