The connections and contradictions of contextualised tasks

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Classroom mathematics and the mathematics of 'real life' or work often appear to be unrelated from a student viewpoint and tasks that are intended to be realistic rarely resemble the real tasks that might actually occur in life. Research highlights the difficulties of crossing the boundaries between the classroom and the world outside, referring to the problems of transferability and the situated nature of learning. In this session qualitative data from discussions with post-16 students about a range of contextualised functional mathematics tasks will provide some insight into their perceptions of relevance and relationship to life. The results indicate ways in which they make personal connections to the context, the activity or the mathematical content at different levels or reject tasks because of the contradictions they present. Their judgements lead to interesting distinctions between tasks that they believe remain firmly situated in a mathematics classroom and ones that may belong in a 'real life' situation. This research involved vocational students in colleges but has implications for much wider consideration across mathematics teaching.

Keywords: relevance; contextualized; vocational; functional mathematics.

Mathematics for life and work

The development of skills that enable adults to apply mathematics in work and life has been a recurring theme for some time in education (Cockcroft, 1982; Department for Education and Skills, 2005). The belief that students need certain skills and abilities in order to function effectively in everyday life and the workplace is accompanied by an assumption that these skills can be developed in a formal learning situation for use in other contexts yet research shows that transferability of knowledge is complex and not easily achieved (Evans, 2000).

It has been suggested that transferability might be improved by increasing students' exposure to applications of mathematics in authentic activities (Boaler, 1998). The use of varied 'realistic' contexts may promote a concept of mathematics as a tool for adaptation and application but the success of this strategy also depends on how students interpret these contextualised tasks. The meaning they attribute to the 'real life' applications presented in the classroom is essential to understanding the value of this possible approach to developing transferable skills.

Context and transferability

Transfer of learning may be considered to occur when learning in one situation acts as either an enhancement or an undermining of performance in a new context (Perkins & Salomon, 1992). Early considerations of the transfer of learning were largely based on cognitive theories and focussed on the individual rather than the social situation. Assumptions were made that transfer could be achieved in mathematics through

individual constructions of abstract mental representations or schema that could then be used in new situations. From this viewpoint the schema acted as mediating devices between contexts and once knowledge was secure application into other contexts would follow.

Empirical studies of learning in formal and informal situations (Lave, 1988; Nunes, Schliemann, & Carraher, 1993) led to challenges to this perspective due to inconsistencies in student performance with mathematical problems in different situations. The distinction between formal and informal mathematics or street and school mathematics (Nunes et al., 1993) prompted interest in learning as a social phenomenon and a situated view of learning (Lave & Wenger, 1991) was developed. This explained the apparent boundaries between learning experiences in different situations but left little scope for transfer to actually occur.

Studies of mathematics in work situations have revealed little resemblance between classroom mathematics and work practices (Pozzi, Noss, & Hoyles, 1998; Williams & Wake, 2007). Viewing these as different activity systems (Fitzsimons, 2005; Williams, Wake, & Boreham, 2001) acknowledged the difficulty of learning transfer but also suggested that crossing the boundaries may be facilitated by boundary objects that could provide links between the two situations.

It is this possibility of creating connections between the classroom and student lives that is of particular interest to this study and how this might be achieved through the use of 'realistic' applications of mathematics in a formal learning situation.

Relevance and 'realistic' contexts

The use of contextualised tasks may, potentially, be a means of creating links between classroom mathematics and 'real life' but it is important to understand the nature of the connections that students might construct. Ernest (2004) makes a distinction between a utilitarian view of mathematics, which pertains to usefulness, and a relevance which involves a consideration of how an activity relates to a person's goals and interests. For the students in this study their main goal may be to gain a qualification for entry to further training or employment (exchange value) but their decisions regarding relevance may also be influenced by their perceptions of the usefulness of the mathematics (practical relevance) they encounter or the transferable skills they identify (process relevance) (Sealey & Noyes, 2010).

The effectiveness of using 'realistic' tasks to connect classroom mathematics to student lives may also be dependent on their personal interpretations of the context. Children's responses to mathematics problems in 'everyday' contexts (Cooper & Harries, 2002) have shown how some children relate the context to their lives outside the classroom whilst others treat the questions as classroom mathematics in a superficial disguise. Their different interpretations also led to varied outcomes from the problem-solving tasks and this illustrates the difficulty of using 'realistic' applications effectively in the learning process.

Context may also be used in different ways and some scenarios may have very little connection to the mathematics being taught whilst others could closely resemble a 'realistic' application of mathematics. In this study the terms *authentic* or *artificial* (Drake, Wake, & Noyes, 2012) will be used to broadly describe the match (or mismatch) students perceive between a mathematics problem and the context in which it is situated.

Research methods

This research forms part of a larger study and data already collected from lesson observations, student focus groups and staff interviews provides a background for this work. The section of the study reported here focusses on the relevance of a number of contextualised functional mathematics tasks to students on vocational courses and seeks to provide some insight into the research question "In what ways is functional mathematics relevant to students?"

Three large Further Education colleges and seventeen vocational groups of students took part in the research from the areas of Construction, Public Services and Hair and Beauty. A small focus group (3-6 students) from each vocational group were shown three functional mathematics tasks taken from a bank of ten. The tasks were unfamiliar to the students and involved practical applications of mathematics in contexts that might have a link to their vocational specialism or to their personal lives. Students were not required to attempt the tasks but were given time to read each task before discussing the following questions:

- What are your first impressions of this task?
- Is the task relevant to you in any way?
- Would you learn any useful maths skills or knowledge through doing this task?

These discussions were audio-recorded, transcribed and coded so that the main themes could be identified, summarised and compared.

Main findings

Connection and relevance

Firstly, students made *connections* at three different levels in their attempts to relate to the tasks.

- superficial level (recognition) – students recognised isolated words that had connections to their vocational area such as hair dyes (hairdressing) or a sink unit (plumbing) and used these to make conclusions about relevance without considering the full scenario. For example, plumbing students concluded that a task about fitting a kitchen was relevant because it involved a sink unit but did not consider whether the actual scenario or task associated with the sink unit related to plumbing.
- scenario level (recall) – students recalled a similar scenario within their personal experience but overlooked differences in the mathematical content of the task. For example electrical students identified with a task about fitting a kitchen because of similarities to wiring plans even though they would not expect to carry out the specific task described.
- task level (resemblance) – students identified the task as authentic and relevant because it closely matched a 'real life' task they had experienced or expected to perform in the future.

Secondly distinctions were made between tasks that had an *immediacy of usefulness* and those that might be of value in the future. Tasks with some immediate practical use were perceived to be most relevant whilst those that students only expected to encounter later in life were deemed to be less relevant.

Thirdly, the context did stimulate a type of *interest* which affected students' judgements regarding relevance although students often expressed views that

mathematics itself could never be interesting. Generally students related most strongly to situations they could identify as part of their vocational specialism although connections to their personal lives also generated interest.

The results of this study suggest that the three 'dimensions' described above (*connection*, *immediacy of usefulness* and *interest*) may form a useful framework to describe and better understand students' perceptions of relevance.

Contradictions and constraints

The *connections* made by students were, however, not always secure and appeared to be easily fractured by apparent contradictions between their personal experience and the scenario described. The limitations of individual personal experience meant some students failed to see the relevance of a task because they had not personally encountered the scenario. For example, students who had not yet carried out reception duties in a salon did not see the relevance of a task about cashing up and some joinery students with no experience yet of site-work failed to see relevance of a task about clearing a site with a van.

Some students were sensitive to inconsistencies in the details of the context compared to their own experience. For example, a reference to tubes of hair dye was consistent with normal salon practice but students who used dispensers for hair dye in their training salon rejected the task as unrealistic and irrelevant. Those with wider experience of their chosen vocational area or broader life experience were able to make connections that other students over-looked and were less prone to misconceptions about working practices.

Students' prior experience of mathematics led to some expectations that conflicted with their attempts to make *connections*. Students clearly differentiated between *artificial* and *authentic* situations using the task descriptions and visual clues (for example whether illustrations were similar to real brochures) but even when situations appeared to be authentic some students were suspicious. They expected to find contradictions in mathematics problems such as unrealistic figures and unauthentic processes because they believed mathematics questions always used "fake figures" and there was usually a "maths way" of doing a task which was different to the "practical way" they would use in life or work.

Variations in personal experience also led to different expectations about the future and in the perceived *usefulness* of tasks. Some students referred to family traditions of tackling various practical tasks, such as planning their own kitchen or fixing a fence, and saw the possibility that they themselves might carry out such tasks in the future. These students identified a use-value for some tasks that others rejected. Similarly some students made decisions based on family values which led to different decisions about the *usefulness* of tasks. For example, those who considered the financial benefits of being able to tackle tasks themselves, such as keeping accounts for their business or carrying out reception duties, made different conclusions about some tasks to those who assumed they would always employ someone else for these duties.

Some of the contexts used in the research did stimulate *interest* amongst students but this interest was often constrained by expectations that mathematics could never be interesting simply because it was mathematics. This separation of context and mathematics was a concern in terms of the impact on learning but students did express views that an interesting context encouraged initial engagement even though it would not make the actual mathematics more interesting or enjoyable.

For these students, many of whom were disaffected and disengaged from mathematics, any means of re-engaging their interest was valuable.

Conclusions

Student perceptions of relevance were closely linked to their decisions regarding the authenticity of the context or scenario. They were able to make clear distinctions between *authentic* and *artificial* contextualised tasks by comparing the task description to their personal experience of similar situations. Their views reflected a predominantly utilitarian view of mathematics with an emphasis on direct practical usefulness rather than transferable skills.

The results of the study suggest that the three 'dimensions' (*connection*, *immediacy of usefulness* and *interest*) could be used as a framework for describing and understanding student perceptions of relevance. However, the connections made were easily fractured by apparent contradictions between students' personal experiences and the scenarios presented. Students were sensitive to details so any disparity between personal experience and task description could quickly destroy tentative links. Their personal experience also limited the connections they were able to construct whilst personal expectations, based on prior experience, led to constraints or conflicts in student decisions.

There were indications that the use of contextualised tasks could stimulate interest and help students make connections between mathematics and real life which may have some value in the learning process. Students felt that relevant tasks could generate interest and engage them in activity but this interest would only extend to the context whilst attitudes to mathematics itself would remain unchanged. Views were expressed that familiar contexts could make mathematics more understandable but context could also confuse, particularly if details were inconsistent with personal experience.

This research does not take into account the influence of teachers in introducing, explaining and facilitating the carrying out of a task in a classroom but some students did refer to the interest being generated by the teacher rather than by the task. Further study of the mediating role of the teacher in strengthening connections and dealing with contradictions in the classroom will add further insight to the findings of this study.

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