

## **Authentic assessment for mathematical achievement**

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This paper explores assessment in mathematics education with a particular focus on authentic assessment. It considers the politics that direct schools through the New Zealand mathematics curriculum and how schools may need to choose between a behaviourist or constructivist approach to their assessment. It questions whether we are getting true results from the data on low decile schools and what role ethnomathematics has to play in classrooms. It examines authentic assessment in a framework of political intentions/influences, learning theory and the development of authentic contexts in mathematics education

### **Introduction**

I have recently moved to a low decile school. Most of my class are Maori, or from the Pacific Islands, and only a handful are currently achieving at the expected levels of the national mathematics curriculum (Ministry of Education, 1992) while the rest are at risk of 'failing'. This is founded on the pre-test, post-test notion and the standardised testing which the school requires. Nowhere does it take into account that the children are working in small groups with equipment and can engage in mathematical processes. I question what these tests are telling us. Are they in fact just reading tests? If so these children will continue to fail. Nowhere in the current mathematics curriculum does it take into account the prior knowledge that children bring into school. As a practising teacher I have observed that one of the biggest difficulties for the children in my class is the language that is used in mathematics. It is sometimes too complex and this can have a detrimental effect. This observation led me to explore the notion of authentic assessment.

### **Authentic assessment**

Authentic assessment is a form of assessment that is as close to children's reality as possible. It must also have a practical performance criterion, which measures what

the tasks set out to do and the National Education Monitoring Project (*NEMP*) (Ministry of Education, 1998) was designed to achieve this. A main goal for *NEMP* is to provide detailed information about what children *can* do in order that patterns of performance can be recognised, successes celebrated, and desirable changes to educational practices and resources identified and implemented.

In aiming to assess students' mathematical performance through authentic contexts *NEMP* used examples considered to be meaningful for the students. For example, instead of being restricted to buying a particular burger and drink from a *McDonalds'* menu, the cost of all items on the menu were given and the students had to spend \$5.00 (or as closely as possible) on any burger and drink. From this problem-solving episode of the *NEMP* research I asked the following questions. How/what does this tell us about children's problem-solving when they are not restricted or when the context is meaningful to them? How engaged are they when the context is closely related to their home life?

### **Assessment through testing**

In New Zealand there is a history of using standardised assessments to identify and classify students. Mathematics, and reading assessments are the yardsticks that are used to measure academic achievement and children's 'at-riskness' is also determined by these measures. Usually it is left to the individual classroom teacher to consider whether the assessment information itself is valuable and to decide how to use the assessment information gathered. This can be problematic, especially with standardised tests which do not necessarily identify and categorise students accurately in terms of the problem-solving aspect of their mathematical learning. In order to meet the individual learning needs of the children, assessment should be an integral part of the planning cycle. Authentic assessment relies on the inclusion of the mathematical processes, as well as the content, of the mathematics curriculum (Ministry of Education, 1992) if it is to provide richer assessment of children's learning needs.

The school must decide whether they are going to take a constructivist or behaviourist approach to assessment. This tension is created by a genuine desire to assess the problem-solving nature of the mathematics curriculum (Ministry of Education, 1992) within a national climate that still expects clear-cut precise results. Neyland (1995) uses the term " neo-behaviourism" to describe one possible direction for assessment against the mathematics curriculum despite its social constructivist underpinnings. He argues that precision-styled testing "... must be relinquished in favour of a less precise system based on exemplars of student work, the professional judgement of teachers, and rich learning programmes." (p.131).

The importance of taking a close look at the manner in which New Zealand's national curriculum is assessed is supported by Aitken (2000: 1) who agrees

classroom teachers use a variety of testing and assessment instruments, some home-grown, some with research-proven capability, but none designed explicitly to complement the single most important dimension of our state school system: the national curriculum.

This year my school decided to return to the Progressive Achievement Tests (New Zealand Council for Educational Research, 1993) to measure the performance of the children in terms of the national bell curve (standard normal distribution). The results showed the children were clustered at the lower end of the curve. Therefore the teachers currently at this school need to be careful not to use these results to 'teach the students to pass the test', as this could influence students' participation in wider aspects of mathematics, such as problem-solving. A corollary to this is that the students' disposition to mathematical experiences might be seriously affected as confirmed by Aitken (2000) when she advises caution that we don't make tests designed more to humiliate and confuse than to illuminate and assure.

### **Behaviourism and assessment**

It is important that teachers have a clear idea of why they assess as reminded by Clarke (1992: 146) with the statement "assessment is a high profile classroom

activity: which impacts significantly on student self-esteem and on student classroom behaviours." Testing can be a very stressful time for some students and this can be reflected in their results. Standardised testing does not assess the essential skills the student may be learning but rather reports on the indicators of achievement in terms of behaviourist achievement objectives. If children carry a label of failing in maths then this adds to the behavioural issue. Teacher reporting can include behaviourist statements such as 'she is unmotivated' or 'he is socially immature'. This is in agreement with Begg (1999: 8) who stresses

The behaviourist view of assessment was that only behaviours could be measured and therefore assessment objectives should be behavioural ones. In addition, a measurement perspective often led to non-measurable aspects being discarded.

Assessing children's behaviour suggests a note of caution as not all children's behaviour is related to their learning. It can be dictated by their home life, peer issues, and medical problems. What if the child had an 'off day' or the teacher's disposition towards that particular child had been pushed to its boundaries? It might result in incorrect or inappropriate decisions being made about that child. This emphasises how a one-off assessment task will provide only a limited sample of a child's mathematical performance. This is summarised by Airasian (1994: 20) who states that "no single assessment procedure or instrument can be expected to provide perfect, error-free information."

### **Constructivism and assessment**

The biggest challenge to behaviourism is constructivist theory. Constructivism is about knowledge and 'how we came to know.' The idea that knowledge is something that each learner must construct must have a major impact on classroom teaching. Barton (1993: 56) claims

It is not possible for someone who 'has' the knowledge to pass it on to someone who has not got it. Furthermore, after the learning has taken

place, the knowledge will still be moderated by the individual's other experiences, ways of thinking and mental organization. To the extent that these things are culturally determined, the mathematical knowledge will be culturally determined.

According to Clarke (1997) teachers' assessment is constructive when it assists in fostering student learning. He writes that assessment can only be constructive when it values what a student can already do and helps that student to gain further knowledge.

It is important, therefore, if teachers are to take a constructive role in their students' learning, that assessment is sound and purposeful. Teachers need to have a clear idea of the action to be taken as a consequence of the assessment.

There must also be recognition of students' personal experiences, their way of thinking, and the extent to which these are culturally determined. Students bring their cultural capital to their mathematics learning and use it to form new knowledge. In considering the impact of this Begg (1999: 9) reminds us that

from a constructivist learning perspective, a teacher is concerned to help students to develop their schemas by providing rich learning activities that involve both new notions and challenge to old ones.

An implication of this is that teachers must be flexible and open-minded even when the politics of the school require them to provide standard results in mathematics as set for any particular age level, rather than utilise better methods of data-collecting. They need to extend, confirm and challenge children's knowledge schemas, to become facilitators of children's learning rather than teaching to the textbook. Howe (1996: 36) supports this notion, stating

because language and culture are intertwined, the acceptance of the role of language in learning implies that learning is also dependent on culture. While social interaction, communication and discussion are

valued within the learning process, the way learners of different cultures view their teachers (as respected elders, or authority figures) will influence the forms of interaction that their culture accepts.

Maybe primary-school teachers should become familiar with *Te Whaariki* (Ministry of Education, 1996), New Zealand's national early childhood curriculum. As well as addressing the holistic nature of learning through, for example, the principle of empowerment, according to Haynes (2000: 95) it

has constructivism as its underlying theoretical framework and ... raises questions such as: how is children's knowledge valued? how do different aspects of (learning) contribute to this knowledge? and again, what are the implications for the teacher?

Teachers need to remain focused on the spectrum of aspects related to learning and teaching if they want to take a holistic approach in their teaching. *Te Whaariki* is a reminder to take into account the prior knowledge children bring with them to the learning environment.

### **Culture and mathematics education**

Barton (1995) argues that New Zealand's approach to mathematics education is based on the British tradition, influenced during the sixties by some American ideas, particularly the New Math revolution. He comments that it is only more recently that mathematics education in New Zealand has developed an antipodean character. Even so, two of the difficulties of the current mathematics curriculum (Ministry of Education, 1992) are the reliance on language as a indicator of mathematical understanding, and secondly no real account of the ethnic beliefs and values of cultural minority groups. Barton further argues that middle-class people with similar values wrote the mathematics curriculum and that maybe ethnic minorities have been set up to fail.

Barton claims that the process of using more than one language to express mathematical ideas is additive in itself, that is, given sufficient proficiency in both languages students are liable to have a better understanding because they have two modes in which to think and communicate. If this is correct, then the introduction of bilingualism into New Zealand's mathematics education will improve the standard of mathematics for some students. An example of this is counting: after counting-systems of other languages, in particular Maori, are included in classroom teaching the western counting system often makes more sense.

### **Ethnomathematics**

Mathematics is seen as a cultural product with a cultural history. Then why did white middle class people write New Zealand's current national curriculum? It is expected to cater for all cultures then why, for example, is the mathematical aspect of the spiral missing when it is such an important part of Maori culture. Ethnomathematics is a mathematics which belongs to a culture as supported by Barton (1993: 57) who writes

constructivists say that mathematics can only be what you perceive or learn as an individual, that is there is nothing 'out there' which is objective mathematics. In that case, it must be possible to distinguish aspects of mathematics, which relate to cultural factors. This is ethnomathematics.

If mathematics programmes were based more closely on a problem solving approach, using contexts that relate to children and their daily life experiences, perhaps children with English as a second language would enjoy more success.

Homes where the value on, or confidence in, mathematics is not high can sometimes be a predictor of children who have a low self-esteem and attitude towards mathematics. However, teachers who make links to students' home cultures, for example counting in their language or using cultural materials to generate geometric discussion on pattern, can effect change in student disposition and achievement in mathematics. Barton (1993: 151) believes that if teachers understand the value of

ethnomathematics, mathematics will become a richer experience for both the learner and the teacher. He recognises that

this richness will not just be because other languages, resources, techniques and contexts are brought into the lesson. It will be richer because teachers and students will become aware of the limitations of a mono-cultural viewpoint, and will seek other perspectives, which may prove to be mathematically valuable, as well as interesting in themselves, and motivating for those students whose culture is represented.

For New Zealand settings Maori culture offers a vast array of examples that can be used in teaching mathematical concepts. However, despite intentions in this area, teachers often find when faced with an increasingly multi-cultural diversity in their classes, that their key focus is on management strategies for running the classroom. This can prevent them from taking into account the mathematical potential available through this multi-cultural diversity of the students.

### **Conclusion**

This paper argues that there really needs to be an evaluation of ways of assessment and teaching in mathematics education. The current document (Ministry of Education, 1992) is the most forward-thinking of mathematics curriculums in recent years as it encourages teachers to look at attitudes and values. Yet in its implementation these values seem to be ignored and they seem to appear even less in mathematics assessment tasks. Teachers need to take into account the cultural schemas children bring to school with them and in schools across all decile-ratings expectations of students' mathematical performance need to be raised. There are varying reasons why children are failing in mathematics and the following questions create a possible framework which for providing answers:

- are the assessment procedures used in mathematics valid and reliable?
- will the results contribute to a satisfactory portfolio of student achievement?
- who are these results for? teachers/parents/Boards of Trustees/students?



Too often methods of testing are related to the expectations and requirements of the Education Review Office: tests for mathematics are set school-wide and the results collected and graphed. Such tests examine a limited range of skills. At no point do they report on strategies for supporting students who need help, or about the full range of skills the students have gained.

Students have different learning styles and some students learn best through co-operative learning. It boosts their self-esteem and confidence, and it improves their social skills. For these students, the more interactive, the more realistic the problem, the more knowledge the children gain. For a learning experience such as a shared problem, the assessment needs to include observation of the way the children go about solving it. This gives a better idea of the next set of skills the students need to obtain.

In some schools it is expected that teachers use the curriculum (Ministry of Education, 1992) in a behaviourist manner and assessment policies reflect this. The result is that students learn a little of everything, but nothing in depth, and too often children are turned off mathematics. Maybe students should have a role in assessing their own progress and the setting of their own learning goals. The complexity of this is seen as problematic by some teachers, but it does focus the students on their own learning and give them an understanding of what assessment is about.

It is important that teachers undertake professional development linked to any mathematics initiatives or projects being introduced, for example the *Early Numeracy Project* (Ministry of Education, 2001), which assesses the skills and strategies that students already have and how they can be supported through their own existing strategies. Mathematics should be enjoyed, it is part of our everyday lives and its assessment should be as close to children's reality as possible.

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