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Inclusion and disability in the primary mathematics classroom: Examples of teaching staff discourses on the participation of visually impaired pupils

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Research on inclusion and disability is underdeveloped in mathematics education. This two-phase doctoral study investigates inclusion and disability in the discourses of teaching staff and pupils in British mainstream primary mathematics classrooms with visually impaired (VI) pupils, first in an exploratory phase and then in an experimental phase. The study endorses the following tenets: that inclusion can be achieved when pupils' academic and social needs are considered and met in lessons; and, that disability is socially constructed. Teaching staff and pupils of four classrooms are taking part in this ongoing study. Data is collected through classroom observations and interviews with teaching staff and pupils. One of the preliminary findings of the first phase concerns teachers' and teaching assistants' frequently different practices of inclusion/exclusion and of enabling/disabling of VI pupils. In this paper, we report a Year 3 (Y3) classroom episode which illustrates said differences.

Keywords: inclusion; disability; discourse; VI pupils

Introduction

"Inclusion" and "disability" are conceptualised in several and different ways in educational research (Nardi, Healy, Biza, & Fernandes, 2018). One proliferating difference in meanings attributed to "inclusion" is between the proponents of the special education model and those of disability studies in education (Slee, 2011). The former consider inclusion as a reconstruction of special education, situated in mainstream settings, while the latter consider inclusion as an educational model of social justice, eliminating any forms of discrimination produced by the special education model. "Disability" as well is endorsed differently in the two prevalent models of disability discourse: the medical model and the social model (LoBianco & Sheppard-Jones, 2007). The medical model considers disability as a medical condition attributed to the individual's impairment, while the social model considers disability as socially constructed.

The study we report from in this paper is an ongoing two-phase doctoral study funded by the University of East Anglia. Phase 1 is exploratory and investigates how disability and inclusion are constructed in the discourses of teaching staff and pupils in mainstream primary mathematics classrooms with VI pupils in England. Phase 2 is experimental, considers issues on inclusion and disability identified in Phase 1 and involves collaboratively designed mathematics lessons that aim to be fully inclusive and minimise disability in the mathematics classroom. We use the terms "inclusion"/ "exclusion" to denote when the VI pupils are invited, or not, to participate in a lesson

activity on an equal basis with the rest of their peers, albeit not necessarily with the same tools (sensory, material, semiotic) (Vygotskii, 1978). We use the terms "enabling"/ "disabling" when the teaching staff consider, or not, the VI pupils' perceptual needs in a lesson activity.

In what follows, we outline key developments in the relevant research literature and conclude with an outline of the study's significance and research questions. We then discuss the theoretical underpinnings of the study and introduce the study's methodology and context of data collection. Preliminary findings from the first phase of the study are then presented, with reference to a particular episode extracted from a Y3 classroom. We close with implications that our conclusions from this episode have for our ongoing analyses and the second phase of the study.

Literature review and theoretical underpinnings

A limited number of studies have been conducted in the area of inclusion of VI pupils in mathematics classrooms. Amongst the foci in the literature are the following: VI pupils' forms of accessing, expressing mathematics and development of inclusive teaching strategies (e.g. Fernandes & Healy, 2013); VI pupils' experiences in mainstream mathematics classrooms (e.g. Bayram, Corlu, Aydın, Ortaçtepe, & Alapala, 2015); and, design of inclusive mathematics teaching and learning materials (e.g. Leuders, 2016).

While the existing literature has certainly been informative and has started to prepare the grounds for the creation of more inclusive mathematics classrooms, research studies that design, trial and evaluate inclusive mathematics lessons in the classroom are sparse. It is in response to this sparsity that this study was conceived.

The study addresses two research questions. How are inclusion and disability constructed in the discourses of teaching staff and pupils in mathematics classrooms? How do collaboratively designed mathematics lessons impact upon teaching staff's and pupils' discourses on inclusion and disability?

The study's theoretical framework is sociocultural and endorses theoretical tools from Vygotskian sociocultural theory of learning (Vygotskii, 1978); Sfard's discursive perspective, known as the theory of commognition (Sfard, 2007); the social model of disability (Oliver, 2009); and, the theory of embodied cognition (Gallese & Lakoff, 2005).

Drawing upon Vygotskii's (1978) sociocultural theory of learning, we see mathematical learning as a social and cultural process which involves the use of a variety of sensory tools (e.g. hands, ears, eyes) in mathematical meaning making and expression. Our consideration of bodily tools as indicators of mathematical meaning making and expression makes us infuse our sociocultural framework with elements from the neuroscientific theory of embodied cognition (Gallese & Lakoff, 2005). Apart from speech, we consider voice, gestures and facial expressions as vital factors for meaning making and expressing mathematics.

Drawing upon Sfard's (2007) discursive perspective, we discern teaching staff's and pupils' discursive activity – word use, visual mediators, endorsed narratives and routines – and particularly the elements of their activity that concern inclusion and disability, as evident in their speech as well as through their bodies, such as voice, gestures and facial expressions.

Drawing upon the social model of disability (Oliver, 2009), we consider disability as socially constructed and arising for people with impairments when environmental and attitudinal factors prevent their participation in activities on an equal

basis with others (United Nations, 2006). In this respect, we endorse the tenet that disability would be significantly mitigated if disabling barriers were removed. We consider inclusive education as an appropriate form of education through which disability can be drastically minimised in the mathematics classroom.

Methodology and context

The study is qualitative in both its phases. Its methodology has ethnographic characteristics (Bryman, 2016), as the data is collected in the naturalistic environment of mathematics classrooms with the aim of investigating the discourses of teaching staff and pupils on inclusion and disability in depth.

Ethical approval for the study has been granted by the School of Education Research Ethics Committee. Participants' anonymity, confidentiality and right to withdraw from the study have been guaranteed to the participants, who have all provided consent for participation in the study (including parental consent for the participating children).

Data has been collected in four mainstream primary mathematics classrooms in England. Criteria for the selection of the classrooms were the presence of VI pupils in them and willingness of the teaching staff and pupils to participate. There is one VI pupil in three of the classes and two in the fourth. Most of the participating VI pupils have severe visual impairment and none of them is blind in both their eyes. Two pupils have congenital visual impairment while three have adventitious visual impairment.[1]

Every class has at least one teaching assistant but the teaching assistant's role differs from class to class. While two of the classes have a teaching assistant supporting the VI pupils almost exclusively, in the other two the teaching assistants support pupils who need help at particular instances and their role does not focus on supporting the VI pupils specifically. We now present an account of the study's first phase of data collection, as this is the phase conducted so far.

We collected data through observations of 26 mathematics lessons (30 hours in total); individual interviews with 5 class teachers (five interviews, 2 hours in total); individual interviews with 4 teaching assistants (four interviews, 2 hours in total); focussed-group interviews with 27 pupils (ten interviews, 1.5 hours in total); and, one ten-minute individual interview with one pupil. During observations, written notes were kept in all lessons. 18 lessons were audio-recorded and 12 lessons out of them were video-recorded, too. All teaching staff and pupil interviews were audio-recorded, except three, during which written notes were kept due to the interviewees' preference.

Each method of data collection used in the study serves distinct purposes. The main focus of the observations is to report classroom evidence showing inclusion, exclusion, enabling and disabling of VI pupils. Such evidence is reported in the discursive activity of teaching staff and pupils in the mathematics classroom. The main focus of the teaching staff interviews is to gather their perspectives on inclusion and disability. Finally, the main focus of the pupil interviews is to gather the pupils' experiences of learning mathematics in the particular classrooms.

[1] "Congenital" and "adventitious" have to do with the age of onset of visual impairment. Congenitally VI are the individuals who have been born with visual impairment while adventitiously VI are the individuals whose visual impairment has appeared later in their life.

We have coded the names of classrooms[2] and of teaching staff[3] and we have used pseudonyms for the names of pupils.

Phase 1 data collection was completed in March 2018 and data analysis of the Phase 1 data is starting now. There are currently two focal points: teaching staff and pupil discourses related to inclusion/exclusion of VI pupils in mathematics classrooms; teaching staff and pupil discourses related to enabling/disabling of VI pupils in mathematics classrooms.

With regard to the first focal point (inclusion/exclusion), we are currently scrutinising the data for evidence of the following: discourses related to academic inclusion/exclusion of VI pupils; discourses related to social inclusion/exclusion of VI pupils.

Here we present a sample of this first scrutiny of our data focusing on one episode which illustrates variation in inclusion and disability discourses: first within the teacher herself and then between the teacher and the teaching assistant. In this episode, the focus is primarily on academic inclusion/exclusion of VI pupils.

A Y3 episode

The following episode was extracted from a lesson on addition and subtraction as inverse operations in Week 2 of the observations during Phase 1. It comes from S1Y3. We first present a factual account – and then a preliminary analysis – of the episode. We conclude with a discussion in which we zoom out of the particular episode and into our analysis of the whole Phase 1 dataset.

As contextual information about S1Y3, we note the following: Fred has severe visual impairment in both his eyes. Ian is VI in one eye and sighted in the other one. TA1a works with them individually, sits in between the two pupils and supports them both perceptually (namely, facilitating their sensory access to materials and resources that may be impeded due to their visual impairment) and substantively (namely, communicating with them about the mathematical content of the lessons). TA1b is the general teaching assistant of the class.

A factual account of the episode

In order to check that 216 is the sum of 176 and 40, the teacher writes the subtraction 216-176 on the interactive whiteboard using the column method. She asks the class what she should write each time in order to find the difference. The class finds the units' digit correctly and the teacher writes the digit in the units' place on the interactive whiteboard. Fred and Ian have access to the interactive whiteboard through an iPad and a computer, respectively. They sit at the front, with TA1a sitting in between them. Some sighted pupils sit on the carpet and others on their tables.

The class struggles with "1 take away 7" (the tens' column) and the teacher asks three sighted pupils to stand up on the carpet facing the rest of the class. She gives a place value hat to each of the three pupils to put on – one hat labelled "H" (for Hundreds), one hat labelled "T" (for Tens) and one hat labelled "O" (for Ones).

[2] The name of each classroom consists of two main parts collated with each other: SNumber YNumber. "S" signifies "School" and "Y" signifies "Year group".

[3] We use "T" for "Teacher" and "TA" for "Teaching Assistant". The names are followed by a number, which signifies the school in which each of the staff teaches. In cases where there is more than one teacher or teaching assistant in a class, the number is followed by a small letter.

The teacher creates 216 with concrete base 10 blocks, giving 2 blocks of Hundred to the 'Hundred pupil', 1 block of Ten to the 'Ten pupil' and 6 Ones to the 'One pupil'. She subtracts 176 gradually: she first removes the 6 Ones from the 'One pupil', ending up with 0 Ones; she then exchanges 1 Hundred of the 'Hundred pupil' with 10 Tens, which she then brings and gives to the 'Ten pupil'. Before completing the subtraction with the blocks, she returns to the incomplete column subtraction on the interactive whiteboard and explains what she has done with the Tens and the Hundreds, drawing on her previous actions with the concrete base 10 blocks. She then returns to the concrete blocks to complete the rest of the subtraction steps, which she subsequently follows on the interactive whiteboard.

TA1a asks Fred to use his iPad and zoom in with his camera so that he can see the teacher's actions. Ian's computer does not have such a function.

TA1a helps Ian follow the teacher's actions, drawing each of the teacher's subtraction steps on a whiteboard, placed in front of her and next to Ian, in the following way (Figure 1):

Figure 1: How TA1a illustrated the subtraction 216-176 for Ian[4].

A preliminary analytical account of the episode

When the teacher works on the subtraction on the interactive whiteboard

We see evidence of inclusion and enabling of Fred and Ian in this part of the lesson. The teacher includes both Fred and Ian through providing them with assistive technology – an iPad and a computer, respectively – connected to her computer. This connection allows the VI pupils to be part of the lesson, as it helps them access the teacher's work on the interactive whiteboard independently and at the same time with the rest of the class. The only difference in the VI pupils' case is that the teacher's work is mediated through a different tool – an iPad and a computer – and not the interactive whiteboard. Furthermore, through the provision of assistive technology connected to her computer without any technical problems, the teacher enables the VI pupils to access her work on the interactive whiteboard, without missing any of this work. Therefore, in this part of the lesson, the teacher both includes and enables the VI pupils. The inclusion and enabling are achieved with the same practice – the provision of assistive technology connected to her computer without any technical problems arising.

When the teacher works on the subtraction with concrete base 10 blocks

We see evidence of exclusion and disabling of Fred and Ian in this part of the lesson. We see exclusion in the use of at least one practice which, albeit concrete, is not considerate of the VI pupils' sensory needs and divides the class into two groups of

[4] The shape of the pictorial representations in each column is similar to that of the concrete base 10 blocks, used by the teacher.

pupils: the sighted pupils, who can access this practice, and the VI pupils, who cannot. The practice is that of exchanging of 1 of the Hundreds with 10 Tens, which are then added to the pre-existing 1 Ten and allow the subtraction in the tens' column to be carried out. The teacher's practice also disables the VI pupils because it is not designed to be accessible to them (at this distance, they cannot see what the teacher does). Therefore, in this part of the lesson, the VI pupils are excluded and disabled by the teacher through non-access to her concrete demonstrations.

When TA1a asks Fred to use his iPad to access the teacher's work with the blocks

TA1a's practice aims at including Fred and enabling him to access the teacher's work with the blocks. Indeed, with the zooming in function of his iPad's camera, Fred is invited to participate alongside those who have access to the teacher's work and he is enabled to access it, too. Therefore, in this action of TA1a, we see evidence of Fred's inclusion and enabling.

When TA1a works with Ian on the whiteboard

We also see evidence of Ian's inclusion and enabling through TA1a's work with Ian towards accessing the teacher's work with the blocks, albeit with a different mediational means to Fred's. While the iPad allows Fred to independently access the teacher's work directly and at the same time as it occurs, the lack of zooming in function of Ian's computer camera makes TA1a be the mediational means, with the help of a whiteboard too, for Ian. Ian is allowed to access the teacher's work indirectly, through TA1a, and with some delay compared to the rest of the class. The delay is attributed to TA1a, who is the mediator between the teacher and Ian, looking at each of the steps that the teacher follows and then adapting these steps to Ian's needs using a whiteboard.

Brief discussion of the episode

This episode is selected to evidence teachers' and teaching assistants' different practices of inclusion/exclusion and of enabling/disabling. Teachers frequently implement practices addressed only to the sighted community of learners and, as a result, they exclude the VI learners from the particular parts of the lesson. They also often rely on teaching assistants for the inclusion of VI pupils. The following excerpt from T1a's Phase 1 interview evidences this reliance on TA1a for the inclusion of the VI pupils in her mathematics lessons, particularly in those occasions when she carries out a demonstration at the front of the class: "[I]f you're modelling something at the […] front of the class and you can't really see that to access it, so it's making sure you've then got someone else in the class that can model what you are doing, do exactly what you are doing".

In this episode, the intervention of the teaching assistant was vital for the inclusion and enabling of the two VI pupils, who would have been excluded and disabled if they had had to follow the teacher's practice through their eyes and without using the additional mediational means. The teaching assistant's sitting in between the two VI pupils allowed her to readily realise that the pupils had no access to the teacher's work and to promptly intervene.

Despite its inclusion and enabling intention, the teaching assistant's intervention did not result in the inclusion of Fred at all times during the teacher's work with the blocks. Frequently, Fred appeared to disengage, by not focusing his iPad's camera on the teacher and by focusing it instead on other things irrelevant to the lesson that captured his attention. While we do not elaborate this issue of Fred's engagement

further here – the focus of the episode in this paper is on the teaching staff's actions – we stress its importance and we note that our subsequent analyses will focus very intently on said elaboration.

Fred's responses in this episode exemplify another potent focal point in our emerging analyses: the cases where VI pupils choose to disengage, to self-exclude from the lesson despite being offered an alternative that would allow them to be included. We also note as of potential interest in our developing analyses that the teacher uses a concrete, tactile practice with the sighted community of learners while the teaching assistant invites the VI learners to use their limited vision rather than their touch to access this practice. In Fred's case, his access to the teacher's practice is achieved with the zooming in function of his iPad's camera while in Ian's case, such access is achieved with the teaching assistant's transformation of the teacher's concrete practice into a pictorial, visual one. At face value, the teacher's work on a tactile practice with the sighted pupils – and the teaching assistant's invitation of the VI pupils to access this tactile practice through their limited vision – may look paradoxical. We discern here though the possibility that what TA1a does resonates with a broader set of institutional and teaching staff's perspectives and practices which prioritise vision as a prevalent sense for learning and working in mathematics. Our ongoing analyses explore this further.

We now conclude with implications that our conclusions from this episode have for our ongoing analyses and for the second phase of the study.

Concluding remarks, also towards Phase 2 of the study

The conclusions from the above episode have several implications for the second phase of the study. One of the implications concerns the teaching staff's role in the VI pupils' inclusion. We are currently designing lessons in a way that brings the teacher into a position of sole responsibility for the inclusion of the VI pupils – and in line with the analogous responsibility she has for the rest of the class. While ensuring the VI pupils' inclusion by the teachers, in close collaboration with the class teachers, we engineer the lessons so that the teacher can ask the teaching assistants to support pupils who need help at particular instances (we noted this need in at least half of the lessons during Phase 1). Another implication of the analysis we discussed briefly in this paper concerns paying attention, to the greatest extent possible, to implementing inclusive teaching practices across the whole class, rather than differentiating practices for sighted and VI pupils – was the frequent occurrence in Phase 1, including the episode we discussed in this paper. With the teacher being the only one responsible for the inclusion of the VI pupils and with designing practices which are common to the whole class, we argue that we can achieve better inclusion of VI pupils in the mathematics classroom. We see better inclusion as being achieved when VI pupils feel included in the lesson: they do not self-exclude and are happy to be part of the lesson.

Another implication of the above episode, which we are currently considering in Phase 2, concerns the institutional and teaching staff's perspectives on vision as the prevalent sense for learning and working in mathematics. Rather than aiming to always take advantage of the limited vision of the VI pupils - and thus use typically visual ways to teach mathematics - we are designing lessons with the participating teachers that invite the whole class to experience mathematics also through non-visual ways. In our current collaboration with teaching staff on said design, we also explore their perspectives on the feasibility of this invitation and we examine potential benefits that this invitation may bring to the class.

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