Implications of Preservice Teachers' Intentions to Use Particular Learning Tasks

Anne Scott
Australian Catholic University
a.scott@patrick.acu.edu.au

Reported are preservice teachers' intentions to use two types of tasks: those they intend to use most and least frequently in their teaching of mathematics. Preservice teachers' intentions indicated high levels of commitment to using tasks that interest children and low levels of commitment to using tasks that help children memorise frequently used facts. Left unchallenged preservice teachers may form simplistic views about the potential value of different learning tasks. It seems that preservice teachers may benefit from examining the purposes of and contexts in which particular learning tasks are used.

A scan of proceedings at MERGA conferences suggests that teacher educators are keen to encourage preservice teachers to value approaches that use interesting, engaging, challenging tasks with opportunity for creative thinking. The purpose of this paper is to challenge teacher educators to consider whether the role of learning tasks that help children develop fluency and automaticity has been de-emphasised too much.

Three questions addressed in this discussion are:

- Which types of learning tasks do preservice teachers' intend to use in their teaching of mathematics?
- Which learning tasks gain highest and lowest levels of commitment from preservice teachers?
- To what extent are preservice teachers' intentions consistent with advice offered in their coursework?

The data discussed below suggest that perhaps teacher educators underestimate preservice teachers' intentions, and in promoting the use of interesting and challenging tasks may devalue the contribution of tasks that encourage the fluency and automaticity of simple number facts or the practice of skills. Findings indicated that preservice teachers entered their courses with intentions to use interesting tasks but were less oriented to helping children memorise the basics such as, simple number facts. Those completing their courses also intended using interesting tasks but were even less keen to use tasks that developed automaticity of number facts.

Essentially the argument here is that it is important for children to learn to develop automaticity with some facts, and that fluency with skills assists children to solve problems and think creatively. Rather than discouraging prospective teachers from using tasks that help children memorise the basics, teacher educators would be better advised to assist them to use such tasks productively.

Learning Tasks

Tasks may be grouped into two broad categories: those that create opportunities for exploration and those which allow children to practise known skills and knowledge. First, the Australian Association of Mathematics Teachers (2002) statement of *Standards for Excellence in Teaching Mathematics in Australian Schools* described what excellent teachers of mathematics "know and do" (p.1) and includes planning and supporting children in worthwhile learning tasks which expect risk-taking and providing timely feedback. There

are wide spread recommendations that effective teachers of mathematics should provide children with tasks that allow them to explore concepts and develop their own mathematical understandings (Boaler, 1998; Carpenter, Fennema, Loef, Levi, & Empson, 1999; Clarke et al., 2002; Nunokawa, 2001). Clearly, not all learning tasks that children find interesting facilitate the exploration of concepts. Yet, as discussed below, preservice teachers surveyed intend to use tasks that interest children more frequently than any other type of task.

The alternative category of tasks promotes "elementary processes become automatic, thus freeing our attention to concentrate on the new ideas which are being learnt" (Skemp, 1986, p. 83). These are those tasks that develop automaticity and fluency. However, Skemp distinguished "the automatic performance of routine tasks from the mechanical manipulation of meaningless symbols, which is not mathematics" (p. 83). The former was likened to good drivers changing gears without thinking and the latter to machines performing an operation.

Several studies reported positive outcomes for learners having used particular types of tasks that required repetition and practice. Pegg, Graham and Bellert (2005) noted faster retrieval times with basic academic facts in mathematics in children in years 5 and 7 participating in a 25-week intervention program. Delayed post-test results also indicated that children's skills were sustained one year after the intervention program ended. Gordon and Nicholas (2005) reported that the act of memorisation performed different roles for various learners such as "to learn patterns and proofs, for precision and to facilitate progress, for speed in examinations, for permanency and to enable application" (p. 62). Hatano (1996) advocated using consolidation exercises to help children refine their understandings and skills.

Although not specifically from the field of mathematics education research from authors in neuroscience provide insight into the way *dendrites* or brain structures develop when individuals are actively engaged in their learning affecting the storage and retrieval of information (Brandt, 1999). Some argue that tasks should create opportunities not only for children to experiment and discuss, but also to practise, and they should provide children with time to gain experience and confidence with a new skill or topic so they may form generalisations and perform tasks efficiently (D'Arcangelo, 1998; Smilkstein, 1998; Valiant, 1996).

In this paper, Skemp's (1986) notion of automatic performance of routine tasks best describes the way in which one hopes children will use frequently used number facts and are also referred to as the basics. Clearly tasks have different purposes and it is desirable to set learning tasks that facilitate the development of robust mathematical understandings and automaticity of the basics.

Preservice Teachers' Beliefs

Preservice teachers' intentions for teaching are considered to be linked to their beliefs about teaching and learning. Such beliefs are socially constructed through a process of enculturation, context-specific, personally meaningful, and "based on evaluation and judgment" (Pajares, 1992, p. 313). Beliefs vary in intensity and long-held beliefs are resistant to change (Beswick, 2003) and they have the potential to influence the decision-making process yet these cannot guarantee predictable behaviours (Sarver, 1983).

Kagan (1992) suggested that preservice teachers enter teaching courses with

preconceptions and personal beliefs shaped by their time and experiences spent in classrooms as students and as such form personal beliefs which are difficult to alter (Kane, Sandretto, & Heath, 2002). With this in mind, a comparison of data is presented below with survey responses from two groups of preservice teachers, those entering and those completing their courses.

Preservice teachers' experiences of schooling impact on the formation of their beliefs about general teaching practices (Kagan, 1992), indeed Mousley and Herbert (2002) reported similarity between preservice and experienced teachers' beliefs about features of quality mathematics teaching and concluded that it was appropriate for preservice teacher education educators to decrease focus on quality teaching in general and increase emphasis on the learning and teaching of specific content. Central to this paper is the identification of learning tasks preservice teachers surveyed most and least intend to use in their teaching of mathematics.

Data collection processes

Two groups of preservice teachers, those commencing and those graduating from preservice primary teaching degrees voluntarily completed written questionnaires about various aspects of teaching and learning literacy and numeracy. A comparison of written responses was one of several approaches used to determine the extent of the influence of coursework on preservice teachers' beliefs about surveyed issues. Participants were studying teacher education courses at two tertiary institutions in Australia, one located inner city and the other in a regional centre. Early in the second semester of their first year of their courses, 163 commencing preservice teachers completed written surveys and during the final weeks of their courses 186 graduating preservice teachers also completed the written questionnaire.

The *Preservice Teacher Intent Questionnaire* (PTIQ), comprising 65 items, was an adaptation of the *Undergraduate Teacher Intent Questionnaire* (UTIQ) piloted a year earlier with 163 participants (Scott, 2003). Both instruments required participants to consider specific beliefs about learning and teaching for two disciplinary areas—literacy and numeracy and sought to identify preservice teachers' intentions for frequency of specific teaching strategies and practices. In other words, the five-point scale enabled participants to indicate how often they intend to include a particular strategy in their literacy and numeracy lessons. The range incremented by 25% of lessons spanned from 100% (in every lesson) to 0% (meaning never), also included a *don't know* (D) option. Figure 1 is an example of the items in PTIQ seeking preservice teachers' intentions to use specific types of tasks in both disciplines.

In _% of lessons	Tasks	In _% of lessons
Literacy	I intend to use tasks that …	Numeracy
100 75 50 25 0 D	interest children.	100 75 50 25 0 D

Figure 1. Beliefs about tasks: Item 35.

Once data were analysed lecturers responsible for the planning and/or delivery of the

compulsory English or mathematics education units at both sites were interviewed individually for 60 - 75 minutes for their interpretations of preservice teachers' written responses to the PTIQ. Using the same semi-structured questions and format for each interview, all discussions were audio taped and later transcribed verbatim. Interviews comprised two parts: descriptions of their coursework and interpretation of tabulated data from questionnaires. Open-ended questions included for example:

- Tell me about the first core mathematics education unit.
- What content do you emphasis in this unit?
- What are some phrases, sentences, keywords I would hear students use that may suggest…? Give me an example of this for…
- What are some phrases, sentences, keywords I would read in your unit coursework documentation that may suggest?

Tabulated data of preservice teachers' responses to PTIQ items were also provided and formed the basis for lecturers' interpretations of data in light of their coursework.

Interview transcripts were first read for potential commonalities, and preliminary categories were formed. Key issues were coded, in some cases with subnodes, with the assistance of a qualitative software program, NVivo (Richards, Richards, Fraser, & Barrington, 2000). Data grouped into similarly coded sections were inspected for coherence. Discrepant comments were re-categorised, or where necessary new nodes created to accommodate them.

Results and discussion

Presented in this section is a summary of preservice teachers' beliefs about teaching using tasks that help children memorise the basics, for example, frequently used words and number facts. Although the items in the questionnaire sought preservice teachers' intentions for teaching and learning both literacy and numeracy, to keep within the constraints of this publication only data pertaining to mathematics education are reported from two sources: written responses to two PTIQ items from 349 preservice teachers surveyed and audio taped comments from three lecturers of mathematics education interviewed individually.

In this section Tables 1 and 2 indicate those tasks gaining highest and lowest levels of commitment from preservice teachers surveyed. Percentages incrementing by 25% indicate the frequency of lessons: e.g. 25% means in 25% of lessons. Table 1 presents the intention to use tasks that interest children for both groups.

Table 1
Comparison of intentions for the use of tasks that interest children

I intend to use tasks that interest children in …			
	50% …	75% …	every lesson
Graduating (n=186)	2	21	163
Commencing (n=163)	2	25	132

Profiles of results are similar and compatible with earlier findings that prospective generalist teachers enter their teacher education courses with beliefs about many aspects of schooling (Kagan, 1992; Kane et al., 2002). Both graduating (99%) and commencing (96%) preservice teachers indicate an intention to use tasks that interest children in either 75% or in every literacy and numeracy lesson. This suggests that they highly value the practice and consider it to be equally appropriate for learning literacy and numeracy however, not necessarily as a by-product of their preservice teacher education coursework. It seems that even preservice teachers commencing their courses are aware of the value of this sound general teaching practice and it is a promising outcome for children's learning. Likewise, Mousley and Herbert (2002) reported similarity between preservice and experienced teachers' beliefs about features of quality mathematics teaching and concluded that it was appropriate to decrease focus on quality teaching in general and increase emphasis on the learning and teaching of specific content.

Lecturers were not surprised by graduating preservice teachers' strong conviction to these types of tasks given a summary of the data analyses during the interviews. For example one said:

> Mathematics education lecturer B1: All of these points here, I would really emphasise in my classes. It's got to be interesting, it's got to be challenging, got to be worthwhile.

It seemed that this lecturer stressed the appropriateness of tasks for learners.

Another lecturer discussed the use of interesting tasks and said:

> Mathematics education lecturer A1: It's really getting children thinking and challenging them a little bit but doing it as a class and having that opportunity to discuss.

It seemed that this lecturer chose tasks prompting class discussions.

In sum, it seems that both groups of preservice teachers have intentions consistent with these lecturers about using interesting and challenging tasks with children most of the time.

Table 2 presents the intention to use tasks that help children memorise the basics for both groups.

Table 2
Comparison of use of tasks to memorise basic skills

I intend to use tasks that help children memorise the basics in …						
	Never	25% …	50% …	75% …	every lesson	Don't know
Graduating (n=186)	7	30	60	58	24	7
Commencing (n=163)	1	7	27	61	54	13

Common to both groups of preservice teachers is that relatively few of them intend to use tasks to help children memorise the basics in either 75% or in every mathematics lesson. Even those commencing their courses perceived such tasks as being the least valuable and/or appropriate of those included in the questionnaire. Only 71% of commencing and 44% of graduating preservice teachers intend to use such tasks.

Distinguishing the two groups is that graduating preservice teachers considered such

tasks even less appropriate or valuable for teaching mathematics than those commencing their courses. Indeed, 20% of graduating and 5% of those commencing indicated either never intending or limiting their use of such tasks to 25% of lessons. It seems that graduating preservice teachers were more likely to refrain from using tasks that help children develop fluency and automaticity with number facts on a regular basis in their teaching of mathematics than those commencing their courses.

It seemed that these lecturers considered results consistent with their advice in coursework which focused on learning with understanding and less on memorisation. For example:

> Mathematics education lecturer A1: We focus less on memorising because we said [and referred to an article by Skemp (1976)], that memorising isn't as beneficial for understanding as is understanding something relationally, so I would say it could be partly that. It's not just learning by memorising them, we are trying to learn and understand the relationships between them. [For example,] if you know strategies like adding nine, you know how to add ten take away one.
>
> Mathematics education lecturer B1: Well, I think, in the first year we would be going for understanding rather than memorising and that's where we're looking at different ways of getting in there and understanding where the kids are at presenting the mathematics in different ways.

At both sites, advice from lecturers was similar - they emphasised learning mathematics with understanding; however, also important was to have children know number facts. Each said:

> Mathematics education lecturer A1: The message we try to give to them is that people do develop strategies for working and thinking but the objective is that they will be able to automatically record them, absolutely because they wouldn't have to think about those when we are solving problems.
>
> Mathematics education lecturer B1: We discussed it was important to know and recall basic facts quickly that's really quite important. Maybe there's not enough of that in the course [about getting children to improve their automatic recall of number facts].

It seemed that lecturers agreed that automaticity of number facts allows children to focus on other aspects of solving tasks; however, perhaps that aspect of their coursework was not as prominent as it could be.

At site A, an assessment task also developed preservice teachers' ideas about learning with understanding. For example:

> Mathematics education lecturer A1: Maybe their experience interviewing students has helped them to realise that people do think about things and can come to understand them more relationally.

It seemed that the benefits of learning with understanding had greater emphasis in coursework than learning by memorisation.

In sum, at both sites both groups of preservice teachers' intentions to use tasks that help children develop automaticity of some facts infrequently were consistent with lecturers' advice for teaching mathematics at both institutions. Having said that lecturers claimed to have discussed with graduating preservice teachers the value of children being able to recall number facts however, their intentions do not seem to indicate that.

Conclusion

It is widely recognised that preservice teachers enter their courses with beliefs; in this case, about the value of using particular tasks that are harmonious with current approaches and specifically with two teacher education programs described in this paper. But data discussed also indicate that those completing their courses graduate without understanding that in order to explore complex ideas and/or tasks children need to be able to use known facts and skills efficiently. Teacher educators have diligently made preservice teachers aware of the decreased emphasis on memorisation in contemporary learning theories, and he need to use tasks relate tasks to children's interests; however, these may have unwittingly reinforced rather than challenged preservice teachers' preconceived ideas about such issues and produced unbalanced or simplistic views of the potential value of particular tasks. Therefore, perhaps more discussion is needed in helping preservice teachers recognise the contexts in which children benefit from "making routine manipulations automatic" (Skemp, 1986, p. 83).

It is suggested that preservice teachers be encouraged to examine the purposes of various tasks and identify the contexts in which they are useful and the features or aspects of such tasks which make them helpful to learning.

With respect to the purpose of the task, it is important to recognise situations in which using tasks to help children memorise the basics are and are not appropriate, for example as a means of practising an understood skill or fact but not as an introductory activity in the exploration of a concept. It is also important that preservice teachers understand that not all tasks that interest children necessarily allow them to explore concepts. Although not discussed in this paper, other items in the PTIQ included tasks with different foci for example, to encourage problem solving.

With respect to the context, it is worth noting subtle differences in tasks which potentially enhance opportunities for learning. Insights from neuroscience suggest restating and reusing known facts in different ways increases retrieval rates and some tasks help children to do that. For example, by asking children to recall specific events or skills similar to those being studied then having them restate and refine what they know in various forms (as questions and statements both spoken and written) and in different modes, such as visual representations and verbal communication (Smilkstein, 1991, 1993; Valiant, 1996) children may begin to use known facts and/or skills automatically as advocated by Skemp (1986).

Perhaps more elaborated discussions about tasks will challenge preservice teachers to choose tasks which more accurately meet children's learning needs.

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