Engagement with task context of applications tasks: student performance and teacher beliefs

Gloria Stillman

This study investigated the impact of engagement with the task context by upper secondary students on their performance on applications tasks and teacher beliefs about the effects of students' engagement with task context. Moderate to high engagement with a task context was not often associated with poor performance which was more likely to be associated with no to low engagement. High engagement with task context was not a necessary condition for success as the degree of engagement necessary for success may be task specific. Engagement with task context alone was not of sufficient explanatory power to account for all the patterns in the data and it is acknowledged other factors need to be considered. Students identified a sense of realism and having an objective to work towards as facilitators of their engaging with task context. Amongst the teachers interviewed, there was support for the following beliefs: (a) students' preferred degree of contextualisation determines whether success is accompanied by engagement with the task context; (b) if the mathematics is not integrated with the task context, students will not engage with the context and will develop the habit of ignoring it; (c) if the two are integrated, students will engage with the task context; (d) the setting of tasks where the context transcends reality is problematic. The last of these was not supported by all teachers, however.

1. Introduction

Currently, there is worldwide interest in the teaching of mathematical modelling and applications at the secondary school level (e.g., Christiansen, 1997 (Denmark); Gravemeijer, 1994 (Netherlands); Klaoudatos, 1994 (Greece); Lamon, in press (US); Smith, 1996 (UK)). This is also the case in Australia. In place of a national, centralised education system, every Australian state has its own education system. In Queensland, assessment in secondary schools is school based. There are no statewide examinations in particular subjects. In

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Mathematics B, the main pre-tertiary mathematics subject, the use of applications is advocated in order to develop positive attitudes towards mathematics and to increase mathematical competence by being concerned with

> *the modes of thinking which provide ways of modelling situations in order to explore, describe or control our social, biological and physical environment. (QBSSSS, 1992, p. 1).*

These reasons for advocating the use of applications in classrooms are based on widely held, though not universal (e.g., Verstappen, 1991; 1994), beliefs about the motivational powers of contexts and their use enhancing the links between the abstractness of school mathematics and the use of mathematics in the real world. The use of contexts, while possibly addressing these concerns, presents other dilemnas, however.

2. Selected literature review

2.1. Task Contexts in Learning and Assessment

Several authors consider the location of mathematical tasks in meaningful contexts for both teaching and assessment purposes to be problematic. Boaler (1993a), Clarke and Helme (1993) and Noss and Hoyles (1996b) contend that contexts are not immutable and interpreted in some universal fashion by all students. Clarke and Helme argue further that it is useful to distinguish between the situation which the classroom task offers the student and the personal context which that student constructs for the task as a result of the interplay between the *figurative context* (the situation described in the task) and the *interactive context* (the situation in which the task is encountered). Presumably, it is this interplay that contributes to a student's degree of engagement with such tasks. Like Noss and Hoyles (1996a), I see applications and «modelling not simply as a matter of decontextualisation and translation but of a synergy between mathematical and situational meanings» (p. 5)[1]. From such a viewpoint, the engagement of task solvers with the figurative context of tasks throughout the solution process is of crucial importance.

Not all students will engage with the figurative context of a task to the same degree and this can be for a variety of reasons such as lack of prior experience with the situation described in the task (Burton, 1993; Clarke & Helme, 1993), or the context being unappealing

1. For further details see Stillman (in press).

(Burton, 1993), or a belief that, as this is a classroom task, the expectation is for the task solver to disembed the mathematics from the figurative context as quickly as possible and work on the mathematics, ignoring the context from then on except to perhaps check the reasonableness of the final result (Hung, 1997; Lave, 1988). There is no suggestion, however, that this lack of engagement is necessarily accompanied by poor performance on the task. Similarly, the fact that a student finds a particular task context engaging does not necessarily mean that this will lead to enhanced performance on the task. Clarke and Helme (1993) suggest that the demands of language and contextual detail may constitute an excessive cognitive load impeding progress towards a solution even though a student may find a particular context interesting and engaging.

2.2. Teacher Beliefs

There is growing evidence (eg, Cooney, Shealy & Arnold, 1998; Jacobs *et al.*, 1997; Thompson, 1992) that teachers' classroom practice is related to their beliefs about mathematics teaching but, as Van Zorst, Jones and Thornton (1994) found, not all teachers (particularly inexperienced teachers) are uniformly successful in translating beliefs into actions. According to Pajares (1992) beliefs are mental representations that guide thought and behaviour. To implement the new teaching approaches associated with the teaching of applications, significant changes in classroom practices will be required by a large section of the teaching profession. Case studies from the area of teacher change (Britt *et al.*, 1993; Prawat, 1992) demonstrate that significant change in practice needs to be accompanied by reconsideration, and perhaps reconceptualisation, of beliefs about teaching mathematics. It was therefore considered essential that the present study investigate practising teachers' beliefs about how students engaged with contextualised tasks as these would be expected to influence the types of tasks they used in learning and assessment and how these tasks are used in teaching.

3. The study

3.1 The purpose of the study

This paper reports part of a much larger study which investigated the effects of context on students' approaches to, and performance on, applications tasks in Mathematics B. Specifically, this part of the study addressed the effect of engagement with the figurative context of the task on students' performance on applications tasks. In addition, the beliefs of their teachers about the effects of students' engagement with the task context during solution of applications tasks were sought. The effects on task accessibility of facilitating or impeding conditions such as language related conditions and representational conditions involving contextual details were dealt with in the main study and will be the basis of a future paper.

3.2. The participants

The study was conducted in two public high schools in a large provincial city. Data collection occurred over a six month period although contact with both schools was continuous during this time. Forty-three students in the last two years of high school (Years 11 and 12) participated in the study. Eight teachers also participated, four from each school.

4. Methodology

4.1. Administration of the Tasks

All students were videotaped as they attempted to solve tasks individually. Eighteen applications tasks were developed as the study progressed with each student completing up to four tasks. Illustrative examples are included in an appendix. These tasks differed in terms of familiarity, complexity and degree of contextualisation. The term *degree of contextualisation* is meant to convey the range of embeddedness that exists between the mathematics that can be used to model a situation and the description of the situation. This can range from the simple case where there is virtually no integration of the model within the context, the context merely acting as a border surrounding the mathematics which can be readily removed without loss of meaning, to the situation where the two are totally integrated and separation becomes difficult as the mathematics derives its meaning from the context.

Although the majority of the tasks used in the study were closed rather than open-ended, the nature of some tasks allowed some degree of «open beginningness»[2] (William, as cited in Boaler, 1993b) because they were modelling tasks rather than mere applications (e.g.,

2. Wiliam suggests that mathematical tasks should incorporate an «open beginningness» as a means for students to develop personal familiarity with the context. The start of the task must be genuinely open, allowing students to move in the directions appropriate to their perception of the problem.

the Tide Problem, see Appendix) or a fair degree of leeway was allowed in students' interpretation of the task. An example of the latter occurred in the Road Construction Problem (see Appendix) where students were asked to determine if they could add a new lane to a highway beside an existing lane as it passed through a cutting. One student chose to solve the problem by widening both sides of the existing highway, then explained how the roadway would be remarked to have a new lane beside a re-alignment of the existing lane. This interpretation was accepted even though a pedantic interpretation of the wording may not allow it.

4.2. Student Interviews

Semi-structured stimulated recall interviews were conducted and recorded immediately following completion of the tasks. Students reviewed the videotape of their task solving sessions in conjunction with the script of the task during the interview. They were asked to draw diagrams during the interview, where appropriate (e.g., Road Construction Problem), to illustrate their understanding of the context in which the problem was set and what it was they had to do. The use of the videotaped task solving sessions as a visual stimulus throughout the interviews allowed both the interviewer and the interviewee to track the student's developing understanding of the task context by discussing changing perceptions of the task as observed in the changing use of diagrams throughout the review of the task solving session. It also gave valuable insight into the degree to which students were able to engage with the figurative context of the task.

4.3. Teacher interviews

The teachers were interviewed using a structured interview schedule. These interviews lasted from 40 to 50 minutes and were audio taped.

4.4. Analysis

All interviews and task solving sessions where there were interactions between the student and the researcher were transcribed. The interviews were analysed using the qualitative data analysis software QSR NUD.IST (Qualitative Solutions and Research, 1997). NUD.IST facilitates «grounded theory» construction (Strauss, 1987) which attempts to capture and interrogate the meanings emerging from data. This is achieved by constructing and exploring new categories and themes as they arise from the data then refining these through a «process of progressive category clarification and definition» (Tesch, 1990, p. 86). This was done using a variety of matrix displays (Miles & Huberman, 1994). To see how cases clustered or dispersed on dimensions of interest and how different clusters related to each other, it was necessary to use a qualitative technique which is close to the scatterplot logic for explaining correlation coefficients (Miles & Huberman, p. 197). The results of using this technique to look at the relationship between degree of engagement with the task context and students' performance on the tasks follow.

5. Results

5.1. Student Engagement with Task Context versus Performance

Qualitative data from all cases were scaled by the researcher using the two dimensions: *degree of engagement in task context* and *quality of performance*.

The task videotapes, student reviews of these during the post-task interviews, and responses to direct questions about their use of the task context throughout the task were examined to scale the cases along a continuum from no to high engagement. As an illustration of the technique used, let us look at the cases for the Road Accident Problem[3]. Three students saw this purely as a mathematical problem, attempting to find the radius of the curve for the given formula by relying entirely on mathematical techniques. Jenny, for example, felt the figurative context was not very helpful to her solution saying that it was a setting for the problem but it did not do any more than that. These three cases were classified as showing no evidence of engagement. Amy, on the other hand, said she understood the figurative context because she had met a similar situation in Forensic Science the previous year. She felt she used the task context to select what mathematics she attempted to use initially and as a check at the end on the reasonableness of her answer. Her case was classified as showing some engagement. Elle said she «sort of» used the task context to select her initial mathematical techniques but kept looking back at the problem statement as she ran into difficulties with her solution. When she realised that her answer was not going to result in a reasonable speed, she divided through by a conversion factor of 10 instead of 1000 «because it made it look like the speed». Elle's case was classified as showing evidence of moderate engagement with the task context. Ann believed that engaging with the task context was necessary to develop a solution to the problem.

3. Adapted from Smith and Hurst, 1990, pp. 67-80.

Interviewer: *So, you thought the two were very much mixed together?*

Ann (Road Accident Problem): *Yeah. Definitely for this one 'cause you had a lot of separate parts with different information relating to different parts and if you didn't understand the context you could never do the problem. It was impossible.*

She claimed that as she worked through the task she had to «keep relating to different parts as I went along with this one». She realised at the end that her speed was unrealistic for a car, giving a little laugh when her calculated speed turned out to be 1046.4768 km/hr. Her case was classified as showing evidence of a moderately high level of engagement with the context. Ben's case was classified as showing high engagement with the task context, despite his saying that he would have been able to do the problem the same way if it had been in a purely mathematical setting. In the post-task interview, Ben recalled how the figurative context had actually hindered him at first as he kept on thinking of alternative interpretations. As he worked through the problem, he gradually reconciled his understanding of the figurative context with the results of his mathematical activity.

Ben (Road Accident Problem): *Well, I kept looking at the fact that there was a skid and the brakes failed but he still braked and [I didn't think that was] a very smart idea but after awhile ...But when I was plotting the points I still couldn't get them even at this point. I figured it was real data then. There was bound to be some sort of misinterpretation or miscalculation.*

He also volunteered examples of points in his solution process where he checked the reasonableness of both interim and final mathematical results with the task context.

The task scripts were then used to rank the performance on tasks along a continuum from the student being unable to make a start, or totally misinterpreting the problem, to the production of a totally correct solution with no conceptual or mechanistic errors. In the performance criterion, the development and implementation of an appropriate solution strategy was considered of major importance. No particular appropriate strategy was considered to have precedence over another and in most tasks more than one strategy was accepted as being appropriate. Correctness of the final result was also considered with a solution using an appropriate strategy but involving mechanistic, but not conceptual, errors being ranked slightly lower in performance than a similar solution with the correct result. The ranking technique will be illustrated using the Road Accident Problem again. Four students' performances were classified as being at the low end of the spectrum as they were unable to find an appropriate solution strategy to even begin working towards a solution. Both Ann and Elle's performances were regarded as moderately high as both chose an appropriate solution strategy but did not realise their estimate of the length of the radius of the curve made by the skid marks was actually the length of a secant and neither understood the acceleration concept sufficiently to carry out the conversion of units correctly. Ben's performance was ranked highest but not at the top of the scale as his appropriate solution strategy was thwarted by an error in his use of one technique.

These two dimensions were then used as axes for scatterplots (Miles & Huberman, 1994, p. 197) where cases were positioned in the space formed by the respective axes so that similarities and contrasts among cases could be seen. In those cases where the researcher assisted the student, two values have been shown with an arrow indicating the direction of the change from the moment in the solution when the researcher intervened.

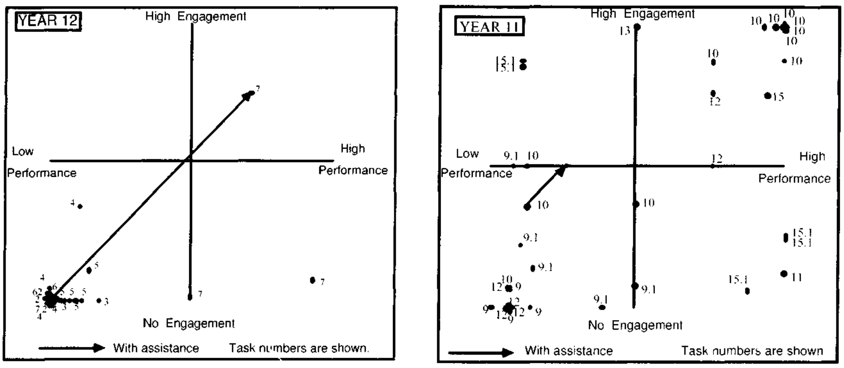

Figure 1. *Scatterplots of Relationship of Degree of Engagement with Context and Performance on All Tasks at School A by Year Level (Codes are Task numbers).*

Figure 1 shows the scatterplots for the Year 12 and Year 11 samples, respectively, at School A. Few students were successful in the Year 12 sample and there was little to no engagement with the task context as this field note written on the second last day of this round of data collection reports:

> School A, Year 12
> *Repeatedly, the interviewees showed almost no engagement with the context. They were not using it to guide the Maths at all. They do not appear to have any notion that they are using Maths to model a situation. When things go wrong there is a tendency to look at the numbers rather than look at the context for help.*

Even when students were having difficulty with the mathematics they did not return to the situational context but looked for «a gateway or a door open so I could actually look at something else» by looking at the mathematics.

> Bea (Petri Dish Problem): *In that long pause I was going, 'Now what do my numbers tell me.'*

Task 7 (see Figure 1) provides the only case where a student engaged with the task context to a high degree but this was with the assistance of the interviewer. It is interesting to note, however, that two other students who displayed moderate to high performance on the task showed little evidence of any engagement with the task context. This confirms suggestions in the literature reviewed that with some tasks some students can solve them without engaging with the task context to a significant degree whilst for other students their engagement with the context facilitates their access to the task. The Year 12 clustering of cases was in stark contrast to the Year 11 pattern where approximately half the cases show at least partial success and some to high engagement with the task context. The clustering of cases by task foreshadowed the possibility that there could be task specific effects so all cases for the four Year 11 tasks where several students had attempted the task were plotted on separate scatterplots (Figure 2). All four tasks were complex with a similar high degree of contextualisation.

From Figure 2 it would appear that to be successful on the Road Construction Problem (see Appendix) a high degree of engagement with task context is necessary. Two appropriate strategies were chosen with neither strategy appearing to effect performance more than the other. However, as Clarke and Helme (1993) suggested the contextual demand of the task did retard progress for some students who had attempted to engage with the context to solve the task.

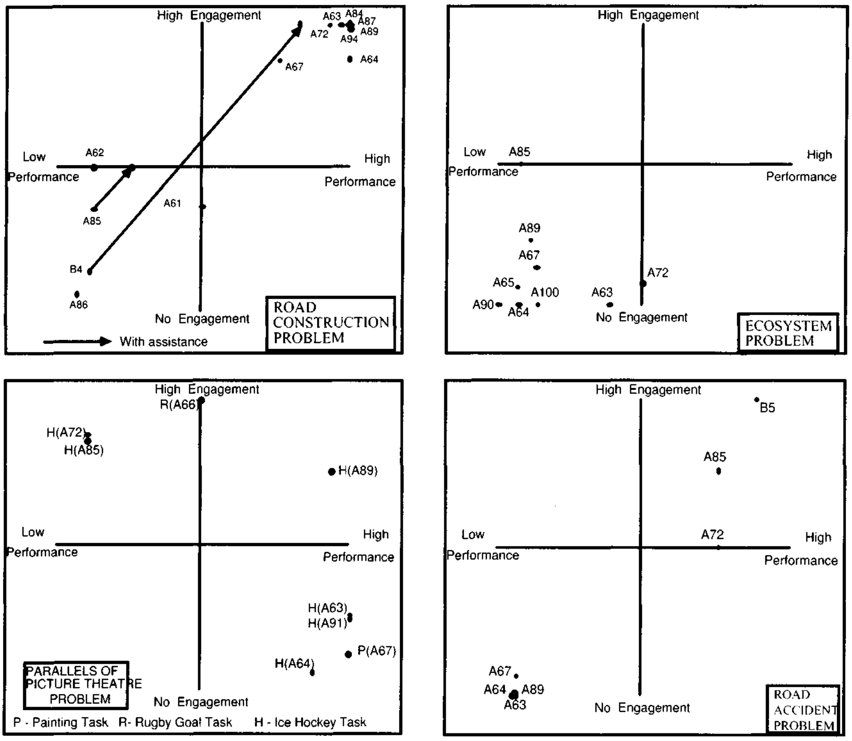

Figure 2: *Scatterplot of Relationship of Degree of Engagement with Context and Performance of Year 11 Students on Specific Tasks (Codes are Student identification codes)*

The students in the study had, at best, only moderate success with the Ecosystem Problem.[4] A high degree of engagement with the context (which did not happen) may have been necessary to be successful but this would require further testing. Two different strategies were used by the students - a matrix approach (which would have been available only to those students in the study who also studied Mathematics C) and a numeric approach using percentages on a calculator. Not all students who studied Mathematics C chose to use a matrix approach, however, the two students who showed more than just a little progress did do so.

It turned out that one of the tasks (the Painting Problem[5]) was similar to a task the students had seen previously in class (the Picture Theatre Problem, Brodie and Swift, 1993, p. 252). It was decided to use the task to develop other tasks that were parallel in mathematical content but embedded in different contexts to investigate the effect of context

4. Adapted from The Netherlands HAVO (Higher general secondary education) Mathematics A Final Examination Experimental Exam May 1991 Problem 3.
5. Adapted from Victorian Certificate of Education 1994 Specialist Mathematics CAT 1 Problem 1 Question 1

in these circumstances. The results for the parallels appear to be contradictory. A confounding factor with this problem was the fact that some of the students used their knowledge of the solution to the parallel problem rather than attempted to develop their solution from the context. These students were quite successful but only one of them reported relying significantly on the context. Students did acknowledge that, if they had not seen the parallel problem, they would have had to engage with the context a lot more in order to construct a suitable representation for the problem. The other two cases appear to be outliers in the upper left-hand quadrant. The students made little progress as they both made a similar misinterpretation of the Ice Hockey Problem (see Appendix), believing that the skater was restricted to skating towards the goal only within the two metre width of the goal mouth. Both played field hockey and reported engaging with the task context to a moderately high degree using visualisation techniques which drew on their prior experience.

> Elle: *Well, I was pretending I was a hockey player.*
> Interviewer: *Hmmm.*
> Elle: *And, umm, you know the angle you had to view the goal.*
> Ann: *In my mind I thought of an ice hockey field. The back line...the middle line and the goal box was there...2 metres.*

Such a finding supports Clarke and Helme's (1993) contention that language difficulties can effect performance even when the student finds the context engaging.

Success with the Road Accident Problem[3] appears to be related to the level of engagement with task context as the more successful students chose the same solution strategy and displayed a much higher level of engagement with the task than the other students but the sample of cases is small so this would need further confirmation. However, as has already been noted, difficulties with subordinate skills tempered the level of performance of the more successful students.

A cross-site scatterplot for all applications tasks (Figure 3) revealed that moderate to high engagement with a task is not often associated with poor performance. Poor performance on tasks is more likely associated with no to low engagement with the task context. On the other hand, high engagement with the task context is not a necessary condition for success as it may be dependent on the nature of the task as shown in Figure 2. There are also a couple more outliers in the lower right-hand quadrant in addition to those

3. Adapted from Smith and Hurst, 1990, pp. 67-80.

from the cases involving parallel tasks and Year 12 students from School A. These are from one student, Tui, who was achieving at the highest level in her classroom mathematics. She solved all three tasks she attempted very rapidly except for one where she found it necessary to engage with the task context at a few points during her solution to monitor her progress. In the other tasks she was dismissive of the context.

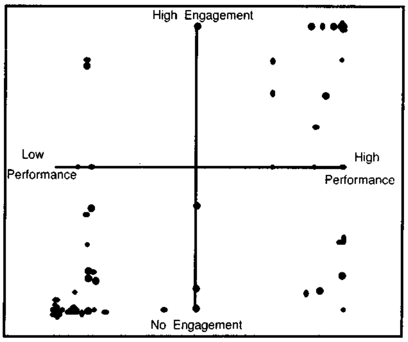

Figure 3: *Scatterplot of Relationship of Degree of Engagement with Context and Performance on All Tasks Across Sites*

Tui (Fertiliser Problem): *I didn't think about that.*
Interviewer: *So, it really wasn't very useful?*
Tui: *No, I just thought of the Maths.*
Interviewer: *You didn't try to use the context to work out what maths you needed initially?*
Tui: *Not really, I just looked at it. I could tell.*

Tui appeared to subscribe to the belief, identified by Hung (1997) and Lave (1988), that in classroom tasks the mathematics is to be disembeded from the figurative context as quickly as possible and ignored from then on. However, even though it was not necessary for Tui to engage with the task context to a significant degree to be successful on all tasks, when the situation was more of a problem for her, she was prepared to engage with the task context in order to make a start and monitor her progress.

Tui (Jungle Problem[6]): *Initially, initially, initially, that's all.*
Interviewer: *Did you use the context to keep on track with your maths...as you worked through it?*
Tui: *Yeah, like when she has to increase and decrease with it because you know you have to know the question says that when it is decreasing that will be the best time for her to get it.*

6. Adapted from Victorian Certificate of Education 1994 Mathematical Methods CAT 3 Question 4.

It is apparent then, that the data has not shown an unequivocal link between performance and engagement with task context. Engagement with task context alone is not of sufficient explainatory power to account for the patterns of student performance found in the data. Other factors need to be explored in order to do so.

5.2. Conditions Facilitating Engagement with Task Context

Students reported two conditions that they believed helped them to engage with the context of a task. They were (a) having *an objective to work towards* and (b) a *sense of realism* in the task. Tasks such as the Road Accident Problem, where students were required to check if a driver was telling the truth about the speed of a car involved in an accident, gave students a benchmark against which they could test their results. Knowing that the speed involved was that of a car and the driver claimed to be travelling at the speed limit of 45k/h, allowed students to check the reasonableness of interim results obtained:

> Ben (Road Accident Problem): *I suppose it gave you an objective rather than... 'cause if you look at this it's not...sometimes you get answers which are like 400000 km/hr.*
> Interviewer: *Yes.*
> Ben: *And unless there is [an objective], 400000 - that could be right because it is pretty doubtful that he would be going that fast if it's a car.*

A sense of realism in the tasks appeared to make engagement with the context easier as then students were able to relate to the situation. Ben had a good understanding of Physics and so a context which relied on an understanding of the physics of a car rounding a bend in the road was something that he knew was real and he also was confident of his own understanding of the situation. This allowed him to use his understanding of the context to make sure his solution was on track as it unfolded.

> Ben (Road Accident Problem): *So, bit by bit you sort of relate it to the answer that is given and if it is in a real time, real place sort of thing, it is easier.*

Similarly, Ann's affinity with the context of the Ecosystem Problem, developed from her study of Geography, assured her the task context was realistic and made it easier for her to understand as it was something she felt she knew about. It was not a context beyond the realms of her experience.

> Ann (Ecosystem Problem): *Yeah, that was very easy for me to understand and it was a...umm...like a realistic problem for me... I could relate to it.*

5.3. Teacher Beliefs about Engagement with Task Context

Teachers were not asked direct questions in the interview dealing with students' engagement with context, however, in answering other questions their beliefs were revealed. A belief was expressed that success and engagement in the context were dependent on student's preferred degree of contextualisation.

> Teacher 2 (School B): *I think it varies from kid to kid, because some kids need it to be in a context and if there is none they have just got no chance. ...I have got some kids if it's not grounded in context, they have no chance. When we were doing those trig. identities, okay, show that this equals that, 'Phew, no chance' [passes his hand over his head to indicate that the idea has passed them by], because it just wasn't grounded in the real world and they didn't see what the point was. But other ones that were, in my opinion, hard, no drama getting it out because it was real for certain kids, yeah. For certain kids I think it is. Other kids couldn't care less and other kids I've found seem to like it better when it is not integrated at all, when it is purely mathematical.*

If the mathematics was not integrated with the context, then teachers believed that students did not engage with the context at all and developed the habit of ignoring the context when doing applications tasks.

> Teacher 4 (School B): *...if they're not integrated the kids will just disassociate the context from it anyway.*
> Interviewer: *What about those ones where you just sort of put the context around like a border, is it totally redundant? It really has no effect?*
> Teacher 3 (School B): *Awh, always, yeah, the context is just window dressing.*
> Interviewer: *And the students see it as that?*
> Teacher 3 (School B): *Yeah, they ignore the words then.*

If the two were integrated, a belief was expressed that students would engage with the task context.

> Teacher 3 (School B): *If you have got a really supportive environment within the context in a contextual question then they appreciate it a lot more and they get into it. If it is not a supporting role, if it's just there to look good or to look appropriate then the kids ignore it and then they develop that habit ...*

As mentioned above, students identified a sense of realism as being important for their engaging with these tasks. Despite this, two of the teachers interviewed did not believe the unrealism of some supposed life related tasks that had been set in examinations at the schools had any effect on students other than those students achieving at the highest level.

> Teacher 4 (School B): *I don't think it bothers them at all and I don't think it tells them any message. Your main thinkers, like your top, your VHA [Very High Achievement] level kids might because they are thinking all the time of other situations. They might be able to take something from it but I'd say just your general maths student would go, 'That's a Maths problem', 'That's a quadratic', 'That's an exponential' or whatever and just do it.*
> Interviewer: *You don't think the others might think, 'Well, this is pretty stupid. We are only doing Maths, really putting it in a context, for the sake of doing it?'*
> Teacher 4 (School B): *Oh, yes, some kids for sure will just go, 'Why are we doing this? Why don't we just do...like why don't we just do the content work? Why do we have to know?' And they're also the type of students that I've found that are just quite happy to get Satisfactory or Sounds*[7].
> Teacher 4 (School A): *I have found that with these kinds of questions generally kids don't understand the whole situation. They don't know what they are being asked or how the function fits in or what they have to do with it. I don't know if it's the language or whatever but they have some problem with it. I don't think that the aspect you are talking of is significant really. It would only affect the very few who are understanding the situation. If they really understand it, that would occur to them, that there was something wrong, but I don't think many of them do.*

This belief was not unexpected as the literature is replete with examples of «school problems coated with a thin veneer of 'real world' associations» (Maier, cited in Boaler, 1993b) and, as Boaler adds, accounts of how students become very skilful at engaging with these tasks and not questioning their distance from reality. However, the other teachers did see the setting of tasks where the context transcended reality as being problematic.

> Teacher 3 (School A): *Well, it is not good for the students, because it is almost telling them that maths... It's conveying to them that maths isn't really connected to what's going on. We are sort of contriving things to fit in and I understand that has to happen to a certain extent because the students don't have a full enough base in mathematics for them to get into some very serious questions but we have to try to avoid that. We just have to because, well, they start putting their hands up and see this as a joke.*

7. To receive a Satisfactory or Sound Achievement rating in Mathematics B, students need success on only 20% of simple applications tasks.

6. Discussion and implications

An attempt was made in this paper to explore the connection between students' performance on application tasks and their engagement with the figurative context of the task. It must be acknowledged that this has not been sufficiently explored to claim that the data clearly shows there is such a link. At best, it can be stated that the data gives qualified support for a link but that further factors must be considered in order to explain all the results obtained.

Even though a clear link has not been established between engagement with the figurative context of an applications task and performance, the fact remains that many students in the study were unable to engage with the context of an applications task to any significant degree and only a few of these students were successful, especially if those who had the advantage of having seen mathematically parallel tasks are ignored. This would not be of concern if the tasks students are expected to solve in assessment items do not require such engagement for success. However, if students are to develop the meta-knowledge associated with the successful modelling of situations in their environment (QBSSSS, 1992), they will not be able to do this by being deliberately shielded from tasks which require a significant engagement with the task context for the development of a successful solution. They need experience in «abstracting *within*, not *away from* ,» (Noss and Hoyles, 1996b, p. 125) a situational context so engagement with the task context continues throughout the solution. This will require that tasks be set where this is possible and that teachers' model this process.

In light of Noss and Hoyles' claim that «there is a mutually constructive relationship between what teachers believe and what they do» (1996b, p. 201), it is instructive to compare the foci of the first two teacher beliefs identified above. The first, that whether success on an applications task is accompanied by a significant degree of engagement with the task context is dependent on student's preferred degree of contextualisation, places the focus on students. The second belief, that if the mathematics is not integrated with the context, then students will not engage with the context at all and will develop the habit of ignoring the context when doing applications tasks, places the focus on the task and indirectly the task setter - the teacher. The onus for change can be viewed as resting with the students in the first of these beliefs as they are the ones who have developed particular preferences. This sense of it being beyond the teacher's control or influence ignores the fact that «one's beliefs or interpretative norms are influenced strongly by the social and cultural practices through which one is encultured» (Hung, 1997, p. 320) which are, in this instance, the practices of the mathematics classroom. On the other hand, the second belief places the responsibility for change on the teacher. This sense of teacher responsibility as the instigator of action is also conveyed in the remaining two beliefs. With the last of these, since students have identified a sense of realism in tasks as a feature that facilitates their engagement with the task context, it is incumbent on teachers to heed this and refrain from the dubious practice of setting tasks that transcend reality as so called applications. Again, classroom practice can be viewed as leading to students' developing an automatic disposition for operating at a procedural level as indicated in the remarks of teacher 4 from school B. There is no necessity to accept that this disposition is the inevitable consequence of the ability range within a classroom. Students need to develop a predilection to analyse, understand, interpret and engage with the context of applications tasks. This can be fostered in the classroom by students tackling tasks that require, or at least have the potential to require, this and experiencing an environment that values such practices.

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Appendix

Example Tasks

Tide Problem: Greenough-on-Sea has an ideal deep water harbour for transportation of goods by sea. The depth of water at any point in the harbour varies with the rise and fall of the tide. The major limitation of this harbour is that during certain parts of the year the depth of water at the entrance to the harbour is shallower at low tide than necessary for some ships to enter the harbour. Water depth is no problem at the wharf all year round.

On a particular day the depth of water at the entrance at high tide is 8 metres and the time between successive high tides is 12 hours 30 minutes. A low tide at the harbour entrance occurs at 12 noon and the depth of water is only 4 metres.

A ship drawing 5 metres below the water-line arrived just outside the entrance at 11 am. The ship entered the harbour as soon as it could. If it took four and a half hours to enter, unload, load and sail back to the harbour entrance, what was the depth of the water at the harbour entrance when it left?

Road Construction Problem: A new traffic lane (of minimum width 6 metres) is to be added to a section of highway which passes through a cutting. To construct the new lane, engineers need to excavate an existing earth-bank at the side of the roadway which is inclined at 25° to the horizontal. This will make the inclination steeper. Local council regulations will not allow slopes greater than 40° due to the potential for erosion. Determine if the new traffic lane can be excavated without expensive resumption of the properties at the top of the bank which is 7 metres above the road surface. [List any simplifying assumptions you have had to make.]

Ice Hockey Problem: Ice hockey is a team game played on an ice rink, in which the purpose is to score a goal by pushing the puck (a rubber disc) into the opposition goal. The goals are actually six feet (1.83 metres) in width but to simplify matters we will assume they are 2 metres wide.

A player is skating towards the end of the rink in a straight line which is perpendicular to the line of the goal mouth. This line is 5 metres from the nearer goal post at its closest point. If the player continues to skate in this direction, where is the player (to nearest 10 centimetres) when their horizontal angle of vision occupied by the goal mouth is a maximum? Justify your answer.

Abstract (in Norwegian)

Denne artikkelen rapporterer fra et større studium som undersøker hvordan konteksten påvirker elevenes angrepsmåter og prestasjoner på oppgaver som handler om anvendelser i matematikk. Artikkelen fokuserer på innvirkningen av engasjement på prestasjonene og lærernes tanker om dette.

Forfatteren påpeker at moderat eller høgt engasjement sjelden var knyttet til svake prestasjoner, mens en fann denne slike forbindelser ved lavt engasjement. Høgt engasjement var heller ikke en nødvendig forutsetning suksess. Et funn var at engasjement knyttet til oppgavekonteksten alene ikke var tilstrekkelig til å kunne gjøre rede for alle variasjoner i datamengden og at andre faktorer måtte studeres for å forklare disse.

Studiet viser at det var grunnlag for å klassifisere følgende oppfatninger blant de lærere som ble intervjuvet:
· Elevene prioritet av kontekstualisering av aktivitetene bestemmes av om suksess er knyttet sammen med engasjement i konteksten til aktivitetene
· Elevene vil ikke engasjere seg i konteksten hvis matematikken ikke er integrert i denne og vil derav tendere mot å ignorere konteksten
· Hvis kontekst og matematikk er integrert så vil elevene engasjere seg i konteksten
· Hvis rammene rundt aktivitetene går videre enn det som er elevenes realitet blir disse aktivitetene problematiske i undervisningen

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