The CAPTeaM Project (Challenging Ableist Perspectives on the Teaching of Mathematics): A preliminary report

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According to the ableist world-view, the able-bodied are the norm in society and disability is an unfortunate failing, a disadvantage that must be overcome. Within education, ableism results in institutional and personal prejudice against learners with disabilities, and has a drastic effect on approaches to teaching. Our project investigates how ableist perspectives impact on the teaching of mathematics, a quintessential part of the curriculum, and a discipline where public perceptions of ability as innate often shape pedagogical perspectives and practice. Our focus is on mathematical faculties typically associated with visual and auditory perception. In this one-year project we are establishing a partnership which combines Nardi & Biza's Task design approaches to investigating and transforming teachers' beliefs about mathematics and about teaching in the UK and Healy's research with mathematics learners with disabilities. We are developing and trialling tasks that invite teachers to reflect upon the challenges of mathematics teaching in inclusive classrooms. In this paper we focus on one task; and, discuss emerging analyses of the data we have just completed collecting.

Keywords: mathematics teaching; ableism; inclusive mathematics

Inclusion and mathematics education

As signatories of the United Nations Convention on the Rights of People with Disabilities (2006), both Brazil and the UK are committed to ensuring an inclusive education system. At the school level, this implies the reorganization of the structures, policies and practices of mainstream schools in order that they might respond to diversity in ways that value all learners equally. Within the mathematics education community, social justice has been a concern for many researchers interested in understanding and challenging the social processes which sustain disadvantage and in building more equitable mathematics classrooms. Until recently, however, disabled learners have been almost invisible within these debates and discourses about students with disabilities, as Gervasoni and Lindenskov (2011) point out, have been infused with narratives underestimating their mathematics learning potential. Borgioli (2008) too cautions against viewing learners' relationships with mathematics as defined by

> *their* internal *dis*ability rather than to factors related to the learning context and environment, such as a mismatch between the learner and the task, conceptually fragile curriculum and/or instruction, inadequate social and emotional support structures, etc. (p.139).

Such views are consistent with what Campbell (2001) terms *ableism*:

> … 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)

Indeed, Hehir (2005) has claimed that "progress toward equity is dependent, first and foremost, on the acknowledgement that ableism exists in schools." (p. 17). With this in mind, our project (CAPTeaM: Challenging Ableist Perspectives on the Teaching of Mathematics) aims, not only to acknowledge, but also to work with practising and future teachers towards challenging the ableist assumptions that currently mediate our interpretations of mathematics learning and our practices as educators of mathematics.

In what follows we outline the two components (UK and Brazilian) of the CAPTeaM project; and, introduce the project design and the two types of Tasks (Type I and Type II) that our design deploys. We then describe one example of a Type I Task and present a sample written response to the Task. An outline of our data analysis approach (categories) follows. We then comment on the sample script in the light of these categories. In closing, we discuss the further steps of our analysis currently in progress, and an outline of our plans for the project beyond its first year.

The UK and the Brazilian components of the CAPTeaM project

The UK component of CAPTeaM (led by Nardi). Nardi and her colleagues (Biza, Nardi & Zachariades 2007, 2009, 2013; Biza, Joel & Nardi 2015; Nardi, Biza & Zachariades 2012) use practice-based and research-informed Tasks in which they invite teachers to consider fictional mathematics teaching situations (scenarios) which are hypothetical, grounded on seminal learning and teaching issues and likely to occur in actual practice. Their research programme aims at *transforming aspirations into strategies in context* and has four strands: Strand 1 (since 2005) focusses on *mathematical knowledge for teaching in the secondary mathematics classroom*; Strand 2 (since 2013) focusses on how *classroom management* may interfere with mathematics learning; Strand 3 focusses on t*eaching mathematics in an inclusive classroom*; and, Strand 4 (since 2014) explores *the meta-use of tasks and task development* (e.g. asking teachers to create their own scenarios and tracking the impact this engagement has on their knowledge, beliefs and intended practice). CAPTeaM, and this paper, is part of Strand 3.

The Brazil component of CAPTeaM (led by Healy). The Brazilian members of the team have been working on the research programme "Towards an Inclusive Mathematics Education" (Rumo à Educação Matemática Inclusiva: www.matematicainclusiva.net.br) since 2002 (Healy, Jahn, & Frant, 2010; Healy & Fernandes, 2011; Healy & Santos, 2014). The programme aims to investigate forms of accessing and expressing mathematics that respect the diverse needs of all students with and without disabilities; to contribute to the development of teaching strategies that recognise this diversity; and, to explore the relationships between sensory experience and mathematical knowledge. The programme consists of a number of connected projects in which inclusive scenarios for mathematics learning have been designed and analysed, through a collaborative process resulting from a series of iterative interactions between researchers, teachers and students. The design of the learning scenarios involves the simultaneous development of material and/or digital tools, tasks and teaching interventions, aimed at enabling multiple ways of interacting with mathematical objects and relations.

The CAPTeaM research design enacts the reciprocity principle of the British Academy International Partnership and Mobility Scheme (http://www.britac.ac.uk/funding/guide/intl/International_Partnership_and_Mobility.cfm) and has been organised around five phases:

Phase 1: Preparatory work towards Brazil to UK Visit
Phase 2: Brazil to UK Visit; task design, pilot
Phase 3: Preparatory work towards UK to Brazil Visit; data collection
Phase 4: UK to Brazil Visit; data analysis planning
Phase 5: Data analysis and dissemination

These five phases have hence involved the design of 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. In Phases 1 and 2, two types of tasks (Type I and Type II) were designed and trialed. Data was collected in Brazil and the UK during Phase 3 from a total of 81 pre- and in-service teachers (60 from Brazil and 21 from the UK) who completed four tasks in a three hour session (3 Type I; 1 Type II). We now describe the format of these tasks.

The CAPTeaM Tasks: design, sample Task and preliminary analyses

The first step in the design of the Type I tasks involved members from the Brazilian team in selecting episodes of mathematical interactions between students and teachers from the database of video evidence collected in the different studies of the research programme *Towards an Inclusive Mathematics Education*. The aim was to locate episodes representative of the 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, to paraphrase Smith, Gallagher, Owen and Skrtc (2009), have other "interesting ways of being alive" (p. 253). 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 also video-recorded).

In the tasks of Type II, which aimed to provoke reflections about how access to mediational means differently shapes mathematical activity, participants worked in groups of three. Two members of the group were asked to solve a mathematical problem whilst, temporarily and artificially, deprived of one of their sensory or communication canals. A group discussion of their experiences followed.

To exemplify the still ongoing process of analysis, in the rest of the paper we focus on an example of a Type I Task, *André and the pyramid*:

> ***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 27 sec video clip shows a blind student, André, describing his view of a square-based pyramid. To give a flavour of this clip, we present a transcript of André's description and present two images to illustrate how, as he spoke, André moved his fingers along the edge that joined the vertices at the base of the pyramid to the vertex at its apex. The transcript is translated from Portuguese.

> I would say that the part underneath is square… the base… is square... *(with fingers positioned on the vertices of the base as shown in Figure 1a)*
>
> 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, Figure 1b).*

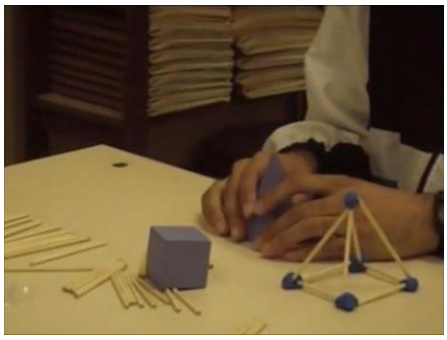

Figure 1a: Feeling the vertices of the base.

Figure 1b: Indicating the vertex at the apex.

Figure 2 presents a sample response to the task (UK participant):

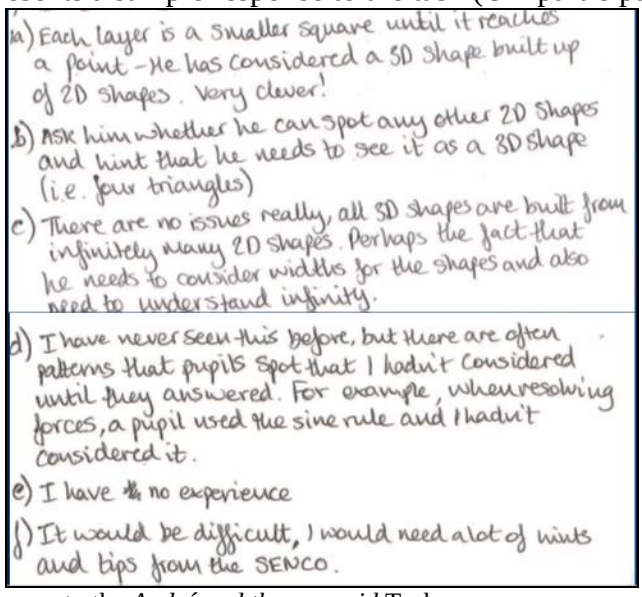

Figure 2: Sample response to the *André and the pyramid* Task.

Our analysis aims to characterise participants' perspectives about teaching mathematics to people with different disabilities, and to explore if and how engaging with the task results in any resignification in relation to these perspectives. The five dimensions of our analysis are:

1. to what extent the respondent attunes to and values André's contribution, and how, if at all, s/he attends to the learning needs in question;
2. how the respondent manages the classroom after André's contribution;

3. how experienced and confident the respondent claims to be in teaching students with André's needs;
4. what institutional possibilities and constraints the respondent identifies as crucial to the teaching of students with André's needs;
5. evidence of re-signification.

In accordance with these, we see the sample script (Figure 2) as offering evidence of attuning to André's contribution (the respondent shapes the response around the idea of 3D shapes being "built up of 2D shapes"). We see expressions such as "very clever" and "no issues really" as evidence of unconditional valuing of André's contribution. Furthermore we see evidence of some attending to the learning needs in question but also an almost exclusive focus on the mathematics. The respondent seems keen on switching André from a consideration of smaller and smaller squares to "four triangles". While we do not discern much in the response in relation to the specific management of the classroom in the wake of André's contribution, the statement in (d) is a robust statement from the respondent – accompanied with a specific example – on how student contributions shape her/his action in class. We note that there is no mention of André's blindness and an explicit statement in lack of experience and confidence. However we note that the respondent seems aware of external authority ("SENCO", Special Educational Needs Co-ordinator) where assistance can be expected from (see (f)).

We are now carrying out the analysis of the 81 scripts – and group discussion video-recordings – across the three Type I tasks as well as the video-recordings of participant engagement with one Type II task. Preliminary observations emerging from these analyses include: the respondents' preference for switching André's perspective on a square-based pyramid towards the textbook definition of a pyramid (via the number and positioning of faces, edges and vertices); their preference for a discussion of a square-based pyramid as a composition of fixed shapes (four triangles and a square); their considerable and explicit valuing of André's contribution but the limited attuning of their classroom action to this contribution; their strong concern about lack of preparation and support for teaching students with André's needs; and, finally, their potentially overestimated expectations from what authoritative sources (such as prior research) have to say about teaching students with André's needs.

Next steps / Beyond the first year of CAPTeaM

Dissemination of findings is taking place in teacher workshops in both countries (UK: June 23; Brazil: April 8, May 5-8, August 12) and elsewhere (e.g. Greece: July 6) and in national conferences (UK: BSRLM, June 6; Brazil: SIPEM VI, Seminario Internacional de Pesquisa em Educação Matemática, November 15-19). This first year of the CAPTeaM project comes to an end in August 2015 and an application for a larger, longitudinal study will be submitted to the British Academy in early 2016.

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