

ASSESSMENT AS A STRATEGIC TOOL FOR ENHANCING LEARNING IN TEACHER EDUCATION: A CASE STUDY

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This small exploratory case study describes an attempt to integrate the academic and practical aspects of a teacher education course in order to promote deep understanding of children's ways of understanding mathematics. The assessment regime of the course was used as a strategic tool for engaging students, and the assessment tasks themselves were used as the means of generating genuine integration, or case knowledge, of the content of the course. The results indicate that the approach was effective in achieving the aims of the course, and student reaction to the approach was extremely positive.

INTRODUCTION

It has been argued that integrating the academic and practical aspects of teacher-education courses can promote more effective learning by children (Even, 1999). That is, teachers who have had the opportunity to make meaningful connections between research and their classroom-based experiences, develop deeper understanding of children's ways of thinking about their mathematics. In Even's (1999) study, teachers conducted a mini research project as part of a professional development program, and their written reports of the research project helped them to reflect on their experiences, generating "genuine integration of knowledge learned in the academy and that learned in practice" (p. 250). These two forms of knowledge have been defined by Shulman (1986) as propositional or declarative knowledge that is hard to be applied and used, and case knowledge that makes propositions real, and embeds them in context:

Case knowledge is knowledge of the specific, well documented and richly described events. Whereas cases themselves are reports of events, the knowledge they represent is what makes them cases. The cases may be examples of specific instances of practice — detailed descriptions of how an instructional event occurred — complete with particulars of contexts, thought and feelings. (p.11)

It is the integration of these two forms of knowledge that we want our teacher education students to achieve.

McInnis and Devlin (2002) state that good assessment at the tertiary level has three objectives:

1. It guides and encourages effective approaches to learning
2. It validly and reliably measures expected learning outcomes
3. It defines and protects academic standards.

We believe that if the emphasis of the assessment regime is on the construction of case knowledge rather than on summative or grading practices only, then assessment can be used as a strategic tool for helping students engage with a course in a meaningful and integrated way. We argue that this focus constitutes good assessment practice at any level, including tertiary education.

In this paper we present a description of a small exploration of an approach that parallels Even's (1999) study, and in addition, uses assessment as the strategic tool for promoting more effective learning as suggested by McInnis and Devlin's (2002) first objective.

BACKGROUND

This paper describes an innovative approach assessment used in the first mathematics education unit undertaken by primary teacher education students. This one semester unit, *Children and Mathematics: Developing Numeracy Concepts*, has a focus on the early years of school, and aims to “promote students’ understanding of how children’s mathematical concepts develop ... in number and measurement” (Deakin University, 2003, p. 351). The unit provides students with the opportunity to engage with young children, examine their mathematical developmental, and consider ways of providing effective learning experiences.

The unit content is presented in lectures that include relevant video excerpts and discussions led by mathematics education staff. The lectures are supplemented by tutorials in which students engage in practical tasks and discussion related to the content of the lectures. The assessment tasks for the unit are a team-based written report on the analysis of children’s responses to a mathematics interview, an individual response to providing appropriate learning experiences for children, and a written examination on both the content and pedagogical knowledge presented during the unit.

An assessment task used for many years in a similar course was a student interview of two four- or five-year-old children about their number development using an interview that included a Piagetian number conservation task. A written report of the analysis of the children’s responses to this interview formed part of the assessment requirements, while a verbal report on the interview tasks and findings was presented in tutorials, with discussion focused on interesting similarities and differences in the results.

The strength of this assessment task was that it demanded the integration of the academy (the lectures and tutorial content) and the practical (the interviews with children), although the extent of the integration was bounded by the students’ engagement with the written report and their participation in follow-up class discussion. The weakness in this task lies not in the task itself, but in its relationship with the other academic and practical aspects of the unit content. For example, later content examined children’s numerical development in more sophisticated aspects of mathematics such as operations with numbers and algorithms.

SHIFTING THE FOCUS

In 2003 for the first time this unit *Children and Mathematics: Developing Numeracy Concepts* was provided for 180 primary teacher education students on the Melbourne campus of Deakin University as well as to students who were attending other campuses of the university. This paper refers only to the implementation of this unit on the Melbourne campus.

As part of the development of this unit, the nature and role of assessment tasks were designed to act as a strategic tool for enhanced learning. An examination remained, but an interview and team-based written report were combined with the individual written description of appropriate learning experiences. The first task, the interview, was to take place while students were on a practicum placement in a primary school. As in previous years the interview had a focus on number. While we are aware of the difficulties for an untrained teacher when acting as a clinician, the highly structured interview protocol and its response format was considered robust enough to generate reliable data for the purposes of this assessment task (see, for example, Hunting & Doig, 1997; Haydar, 2003, on the value of training in clinical interviewing).

The first assessment task

The outline of the first assessment task to the students was similar to the description that follows:

This is a team-based assignment with a focus on children's number development. You will form a Team that consists of four students, where one member of the Team will interview at each of the four year levels (Prep, 1, 2, or 3). Each member of the team will conduct an interview with two children from the same year level. The Team will thus have interview records from two children from four year-levels, a total of eight interview records. Teams will write a team report that includes an analysis and discussion of the development of children's number understandings as evidenced by the data that they have gathered across the year-levels.

The Team's data and report will be entered on to a database *via* a web site. The contents of the database will be available to students for use in the second assessment.

The Team report must indicate what the Team considers to be the main findings of their analysis of their combined data; and the implications of their findings. Team reports must be linked to the evidence gathered.

There are two points to note here: first, the focus is on the team and the analysis and discussion of the team's data, not the individual student's data. This places responsibility on students for conducting interviews and reporting accurately. Secondly, the use of the combined data allows the students to examine the development of children's mathematics over four years and not, as previously, within a single year level. This mirrors the academic content presented later in the unit that examines children's longer-term development. The requirement that the team's report

focus on the implications of the findings was a further step towards integration of the academic and the practical.

The format of the team reports was a poster that had a printed copy of the data attached, thus allowing a reader to see a reduced version of all the data, grouped into eight themes by content type (for example, numeral recognition, place value), together with written comments highlighting the implications of the findings. The posters were displayed for all students to read and follow-up discussions were held in tutorials, using the posters shown below in Figure 1 as aids.



Figure 1: Team posters reporting interview data and analysis

We agree with Crespo and Nicol (2003) that discussion springing from student-teacher interviewing provides insights into their underlying beliefs about teaching. For example, during follow-up discussions in tutorials some students were surprised to hear that there were children who were able to respond correctly to items beyond those expected by the curriculum. The response of some of these students was that the teachers, or parents, were ‘pushing the children’, the implication being that this was not a good practice. Other students responded quite differently, suggesting that these ‘advanced’ children must be attending private (non-government) schools, apparently implying that these schools were also ‘pushing’ the children. Other students suggested that as the children could respond correctly, then the mathematics was not beyond them at all. The discussion regarding this ‘pushing’ was lively, and students were able to draw on the data collected by themselves and their peers to support their points of view.

Tutorial discussion also raised issues that sparked interest. For example, a common finding in the data of many groups was that the Year 1 children frequently achieved

better than the Year 2 children. As this appears to be the case for children from different schools and areas of the city, this was seen as a real trend and generated many hypotheses as to its likely cause.

The tutorial discussions also revealed some of the students' own problems in mathematics. For example, discussion of the question "Which is larger, -7 or -4 ?" revealed that for some students the value of the digit identified the correct answer. During discussion it became apparent that students' analogies for working with negative numbers, as learnt in school, were sometimes misleading or erroneous.

A second point to note in the description of this assessment task is the requirement that children's responses to the interviews be entered onto a data-base for use in the second assessment task. This requirement was facilitated by two aspects of the poster format of the report. First, all interview items and (where applicable) correct responses were available to the students in electronic format for entering children's responses and printing a copy to form part of the poster.

Thus the entire data-set of responses from approximately 360 children, 90 at each of the four levels Prep, Years 1, 2, and 3, were available to one of the authors, who randomly selected sets of 30 children's responses to form four virtual classes (a Prep, a Year 1, a Year 2, and a Year 3). These four virtual classes provided the following details for each child in the virtual class: a pseudonym, sex, age, and all their interview responses. These virtual class details were provided on a web-site for student access. Down-loading their chosen class gave students access to the data on every child in the selected virtual class as collected by the students in their first assessment task.

The second assessment task

The second assessment task built upon the first in two distinct ways. The obvious way is the use of the virtual classes, based on the responses from the interviews of the first assessment task, as described. The second, less obvious, way, is that it required students to use their knowledge of children's mathematical understandings across year levels developed by the first assessment task, integrate it with their understanding of the content of the lectures and tutorials during the unit, and apply the resulting case knowledge. That is, the integration of the academic knowledge with the practical experience is embedded within the second assessment task by the requirement that students address the mathematical needs of children within a selected virtual class and adopt the role of a teacher of real children who have real mathematical needs.

The details of the second assessment task were

This assignment is meant to give you a taste of creating focused, appropriate learning experiences for a whole class, or a small group within the class. There are several options for you to choose from, and these are set out below. First you must select the year level that you wish to have as your virtual class. Perhaps the level that you

worked in during your placement could make life easier, as the context may be more familiar to you.

Remember that the interview tasks run beyond what we would reasonably expect of Year 3s in order to 'capture' those children who are working beyond the usual. So, you are not expected to plan experiences to cover all the interview tasks, simply those you consider to be most critical for your children.

Option 1

Look at your class. Think about whether there is an identifiable group of 4 or 5 children with a similar mathematical need; and if there is, you may want to focus on that need for these children. You must select and describe 3 to 4 tasks addressing the mathematical needs of this small group if you choose this option.

Option 2

Look at the range of abilities, described by the responses to the interview tasks, across the whole class. Look at the least capable and the most capable children. Can you plan a single experience for this 'spread' of capabilities? For this option, you will need to select and describe one task addressing the mathematical needs of all the children. The task should be one that the least able children can tackle successfully, but also one that is open to extension for the more capable in the class; this sort of task is often termed a 'ramped' task as it goes 'up' in difficulty and the children are able to continue exploring it as far as their ability will allow.

Specific questions

Once you have the topic and the children sorted out you should address the questions below to complete the main body of your assignment. The questions to answer are:

1. What are the mathematical learning needs of your selected children?
2. What tasks were surveyed, and from what sources?
3. What mathematics do the selected task(s) deliver?
4. How will you know if the tasks have achieved your aims?
5. What have you learned from this assignment?

Student responses to this second assessment task were, as expected, mainly positive with some themes evident across many of the responses to a particular question. These themes related particularly to Questions 2, 4, and 5.

The most common sources of information for responding to Question 2 were educational Internet sites. Many of these sites were North American in origin, and students modified and adapted the information to suit local curriculum and conventions. It appears that the Internet is replacing the photo-copiable worksheet book as a major resource in primary classrooms. Another source, that was cited frequently, was the teacher in the class where the first assessment task (the numeracy interview) had taken place.

Surprisingly, responses to Question 4, that focused on assessing the effectiveness of one's teaching, seldom involved re-using the interview items that had revealed the original strength or weakness. Most responses considered that success on the selected 'new' task was sufficient to establish effectiveness. While this is in part true, the re-use of the interview items would seem a more reliable and valid approach to this question.

The final question of this assessment task was designed to provide students with a space in which to reflect on their experience and there were strong themes in the responses. One of these themes centred around the reality of the task, with this task compared favourably to other assessment tasks in the students' course that were considered not as relevant to their futures as teachers. Another common theme was the students' realization of the difficulty of finding and selecting tasks suitable to address particular needs. Comments focused on the length of time needed to find and select such tasks, as well as the time needed to unpack the mathematical content of many tasks. Comments on the low quality of many Internet sites were also common.

Student reactions to the two assessment tasks overall were very positive. Comments from students revealed that the workload was reasonable, the use of groups and posters was an engaging way to respond to tasks, and that re-using the interview data was a sensible and useful exercise. In particular, students commented on the re-use of the data as providing a familiarity that made the second assessment task less daunting, although many students wondered whether they would have enough time to do this type of task properly in a real classroom.

DISCUSSION

There are many facets to this exploratory case study but two aspects are of most interest here. The first is the effects of integrating the academic and practical aspects of a teacher education course in order to promote deep understanding of children's ways of understanding mathematics. The modifications to the assessment regime of the course were made in order to ensure that assessment would act as a strategic tool for engaging students, and promote such integration as an integral part of the course. This was accomplished by the two-fold use of the same data: in the first instance for examining children's development across the years, and in the second, to conduct a more detailed examination of the variation in children's needs at one year level.

The success of this strategy can be established by reference to student responses to the assessment tasks themselves, and their comments in their unit evaluation surveys (an obligatory part of the teaching process). While many of the comments were typical of student comments everywhere, with complaints about early morning lectures, too much content to be learned, and praise for particular aspects of the unit, a large number of comments were related to the professional aspects of their experience in this unit. These comments focused on those aspects of the unit that we believe were critical to achieving our aim of integrating the academic

and practical, and that built a strong relationship, between the unit content and assessment, and the students' own case knowledge and professional preparation. We believe that such integration of the different knowledge forms is a basis for a teacher's professional practice and should be the aim of all teacher education courses

Students' reflective comments indicated that there was sufficient evidence for continuing to use assessment as a strategic tool for integrating the academic and the practical, and that these students were building a reflective approach to teaching mathematics likely to promote effective mathematical learning experiences for children..

A further outcome of this study is that it raises the issue of Shulman's case knowledge and its place in teacher-education. Clearly case knowledge represents an ideal for student outcomes in this context, and the attempt described here shows a possible way forward in achieving this goal. It is hoped that the more detailed study underway at present will reveal more clearly those features of assessment as a strategic tool that are critical to achieving our goals.

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