Language, mathematics and social disadvantage: a Bourdieuian analysis of cultural capital in mathematics education

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What do students need to know if they are to be constructed as effective learners of mathematics? This question provides the stimulus for this paper where the question is rephrased to: "What do students need to know in order to operate in a manner which is acceptable in the mathematics classroom?" Such a question is not without political implications and so needs to be extended to include questions about the consequences of participation in mathematics classroom. It is widely recognised that success in mathematics is not random, but rather falls into quite distinct patterns whereby students from certain social groups are more likely to be successful in the study of mathematics than others. The focus in this paper is the examination of why students from socially-disadvantaged backgrounds are less likely than their middle-class peers to be successful in the study of mathematics. The paper uses wo key notions. The first is the classroom interaction patterns noted by Lemke (1990) in which students must be conversant to be able to participate effectively. This knowledge becomes a form of cultural capital (Bourdieu, 1983) which can be transfered later to academic success.

Language as a Form of Capital

The framework used for this paper supports a critical perspective of educational successful and it is through the concepts developed by Pierre Bourdieu that educational success is framed. Of particular importance to this paper are Bourdieu's notions of cultural capital and habitus. Bourdieu (1983) has argued for the notion of cultural capital which exists in a number of forms. Of particular import to this paper is the notion of linguistic capital in which language is seen as a form of capital which can be exchanged for other forms of capital - social, economic or cultural. Using this framework, I argue that students enter the mathematics classroom from a range of socio-cultural backgrounds. Within these contexts, students whose socio-cultural background is congruous with that of the culture represented in and through the practices embedded within the mathematics classroom - including linguistic practices - are more likely to be constructed as successful students.

Bourdieu (in Bourdieu & Wacquant, 1992) argues that access to legitimate language, in this case mathematics, is not equal and that linguistic competence is monopolised by some. In considering the case of mathematics, this suggests that access to the discourses and discursive practices of mathematics is differentially accessible. For those students who enter the mathematics classroom with a competence in the discursive practices, access to mathematics is made more easily. Simultaneously, such students are more likely to be constructed as successful students based on the teacher's judgement of their ability. Within this context, language background is a form of capital which can be converted to academic reward.

Linguistic competence – or incompetence – reveals itself through daily interactions. Within the mathematics classrooms, legitimate participation is acquired and achieved through a competence in the classroom dialogic interactions. Students must be able to display a discursive competence which incorporates a linguistic competence, an interactional competence along with a discursive competence if they are to be seen as competent learners of mathematics. Classroom interactions are imbued with cultural components which facilitate or inhibit access to the mathematical content. To gain access to this knowledge, students must be able to render visible the cultural and political aspects of the interactions. Bourdieu (in Bourdieu & Wacquant, 1992) argues that

> Linguistic competence is not a simple technical ability, but a statutory ability. ...what goes in verbal communication, even the content of the message itself, remains unintelligible as long as one doe not take into account the totality of the structure of the power positions that is present, yet invisible, in the exchange. (p. 146)

From their early years, students are located within family structures and practices which will facilitate the development and embodiment of particular cultural features, least of which is language. For these students, the embodiment of their cultural background into what Bourdieu refers to as the habitus, predisposes them to think and act in particular ways. This embodiment of culture includes a linguistic component. Students whose linguistic habitus is congruent with that of the discursive practices represented in mathematics classrooms are more likely to have greater access to the knowledge represented in and through such practices.

From this perspective, language must be understood as the linguistic component of a universe of practices which are composted within a class habitus. Hence language should be seen to be considered as another cultural product - in much the same ways as patterns of consumption, housing, marriage and so forth. When considered in this way, Bourdieu proposed that language is the expression of the class habitus which is realised through the linguistic habitus.

> Of all the cultural obstacles, those which arise from the language spoken within the family setting are unquestionably the most serious and insidious. For, especially during the first years of school, comprehension and manipulation of language are the first points of teacher judgement. But the influence of a child's original language setting never ceases to operate. Richness and style of expression are continually taken into account, whether implicitly or explicitly and to different degrees. (Bourdieu, Passeron, & de saint Martin, 1994a) p. 40

The intersection of language, mathematics and culture has been recognised in both the literature and by teachers. Most often it is seen through deficit models where the linguistic background of the students is seen to be poor and hence contributes to the students capacity to participate in classroom activities. Comments such as those below are common explanations of the role of language in mathematics learning and teaching.

> T You talk to the preschool teachers. Some of the kids can't even speak properly....They can't communicate properly to get their message across. There are no sentences. Saying one word things to get something. Things like boundary, we had ummm., out of bounds, you know you're in trouble. They know that. Out of bounds, they get booked, no trouble with that. We were doing mapping and I said where is the boundary between such and such and such and such and I had all these blank faces and I had to explain boundary. I said what does boundary mean. They didn't know what boundary meant. I said "What does out of bounds mean?". Their answer was you get in trouble. They didn't understand that it is the boundary.

In contrast, the model proposed in this paper is based on a difference model and suggests that the linguistic habitus of the student will have substantial impact on his/her capacity to make sense of the discursive practices of the mathematics classroom and hence their subsequent capacity to gain access to legitimate mathematical knowledge along with the power and status associated with that knowledge. The processes through which the schooling procedures are able to value one language and devalue others must be systematically understood. Through this process, we will better understand how mathematical pedagogy both inculcates mathematical knowledge and imposes domination. In order to understand how the linguistic practices of the mathematics classroom position and hinder the effective participation of some students, the notion of "mathematical pedagogy as a text" is proposed.

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Mathematics as a Text

Gore (1990) has argued that pedagogy can be seen as a text which can be read and interpreted by the reader. Texts can be read in a multiple of ways, so that the student entering the mathematics classroom will be required to read, interpret and make sense of what transpires in the mathematics classroom - not only of the mathematical content, but also the pedagogical approaches within which the content is relayed. To be able to read these texts, the students must have some linguistic competence in the reading of social texts and discursive practices.

The interactions that occur within the classroom have been subjected to ethnomethodological approaches and have been found to have highly ritualised components with clearly identifiable discursive practices (Lemke, 1990; Mehan, 1982a). They argue that these components are not explicitly taught but are embedded within the culture of the classroom. The highly ritualised practices of classroom interactions can be seen in the types of interactions which occur across the various phases of the lesson. For example, the most common form of interaction consists of a practice in which the teacher initiates a question, the students respond and the teacher evaluates that response which Lemke (1990) refers to as "triadic dialogue". Lemke (1990) argues that this practice allows teachers to keep control of the content and flow of this phase of the lesson along with social interactions. While Lemke focussed on the science classroom, the style and purpose of this interaction can be just as readily applied to the mathematics classroom. This practice is not made explicit to students, rather it must be learnt through implicit means. To participate in the classroom interactions effectively, students must have knowledge – either intuitive or explicit – of these unspoken rules of interaction.

Furthering the work of Lemke, Mehan (1982b) has identified three key phases of a lesson - the introduction, the work phase and the concluding/revision phase. In each of these phases there is a shift in the power relations between the students and teacher which permits different forms of interactions to occur (Mehan, 1982b; Schultz, Florio, & Erickson, 1982). For the purposes of this paper, it is my intention to discuss the introductory phase only.

Mehan (1982) argues that during the introductory phase of the lesson, the teacher maintains tight control over the students, initially to ensure that the students are ready for the content of the lesson. Once control has been established and attention gained, the lesson can then proceed. Triadic dialogue is commonly observed in this phase in order to keep control of the academic content of the lesson and the control of the students. Dialogue between students and between teacher and students is not generally part of this phase. If the teacher initiates a question but the student is not able to respond, it is not appropriate for students to express their lack of understanding since this will interrupt the flow of the phase. If there is a misunderstanding or lack of understanding, it is more appropriate for this to be voiced in the work phase of the lesson.

What is lacking from this corpus of knowledge of classroom interaction is the failure to recognise that these interactions recognise a particular linguistic form which will be more accessible to some students than others. In this sense, the interactions within the classroom can be considered as another cultural product which is more familiar to some

students and not others. The linguistic habitus of the students will or hinder a students capacity to render visible the mathematical content embedded in the pedagogic action. The

> ...such cues [IRE] are not necessarily "understood" by all participants, but they are certainly part of the "functional conflict" between dominant and dominated languages in (and out of) educational settings. (Collins, 1993, p.131)

In the previous sections, I have drawn on the work from a number of traditions – theoretical and methodological – and have proposed that the social background of the student will the construction of a particular linguistic habitus. The field of mathematics, having its own regulatory discourses and discursive practices, will recognise and value some linguistic practices and not others. These practices are socially biased.

Classroom Interactions

An ethnography of two classrooms was undertaken in which mathematics lessons were videotaped. The two classrooms were located in socially divergent sites - one an independent school which serves a middle- to upper-class clientele (Angahook). The other classroom was in a state school serving a predominantly working-class clientele (Connewarre). The classrooms were in the second last year of primary school and most students were approximately 10-11 years old. The video-taped lessons were transcribed and analysed. Extracts from one of the lessons from each classrooms will be used as examples for this paper.

Angahook

This school serves a middle- to upper-class client group. The mathematics teaching, learning, assessment and curriculum are relatively conservative with a strong emphasis on rote learning, preparation for examinations and teacher-directed pedagogy. The class sizes are small with only 12 students in classroom observed. In the lesson presented here, the students were undertaking an activity from the Mathematics Curriculum Teaching Package. Prior to the extract shown, the teacher (Helen) has used a number of short mental arithmetic tasks. The following is the introduction to the lesson.

T: You are asked to judge the diving for the Olympics, you will need to know the degree of difficulty because what if someone did just a plain dive and did it perfectly and got full marks for it and what if someone else did a triple somersault, back flip, side swinger double pike and knocker banger and only got half marks for ti because they entered the water and made a bit of a splash. Is that fair?
C: No
T So we have to talk about degrees of difficulty. What do you think that means? What does that actually mean? Robert?
B You have to add a bit more to the score because of the degrees of difficulty.
T Good boy. Yes, good. Daniel?
B Well the performance of their dive, how they dive and well like they might have a very good dive and make a very big splash and may even get off
T Right, good. OK you are on the right track. What do you want to say about degree of difficulty Cate?
G How hard it is?
T How hard it is. Tom what would you like to say about degree of difficulty? That's not a word we use much in our everyday language..... degree of difficulty.
B The percentage of how hard it is
T Good. Because you're focussing on the word degree though aren't you. So a really hard dive. Now you can see on this sheet they're talking about DD which is short for degree of difficulty and a really hard dive. What would be a really hard dive? What would be the highest number for a degree of difficulty be? Have a look at your sheet. Try and work out the degree of difficulty. Vicky?

From this extract it can be seen that the teacher follows the triadic dialogue identified by Lemke. The teacher retains control of the content and interactions through the use of the three phases of interactions. Using this approach she is able to control the flow of the lesson as can be seen in the last interaction where Tom has mentioned "percentages" which she then takes as a cue for linking percentage and degree in a way which suits her purposes.

Examining the flow of the interactions indicates that there is a complicit agreement between the teacher and students to participate in the interactions. There are no transgressions or challenges to the teacher's authority. This allows for substantive content to be covered.

The teacher is able to maintain control over both the form and content of the lesson and the students through a mutual compliance with the implicit rules by both the students and the teacher. She has used Triadic Dialogue to structure the interactions and students infrequently transgress the rules. This allows her to retain the focus of the lesson and in so doing, the students are exposed to a significant amount of mathematical knowledge that is embedded in that dialogue. The teacher's capacity to deliver the lesson in this way allows for her to use a very rich mathematical language as she discusses the mathematical content. In other words, the students are exposed to mathematical language and concepts in a style which takes for granted their linguistic background. The work of Brice-Heath (1982) has shown that middle-class students are more likely to be familiar with these forms of school interactions due to their similarity with the linguistic patterns of the home environment. This familiarity has facilitated a linguistic habitus which is similar to that of the formal mathematics classroom and hence permits access to the codes and signifiers of school mathematics.

Connewarre

Connewarre is a large government school which is located within a large housing commission estate. The clientele of the school is predominantly working class with many of the parents receiving government support. The classrooms are smaller than Angahook with approx 25-30 students in each class. The teacher introduces the mathematics lessons with problem solving activities which the students undertake as small groups. They are able to be physically involved in the activities and it is not uncommon for the students to draw on the carpet with chalk to represent the task or physically construct the problem. The mathematics has a strong emphasis on real life situations. The following extract is the introduction to a lesson in which the teacher has drawn a net on the board which the students will have to draw onto card and then construct. Students are then required to develop a number of nets for nominated prisms.

T So if I put those together we start talking more about a shape I am talking about. It's sort of a rectangle on the sides, all the way round but you don;t call it is a rectangle, because a rectangle is jus the flat surface. What do you call the whole thing if that was one whole solid shape. What do you call that?
C A cube
T He said a cube. Don't call out please.
C A rectangular rectangle
T You're on the right track
C A 3D rectangle
T Three dimensions, technically I suppose you're right.
C A rectangular
It's a rectangular something. Does anyone know what it is called?
C A parallelogram
T Put your hand up please.
C [unclear]
T No
More calling out

T I guess you could have a rectangular parallelogram, but no. A rectangle is a special parallelogram.,
C A rectangular oblong
T The word we are looking for is prism
C Yeah that's what I said
T Say the word please
Cs Prism
T Not like you go to jail "prison", that's prison. Excuse me, could you return those please.
[calling out]
T So one thing that we think about with rectangular prisms and that this shape on here is, excuse me...Now you can leave them down please. You need a little bit of practice at lunch because you can't stop fiddling. This shape here is drawn out on the graph, this grid here [net for a rectangular prism]. We 're going to try and do the same thing. Draw the shape and then cut it out. If you look at the shape, it's made up of rectangles and squares.

In this extract, it indicates that the flow of the lesson and content is hampered by the challenges to the teacher's authority. The triadic dialogue does not serve the same purpose as noted by Lemke (1990) and found at Angahook. The field of mathematics education has particular unspoken rules of interaction which have not been appropriated by the students at Connewarre, or may be resisted by the students.

There are many transgressions of the implicit rules of classroom interactions. The flow of the lesson is fragmented as students challenge the teacher's control for the floor and content of the lesson.

The linguistic habitus of the student implies a propensity to speak in particular ways which, as can be observed in the case of the interactions in this extract, works to exclude students from the mathematical content. The students are not as competent in the linguistic exchanges of the mathematical interactions as their middle-class peers thereby marginalising them in the process of learning. The teaching of mathematics in this way tacitly presupposes that the students will have the discursive knowledge and dispositions of particular social groups, namely the middle-class. The students are not as complicit in the classroom practices and in so doing are being excluded from active and full participation in the mathematics of the interactions. In this way, students have been exposed to the symbolic violence of formal education.

Conclusion

Using data from mathematics classrooms, Voigt (1985, p. 81) has argued, "The hidden regularities, the interaction patterns and routines allow the participants to behave in an orderly fashion without having to keep up visible order" so the idea is far from new. However, what I have sought to uncover using an interactionist approach is the ways in which some students are able to gain access to mathematical content and processes more readily than others. I have proposed that one subtle and coercive way is through the linguistic habitus of the students and the practices of classroom interactions whereby some students enter the formal mathematics classrooms with a habitus that is akin to that which is valorised within that context. These students will be able to participate more effectively and efficiently than their peers for whom the patterns of interaction are foreign to their habitus, thereby making the habitus a form of capital which can be exchanged for academic success within this context.

The predominantly implicit codes of curriculum and classroom interactions take as a given that students will have a familiarity with the legitimate linguistic practices of the mathematics classroom, but neither curriculum nor pedagogy render that language visible. gaining access to mathematical knowledge is facilitated, or hindered, but a match or mismatch of codes. Rather than perceive this a function of language deficiency, but as systemic through which the dominant classes are able to maintain control:

> pedagogies that tacitly select the privileged and exclude the underprepared are not regrettable lapses; they are systemic aspects of schooling systems serving class-divided societies. (Collins, 1993, p.121)

The linguistic habitus of the middle-class students positions them so that their possession of knowledge of what constitutes "appropriate" classroom linguistic exchanges is similar to that which the system values thus allowing them to participate effectively in classroom practice. Alternatively, the linguistic habitus facilitates the appropriation what the system offers. The dispositions, as per the linguistic habitus, of each of the classes have facilitated or hindered their acquisition of mathematics. The linguistic habitus is differentially valued within the mathematics classroom so that for some students the linguistic code with which they are familiar and use within the classroom becomes a form of capital which can be exchanged for other cultural goods - in this case, grades and the subsequent academic success conveyed to the individual thereby reinforcing the claim that "The more distant the social group from scholastic language, the higher the rate of scholastic mortality (Bourdieu, Passeron, & de saint Martin, 1994b, p.41).

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