CHALLENGING ABLEIST PERSPECTIVES ON THE TEACHING OF MATHEMATICS THROUGH SITUATION-SPECIFIC TASKS

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CAPTeaM (Challenging Ableist Perspectives on the Teaching of Mathematics) investigates how ableist perspectives – according to which to be able-bodied is the norm and disability is a disadvantage that must be overcome – impact upon the teaching of mathematics. CAPTeaM is a partnership between researchers in the UK and Brazil which brings together approaches to investigating and transforming teacher beliefs and research into the mathematical learning of disabled students. We develop and trial situation-specific tasks that invite teacher reflection on incidents of disabled students' mathematical contributions. In this paper we present two types of tasks and illustrate analyses of data collected from 81 teachers that explore their views on including these contributions in their mathematics classrooms.

INTRODUCTION: ABLEISM AND THE TEACHING OF MATHEMATICS

As signatories of the United Nations Convention on the Rights of People with Disabilities (2006), both Brazil and the UK are committed to upholding the right of disabled people to education and to ensuring an inclusive education system at all levels. In order that this right be realised, signatory countries also undertake to implement appropriate measures to

> "train professionals and staff who work at all levels of education. Such training shall incorporate disability awareness and the use of appropriate augmentative and alternative modes, means and formats of communication, educational techniques and materials to support persons with disabilities." (Article 24, paragraph 4).

Within the mathematics education community, while social justice has been a concern for many researchers interested in building more equitable mathematics classrooms and in analysing and criticising the processes which sustain disadvantage, until recently, attention to disabled learners has been rare and, in particular, is almost non-existent in the literature related to mathematics teacher education. As Gervasoni and Lindenskov (2011) have argued, the discourses about disabled students that do exist have tended to underestimate their potential for learning mathematics. There are signs that this is beginning to change, with a small but growing body of research that points to how ableist[1] assumptions about what constitutes the normal body contribute

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[1] Campbell (2001) defines *ableism* as "a network of beliefs, processes and practices that produces a particular kind of self and body (the corporeal standard) that is projected as the perfect, species-typical and therefore essential and fully human. Disability then, is cast as a diminished state of being human." (p.44)

to the creation of learning environments which disable those whose cognitive, emotional, physical and or sensory configurations differ from what is currently defined as socially desirable (see, for example, Healy & Powell 2013). One message from this research is that, rather than being the consequence of internal, individual factors, students' underperformance in mathematics can result from "their explicit or implicit exclusion from the type of mathematics learning and teaching environment required to maximise their potential and enable them to thrive mathematically" (Gervasoni and Lindenstov 2011, p. 308).

To fulfil our commitments to disabled mathematics learners, then, we need to dismantle belief systems which "regard some students as being 'in need of fixing' or worse, as 'deficient and therefore beyond fixing'' (EADSNE 2010, p. 30). It was with this in mind that the project, CAPTeaM (**C**hallenging **A**bleist **P**erspectives on the **Tea**ching of **M**athematics), was conceived.

The project aims to work with pre- and in-service teachers towards challenging the ableist assumptions that currently mediate our interpretations of mathematics learning and our practices as educators of mathematics. This involves the development and trialling of tasks that encourage teachers to reflect upon the challenges of teaching mathematics to disabled students. In this paper, we introduce the two types of Tasks (Type I and Type II) that our project deploys. By focusing on the responses of one participant and her colleagues to a task of each type, we illustrate how the design principles were played out in practice and the extent to which the tasks contributed to reflections about including students whose interactions with mathematics differ from those of students deemed more typical. We close by reflecting on findings that indicate the need to question more explicitly the notion of the typical mathematics classroom, a notion that might be seen as ableist itself.

THE CAPTEAM PROJECT

CAPTeaM is a collaborative project involving researchers and pre- and in-service teachers in Brazil and the UK. A British Academy International Partnership and Mobility Scheme grant has enabled us to combine the different research foci of two research teams in a reciprocal manner. The UK component of CAPTeaM uses practice-based and research-informed Tasks which invite teachers to consider fictional mathematics teaching situations (scenarios) that are hypothetical, grounded on seminal learning and teaching issues and likely to occur in actual practice (Biza, Nardi & Zachariades 2007). This research programme aims at *transforming aspirations into strategies in context*. The Brazilian component of CAPTeaM, *Rumo à Educação Matemática Inclusiva* (*Towards an Inclusive Mathematics Education)* has been investigating forms of accessing and expressing mathematics that respect the diverse needs of all students with and without disabilities. Its aims include: understanding how mathematical learning processes are shaped by bodily, material and semiotic resources; contributing to the development of inclusive teaching strategies; and, exploring the relationships between sensory experience and mathematical knowledge.

TYPE I AND TYPE II TASKS

In this paper we report from the first, one-year phase of CAPTeaM (2014-15) during which Type I and Type II tasks – aimed at providing opportunities for pre- and in-service teachers to reflect upon issues related to the inclusion of disabled mathematics learners in their classes – were designed and trialed . Data was collected in Brazil and the UK from a total of 81 teachers (60 from Brazil and 21 from the UK) who completed four tasks (three of Type I and one of Type II) in a three hour session. In Brazil, the participants included secondary mathematics teachers and primary teachers, while all the teachers who engaged with the tasks in the UK were secondary mathematics teachers. In both countries most of the participants were pre-service teachers although a small number of in-service teachers also completed the tasks. The tasks were designed to emphasise different issues related to inclusion and to challenge what we identify as ableist assumptions in different ways.

The design of the Type I tasks involved the selection by members of the Brazilian team of episodes of mathematical interactions between students and teachers from the database of video evidence collected in the different studies of their research programme. Following Healy and Powell (2013), the design principle behind the selection process was the idea of highlighting the mathematical agency of disabled students: instead of attempting to determine “normal” or “ideal” achievement and positioning those who deviate from supposed norms as problematic and in need of remediation, attention should be directed to how students’ mathematical ideas may develop differently and what pedagogical strategies are appropriate for supporting these developmental trajectories. The aim was hence to locate episodes representative of the successful mathematical practices associated with particular forms of interacting with the world – practices of learners who see with their hands and ears, who speak with their hands, whose visual memory is more efficient than their verbal memory, or, have other interesting ways of interacting with the world. We opted for episodes involving the use of interesting and valid mathematical strategies, but in which the properties and relations were expressed in unconventional or surprising forms.

Using the approach described by Biza, Nardi and Zachariades (2007), each episode was inserted as a video clip into a brief narrative about a fictional mathematics classroom. We then invited the participants to assume the role of the teacher of this class and evaluate the interactions of the disabled students that were presented in the video clips – first individually and in written responses to a set of questions and then in a group discussion (which we took observation notes from and also video-recorded).

We now present an example of a Type I task, *André and the pyramid*, and a sample response to the task. The video clip used in this task shows a short episode from an activity in which a blind student proposes a description of a square-based pyramid. More details on the research context in which this activity was used are in Healy and Fernandes (2011). An example of a Type II task, and also a sample response to it, follows.

Example of Type I task: *André and the pyramid*

Imagine you are teaching a class about three-dimensional geometric figures. As the students work on exploring how they would describe what a square-based pyramid is to someone who doesn't know, you move around the class to observe their strategies. You notice many are counting faces, edges and vertices. André, who is blind, has been working with materials, such as 3D solids. He offers this description. [Video clip follows]

Questions:

a. What is André proposing as a description of a square-based pyramid?

b. What do you do next?

c. What do you think are the issues in this situation?

d. What prior experience do you have in dealing with these issues?

e. What prior experience do you have in supporting the mathematical learning of blind students in your classroom?

f. How confident do you feel about including blind students in your classroom?

The 27sec video shows a blind student, André, describing his view of a square-based pyramid. As he spoke (the transcript is translated from Portuguese), André moved his fingers along the edges that join the vertices at the base of the pyramid to the vertex at its apex (stills from this video are presented in Nardi, Healy & Biza 2015, p. 55):

I would say that the part underneath is square… the base… is square...

And as you go up, they get, the sides of the square get smaller...

Until they form a point here on top (moves his fingers along the edges to the vertex at the apex of the pyramid).

Example of response to the *André and the pyramid* Task: Beth

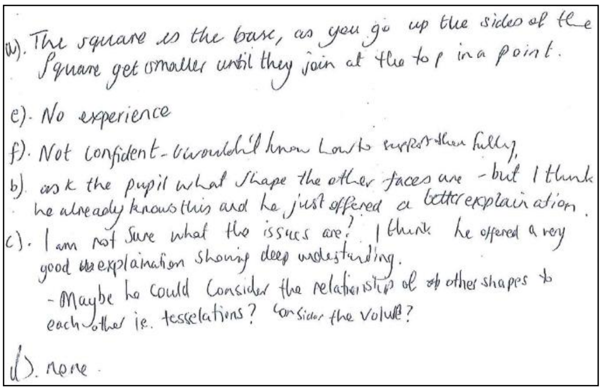
a). The square is the base, as you go up the sides of the square get smaller until they join at the top in a point.
e). No experience
f). Not confident - wouldn't know how to support them fully
b). ask the pupil what shape the other faces are - but I think he already knows this and he just offered a better explaination.
c). I am not sure what the issues are? I think he offered a very good ~~ex~~ explaination showing deep understanding.
- Maybe he could consider the relationship of ~~th~~ other shapes to each other ie. tesselations? Consider the volume?
d). None.

Figure 1: Sample response to the *André* and the pyramid Task (Beth).

Beth recognises André's description: "The square is the base, as you go up the sides of the square get smaller until they join at the top in a point." (a). She intends to "ask the pupil what shape the other faces are" (b) but she thinks that "he already knows this and he just offered a better explanation." (b) She is "not sure what the issues are" and she thinks that André "offered a very good explanation showing deep understanding." (c) She also suggests that "maybe he could consider the relationship of the other shapes to each other i.e. tessellations? Consider the volume?" (c). Beth states that she has no experience in teaching students like André (d, e) and she is not confident about knowing "how to support them fully" (f). We return to a brief analysis of Beth's response in what follows.

Example of Task Type II: *Artificially restricting mathematical interactions*

The Type II tasks were designed with the aim of provoking reflections about how access to mediational means differently shapes mathematical activity. Participants worked in groups of three. One member (A) acted as observer, the second (B) was asked to solve a mathematical problem whilst, temporarily and artificially, deprived of access to the visual field and the third member (C) acted as the teacher, with the role of communicating the problem intervening as judged necessary, but without speaking.

For this activity we will split in groups of three.

One member of the group (A) is the observer.

A second group member (B) will temporarily lose access to the visual field (by shutting their eyes).

The third member (C) can see but cannot speak.

C will be given a piece of paper with the rest of the instructions.

> *Instructions to C:* Your task is to ask (without speaking) B to multiply 347 by 35 and to indicate whether or not the answer suggested by B is correct.[2]

B should not have access to these instructions.

Once the task is complete, A, B and C have a short discussion about how the restrictions influenced their strategies.

We stress that the aim of the task was not that the participants would attempt to role play the part of someone with a disability; rather, that the experience of doing mathematics without access to a resource that they are accustomed to use might heighten awareness of the importance (or not) of this resource as well as involve the participants in seeking new forms of expressing mathematics. Trios of participants engaged with the task for about 15 minutes. Then all convened for plenary discussion of the strategies that had emerged in the small groups. Small group activity as well as plenary discussions were video-recorded. We return to Beth –whose response to the *André and the pyramid* task we sampled earlier – this time as she collaborated with Mike and Ted.

Example response to *Artificially restricting mathematical interactions:* Beth's trio

In Beth's trio, Mike assumed the role of observer (A), she had the responsibility of communicating the problem without speaking (C) and Ted for resolving it (B). Early difficulties in communicating the problem were eased after signs for "yes" (a gentle squeeze of the hand) and "no" (a gesture involving a rubbing out movement on the palm of Ted's hand) were established. Beth then traced out the digits 3, 4 and 7 on Ted´s palm, used a cross to represent the operation and then traced out the 3 and the 5.

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[2] In each trio the problem involved multiplying a three-digit number by a two-digit number, although the numbers given varied across the groups.

Ted wrote out the multiplication correctly in columns even though he could not see what he had written. As he began to execute the long multiplication algorithm, he asked Beth to move his hand to record the results in the standard positions on the paper. They completed and recorded the two operations (347 x 5 and 347 x 30) without difficulties, but by the time it came to adding the two results, Tom had forgotten what numbers he had written. Beth took his hand to remind him of the two results using the method of tracing numbers on his palm. He suggested it would be easier if she simply reminded him of the digits in each column, starting with the units. This would have worked very well, except that it turned out to be very difficult to communicate the digit "0", as Ted first felt 6 and then 9 as it was traced out on his hand. Eventually, this difficulty was overcome, and with Beth once again guiding Ted´s hand to the correct location on the paper, he recorded the answer correctly. At this point, Ted removed his blindfold and the trio discussed the solution strategy. Beth was worried that Ted didn´t "know" what the answer was before removing the blindfold. Did his answer count? She and Mike questioned him about why he had insisted on writing when he couldn´t see what he recorded on paper. He answered "Yeah, yeah, because between us we had everything". Indeed, Beth clearly felt some joint ownership of their production, saying "It´s quite neat, let´s show it to the camera".

They agreed that Ted´s strategy had been strongly molded by his previous experiences, which led to reflections about other methods they might have used with someone without access to the visual field who did not already know the algorithm. Beth was concerned that it would be hard to solve mentally and felt she too would have relied on the same method in Ted´s place. Ted accepted that he could not have resolved the algorithm on his own and other methods of what they called "breaking the task down" were considered. As the discussion was finishing, Beth had another idea of how she might have presented the problem to Ted, using "mirror writing" then turning the paper over to set out the algorithm in a raised form that Ted could have read with his fingers, to which he replied "that would have been great, oh wow."

SAMPLE ANALYSIS OF TASK TYPE I AND TYPE II DATA

Thematic analysis of the data (written protocols of Type I tasks, video-recordings of small group engagement with Type II tasks and plenary discussions of both types of tasks) was carried out according to the five dimensions below and aimed to encourage participants' to reflect on teaching mathematics to people with different disabilities.

1. *Value and Attuning:* to what extent the respondent attunes to and values the disabled learner's contribution(s), and how, if at all, s/he attends to the particularities of their mathematical agency (Type I) or adapts to the restriction imposed on the communication (Type II);
2. *Classroom Integration and Benefit:* how the respondent manages the classroom after the contribution has been made (Type I) or comments on classroom management after engaging with Type II tasks;
3. *Experience and Confidence*: how experienced and confident the respondent claims to

be in teaching students with the disability exemplified in the task (Type I and II);

4. *Institutional Possibilities and Constraints:* what institutional possibilities and constraints the respondent identifies as crucial to the teaching of students in the task (Type I) and reflection about the strategies developed in Type II tasks;
5. *Resignification:* evidence of respondent's reconsideration of their views and intended practices in the light of engaging with the tasks (Type I and II).

Returning to Beth's response to the Type I task, we see evidence of unconditional *valuing* of André's contribution ("he just offered a better explanation"; "very good explanation showing deep understanding") as well as *attuning* her further action to this contribution ("consider the volume?"). At the same time Beth mentions "the other shapes" (triangle faces of the pyramid) in order to *integrate* André's contribution, and bring it in line with, with what had been a prevalent preference in the classroom for seeing a pyramid in terms of its faces, edges and vertices. She does not seem intent though on switching his views to a more conventional description: her suggestion that he has "offered a better description" indicates that the video clip allowed her to focus on the mathematical agency of a student who saw with his fingers rather than with his eyes – André's difference hence was not viewed by Beth as a deficiency. Finally, in common with nearly all of the participants in the study, Beth states her lack of *experience and confidence* in teaching students like André.

In relation to the Type II task, Beth began by highlighting her preconception of how hard it would be to attune her interventions given the restrictions imposed on the interactions between her and Ted. As it turned out, once the initial system of signs had been established, with the exception of the problem with zero, she was able to create a variety of ways of communicating that made sense to Ted. The importance of establishing shared signs was mentioned frequently in post-Type II task discussions. To a certain extent, we might see this practice as the ultimate in *attuning*. Indeed we have argued elsewhere (Healy 2015) that both learners and teachers in inclusive settings attempt to make use of words and gestures in ways they believe will re-invoke the multimodal content they associate with mathematical concepts in ways that can be felt by others. The Type II task was not intended to involve Beth in simulating teaching mathematics to a blind student or working with someone who does not share the same spoken language; rather, it was to encourage reflections about different ways to permit others to feel mathematically. In this sense, the task achieved its aim. Issues related to *resignification* and to *institutional possibilities and constraints* also emerged. For example, Ted's comment that between he and Beth they had "everything", indicated that solving a mathematical problem under the conditions imposed became a joint activity, not an individual one, with Ted using Beth's sight to substitute the absence of his own. This is a powerful idea and one that, at least implicitly, challenges the notion that mathematical achievement necessarily be judged on what the student achieves individually. As the discussion progressed, however, this institutionally imposed norm was returned to place, with all three students remarking on how Ted could not have implemented his strategy alone.

INCLUSIVE MATHEMATICS CLASSROOMS ARE NOT YET TYPICAL

Our evidence suggests that the participants in our study were encouraged to think about how the mathematical agency of disabled students might be supported or restricted by aspects of the learning environments in which they experience mathematics and to recognise that they are not *a priori* mathematically-deficient. Perhaps our tasks were even successful in motivating the pre- and in-service teachers to rethink the notion of the normal student. We believe that this is an important step towards preparing teachers to work with learners with disabilities and influencing how they choose to organise the learning activities they offer to all their students. On the other hand, our choice to embed the Type I tasks in classroom settings that the teachers are likely to experience (or have experienced), may have contributed to the edifying of a different norm, the normal classroom. Building an inclusive school mathematics requires the deconstruction of this notion too. This is no easy feat, but perhaps a small step in this direction would be to work towards a third type of task which involves us all in imagining what a truly inclusive mathematics classroom might look like.

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