Assessment in the Primary Mathematics Classroom.

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## Contents

- Introduction ......................................................... 3
- Review of assessment in mathematics (Literature Review) .......... 3
- Rich Assessment Task .................................................. 5
- Analysis of student work samples .................................... 6
- Classroom implications as informed by the literature .......... 8
- Conclusion ................................................................. 8
- References ................................................................. 9
- Appendix ................................................................. 12
Introduction

Assessment is the process of “gathering, analysing and reflecting” upon student’s abilities and understandings in the aim of making informed decisions to guide future learning (VCAA, 2013, paragraph 1). Assessment assists teachers in identifying each student’s prior knowledge, current learning, misconceptions and zone of proximal development (ZPD) (Van De Walle et al, 2010; Charlesworth & Leali, 2012).

Different approaches to learning require different forms of assessment (Callingham, 2008). In this paper the learning will be informed by Vygotsky’s social constructivist theory (Hernandez-Martinez et al, 2011).

Review of assessment in mathematics (Literature Review)

Since the introduction of NAPLAN testing in Australia in 2008, there has been increase in pressure upon schools, and teachers, to be accountable for student learning outcomes (Greenless, 2011; Liang, 2010). This has led many teachers to use tests for assessments in mathematics, as they believe the students will be more at ease when sitting the NAPLAN tests. Yet, teachers need to consider whether the data they are receiving from tests is a true representation of the “students’ mathematical knowledge” (Greenless, 2011, p.28).

When teachers’ instruction and assessment is skewed toward ‘to the test’, students are given less opportunity to think critically, innovatively and creatively (Black & Wiliam, 2010). As a result these students are often weaker in real life problem solving situations (Koh et al, 2012, p.147).

Ongoing formative assessment illustrates and promotes students learning, and allows teachers to witness and analyse the students’ conceptual, procedural and process knowledge (Callingham, 2008; Liang, 2010). Low achieving students benefit particularly from formative assessment, due to the ability of the teacher to offer immediate scaffolding and correct misconceptions (Black & Wiliam, 2010).

For formative assessment to be effective a number of varied forms should be used. This will fully allow for the individual skills and abilities of all students to be demonstrated (Charlesworth & Leali, 2012; Black & Wiliam, 2010).

A recent study found that the use of formative assessment embedded in learning tasks resulted in higher student mathematical self efficacy, motivation and ability to retain knowledge (Liang, 2010; Black & Wiliam, 2010). As Vygotsky’s
theory contends, student’s mathematical self efficacy is enhanced when social interactions and discussions are promoted throughout both lessons and assessments (Hernandez-Martinez et al, 2011, p. 210). This is especially effective when combined with purposeful feedback regarding the skills or knowledge displayed within the student’s work (Black & Wiliam, 2010).

Recently more emphasis has been placed on the need for affective assessment within the mathematics domain. When teachers are aware of their students affective knowledge they are able to adjust their instruction accordingly, which can lead to higher achievement outcomes and “greater academic self-efficacy” (Sakiz et al, 2012, p. 246).

Formative assessment is commonly conducted in the mathematics classroom through means such as; observations, discussions, rich assessment tasks and student self assessments (Black & Wiliam, 2010).

Observation, discussions, interviews and rich assessment tasks allow for teachers to observe and record the “concepts and skills” that the students have attained and are able to apply when problem solving and thinking mathematically (Charlesworth & Leali, 2012, p.375).

Rich assessment tasks (RATs) are specifically designed to allow students to demonstrate their understanding of key concepts and strategies while at the same being a task which promotes learning. Rich assessment tasks have been found to provide teachers with rich data on students’ mathematical knowledge as well as highlighting any misconceptions the students may have (Dole, 1996, p. 164).

Student self assessments have become increasingly common forms of assessment in mathematics. Self assessments promote self reflection which can often be unnatural for many students (Black & Wiliam, 2010). Therefore, there may be the need for direct instruction to support this approach. Additionally, for this assessment to be successful it is imperative that the learning intentions are clearly defined and identifiable by the students. This will enable the students to assess their performance against the learning intention/s (Black & Wiliam, 2010).
Rich assessment task

Six students of varying abilities from a Year 5 class completed a rich assessment task (Appendix A). This task aimed to assess the students’ data representation and interpretation skills and specifically their ability to “describe and interpret different data sets in context” (VCAA, 2013).

The task required the students to observe a bar graph void of labels. The students were then required to describe what the graph might represent, labelling the graph and the axis. The students then recorded three things they could interpret from their graph.


**Analysis of the student work samples**

The following explores the responses of two students from the focus group.

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**Student A:** This student has shown some progress in developing their data representation and interpretation skills. The student was successfully able to label the graph and the markings on both the X and Y axis. The title of the graph, “Favourite Pattern” and the labels given to each bar suggest that the student interpreted the graph as a pictograph rather than a bar graph; yet, this is still a valid interpretation.

The student demonstrated their ability to interpret the data, commenting on the numerical value of different columns. Yet, these values were never described in terms of what the Y axis represented. The student also commented that “Zig Zag got the winning position on 10”, suggesting that the student was interpreting the data as a competition rather than the representation of a collection of data.
Student B: This student was able to successfully complete the task. The graph was titled and both the X and Y axis were labelled clearly and were realistic in context. The student was able to successfully interpret the graph combining the numerical data from the Y axis with the variable data represented on the X axis. For example, the student stated “2 people like almost naked animals” drawing the ‘2’ and ‘people’ from the Y axis and the program name ‘Almost naked animals’ from the X axis. The student also successfully identified the total number of people represented in the data on the graph, indicating a clear understanding that each column represents a percentage of the total sample size.
Classroom Implications as informed by the literature

There are a number of implications which teachers will need to consider when conducting assessments.

- **Varied Assessment.** Assessment should be varied and embedded into learning tasks to allow for the development of critical, creative and problem solving skills (Koh et al, 2012). The limitation with this is the lack of test experience that the students will have. Ideally, a combination of both formative and summative assessments should be used.

- **Varying degrees of ability.** As informed by social constructivist theory, students’ learning is enhanced when they are involved in social interactions (Woolfolk, 2010). Dividing the class into smaller groups, such as ability groups can provide these opportunities. A perceived difficulty is the extra planning needed to accommodate multiple activities and assessments.

- **Mathematical Literacy.** Second language learners and students with learning disabilities often find it difficult to develop mathematical literacy skills. This has been identified as a possible reason for the difficulty many students have with reading and interpreting questions on the NAPLAN tests (Greenless, 2011). Therefore, explicit instruction in mathematical literacy is required (Carter & Quinnell, 2012; Greenless, 2011).

- **Transparent learning intentions.** Students should be clearly informed in regard to the purpose and learning intention of the task they are completing. This can be done be identifying the WALT (We Are Learning To…) and TIB (This Is Because…) for each lesson.

Conclusion

It is the responsibility of the primary mathematics teacher to provide their students with sufficient support and scaffolding to promote learning in the mathematics discipline (DEECD, 2007). To enable teachers to identify the needs of the students and to plan lesson that support these needs assessment needs to be conducted in a variety of ways and should where possible be embedded within the learning tasks (Charlesworth & Leali, 2012).
Ultimately, assessment needs to promote student learning while providing rich information and purposeful data that can enable changes to instruction and program to assist in the development of all students (Black & Wiliam, 2010; Van De Walle et al, 2010).

References


Appendix A.
Adapted from Downton et al, 2006, p.

- What do you think this might be the graph of?
- Put names and numbers on the graph to show what you mean.
- Write down three things you know from your graph.