

Working with mathematics teachers and immigrant students: an empowerment perspective

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Abstract This article centers on a professional development project with a group of high school mathematics teachers in Barcelona. The eight participating teachers taught in low-income schools with a high percentage of immigrant students. Our model of professional development is based on the involvement of the teachers as co-researchers of their local contexts and practices. In this approach, our concept of social justice is tied to the notion of empowerment, both for teachers and for their immigrant students. Our analysis of data from twelve sessions with the teachers shows the development of a shared awareness of their local situation that leads to their questioning of their practices followed by a reconstruction of those. Teachers worked together to move from talking to action. Our analysis of data from the implementation of one lesson in a classroom shows that action, and illustrates signs of empowerment in the teacher and the students, such as students' challenging of aspects of the task and taking on a more participatory role and the teacher's reflection on the overall experience.

Keywords Mathematics education · Professional development · Study groups · Empowerment · Social justice · Immigrant students

Background

In July 2004, a group of teachers of mathematics voluntarily attended a summer seminar on mathematics education conducted by Núria Planas in Barcelona, Spain. At the end of the seminar, the teachers expressed an interest in creating a group that would meet regularly to continue the work started in the seminar. They were interested in exploring which classroom activities gave immigrant students the greatest benefit. In January 2005, eight of those teachers started working together under the name of "Critical Mathematical

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Education Group.” Núria has coordinated this group since 2005, while Marta Civil serves as a consultant drawing on her prior study with a group of teachers with similar goals in Tucson, Arizona, U.S. (see, Civil and Andrade 2002).

In Catalan multiethnic secondary schools (12–16-year olds), to ensure that “all” students achieve the standards in mathematics, a parallel system of special classes has been created within the regular system. This means that certain students attend separate classes for the subjects of mathematics and language, and they also spend some time in the “regular” classes (for more details, see Planas 2007). Until 2000, immigrant students in high schools were put in special classes with students with learning difficulties and physical disabilities. Recently, a distinction has been made between students with “language problems” (referring to immigrant students) and with “physical or learning disabilities.” These two groups of students, however, still have the same teachers and tend to work on the same adapted curriculum that often covers material two or three grades below their current grade. The teachers in our group are in charge of special classes with a high diversity concerning ethnic origin and language—Spanish and Catalan—competence. Generally speaking, teachers do not choose to work with these classes but they are assigned to them, usually because they are new to the school.

In this article, we look into some aspects of the professional development project that took place with the group of teachers in Barcelona. Our research focuses on the development of teachers’ empowerment processes. We investigate this development within the group discussions as well as within a mathematics classroom. We are interested in what teachers think, say, and do about their teaching of mathematics in classes with immigrant students. Thus, in this article, we present and discuss data from two settings. One comes from the sessions with the teachers as we worked toward developing a sense of community with a common goal of seeking ways to improve the mathematics teaching and learning experiences of immigrant students. The second setting is grounded in a classroom experience and the follow-up teachers’ discussions to debrief this experience. We interpret the development of empowerment skills as an expression of getting nearer to issues of social justice, and therefore we consider the idea of empowerment as part of the more general concept of social justice.

Social justice, empowerment, and responsibility

Our approach to research draws on Bauman’s (1999) complexity model. One of the challenges of this model is to be capable of producing meanings that may vary depending on the diversity of the social contexts of reference. According to this approach, the idea of social justice cannot be rigidly fixed but needs to be interpreted in terms of the diversity of experiences and practices. Our concept of social justice involves

1. equal access to opportunities to participate in the social construction of reality;
2. freedom in the sense of having access to opportunities to improve the living conditions of individuals and groups.

All of us construct reality socially all the time, but by “equal access to opportunities to participate” in these processes of construction we refer to having this participation recognized. On the other hand, by *reality* we mean a diversity of realities, each of which is common to the experience of groups of people that share views of the world, of their positions within the world, and of their relationships to other groups. A condition for social justice is that individuals and groups recognize also the opportunities and not only the

limitations, and that they use them in a positive manner in their relationship with others. This characterization of social justice has to be complemented by a model of conflict where it is assumed that society is formed by groups with different levels of power and control over resources (Popkewitz 2002). This makes it such that the access to opportunities (even if those are the same for everybody) does not require the same effort depending on each individual's position and the groups to which he/she belongs.

People with less control over the legitimate cultural and social resources in a context need to develop a process of "empowerment" that will enable them to actively participate in the social construction of this context. Our study with teachers is based on an empowerment perspective, which claims that issues of power and powerlessness are integral to both the school experience of immigrant students and the teachers' practices in special classes. We see empowerment as a process of increasing personal and interpersonal power so that individuals can take action to improve their life situation (Gutiérrez 1995). We believe that those individuals with a feeling of having power are more likely to contribute to the actions for social change.

The complexity model understands freedom as responsibility oriented toward an improvement of the living conditions of the different groups in order for all of them to gain more control over resources. Responsibility, however, is a difficult challenge (Valero 2007). Teachers may avoid responsibility by referring to the limitations of the "system" and thus, expressing a feeling of powerlessness toward the situation (Planas 2007). The process of empowerment cannot begin until a person accepts responsibility. Moreover, there is no social justice if the access to opportunities benefits only certain individuals and groups. Any process of "individual" empowerment is necessarily a collective process based on the improvement of the community (Gutstein 2006). Here, the teaching of mathematics is related to transformative actions guided by a dialogue of confrontation between the "established" mathematics and the mathematics of excluded groups (Chronaki 2005; Knijnik 2007).

In an earlier study (Civil and Planas 2004), we have addressed the need to develop processes of empowerment among immigrant students as a way to improve both their mathematical learning and their life situation. We have argued that students who are empowered by their school experiences develop the ability, confidence, and motivation to academically succeed. In this study presented here, we take the processes of empowerment of immigrant students and of their teachers as being inseparable parts of the same reality, especially due to the central role that we assign to the classroom interactions between students and teachers. Although we know that the link between teachers' and students' empowerment and performance has not been clearly established by educational research (Cochran-Smith 2004), we assume similar to Cummins (1995) that students from minority groups are "empowered" or "disabled" as a direct result of their interactions with teachers in the classrooms. In order to understand the mathematics underachievement of certain groups, therefore, we need to understand the perceptions of opportunities to learn, from the perspective of both the students and the teachers and further study on the relationships between students' and teachers' empowerment.

In this study with a group of teachers, we focus on issues of teachers' empowerment. Similar to the notion above, we interpret the empowerment of teachers as a way to improve both their mathematics teaching and their life situation by means of gaining ability, confidence and motivation to professionally succeed. We consider that teachers with an increased sense of empowerment will tend to accept more responsibility for the mathematical success of their students (Godoy-Penteado and Skovsmose 2009). We work with the teachers to help them develop the ability to work with other teachers, and with their

students to change expectations and foregrounds (Alrø and Skovsmose 2004), both for the students and the teachers themselves. The group cohesiveness is given by the sharing of a common problem (the academic failure of immigrant students), the identification of the groups who are directly affected by it (the immigrants and their teachers) and the motivation to better understand this problem. The group is held together by a professional identity but also by a shared sense of having been assigned to difficult classes, those with immigrant students.

The teachers' processes of empowerment need to start with a reformulation of reality in terms of opportunities. Teachers see the parallel system of schooling, the official mathematics curriculum, the restricted resources, and the inadequate support to teachers as "big problems" that impact the teaching and learning of mathematics (Planas and Civil 2008). This perception becomes an obstacle in the teachers' empowerment because these "problems" are viewed as outside of what they can decide on or change. Certain views therefore can be a real obstacle to a social justice approach. The processes of empowerment require that we pay attention to the limitations while we formulate new problems in which it makes sense to take responsibility for actions. Bauman (1999) talks about the shared representation of the inability to act in some situations and describes it as an obstacle in the identification of opportunities for participation and communication in the social construction of the realities that we wish to change.

More generally, our position toward the teaching of all students, but in particular immigrant students, is based on the development of a mathematics classroom environment that encourages and supports participation and communication. Moschkovich (1999) raises the issue that although an emphasis on discourse could make second language learners vulnerable to be assessed as deficient in terms of their language skills, it could also be seen as an invitation for these students to engage in meaningful, context-based conversations about mathematics, thus providing them with more opportunities to enhance their learning of language and mathematics. Moschkovich (2007) describes three views of second language mathematics learners and argues that one of these views, the one grounded on a sociocultural approach "expands what counts as competence in mathematical communication, and provides a basis for designing equitable instruction" (p. 91).

Method

The main goal in our research was to investigate teachers' empowerment processes through a number of group discussions and classroom implementations. In order to address this goal in our study with teachers, we adapted the approach followed by the *Funds of Knowledge for Teaching* Project (González et al. 2005) and implemented by Civil and colleagues with a focus on mathematics education (Civil and Andrade 2002). This approach is both a form of professional development and a research method. Teacher-researchers and university-researchers meet in a Study Group format to jointly explore a common problem (in our case the teaching and learning of mathematics for immigrant students). While our concept of Teacher Study Group includes typical characteristics of this form of professional development in mathematics education (e.g., reflecting on practice, developing a community, exploring connections between participants' mathematical understandings and practice) (Arbaugh 2003; Kazemi and Franke 2004), our key emphasis is on the development of theory and action toward the transformation of the mathematical learning experiences of immigrant students.

Through analysis of data from the teachers' professional contexts, teachers' narratives of their experiences, and data from classroom implementations, we engage in theory construction by means of a grounded theory approach (Glaser and Strauss 1967), and develop further ideas for action during the revision of lessons. During the academic year 2005–2006, we met 18 times for 90 min per session on alternative Wednesdays from October 2005 to June 2006. Classroom implementations took place in May and June 2006. The eight teachers had extensive teaching experience but had never part of in-depth, collaborative professional development projects. During the meetings, Núria assumed the roles of participant observer and discussant, and eventually took some notes. All the meetings were structured around a first set of focus questions and a period for discussion that was conducted by a different teacher each time. The first lesson, for instance, began with general questions about the ways that teachers could change as a result of their participation in a study group. Some of the sessions started with a fragment of a class video and were followed by the focus questions. From meeting to meeting, e-mail contact was frequent as teachers often sent each other messages concerning the case of an individual student in their classes or went on discussing some of the most recent focus questions.

For this article, we draw on data from 12 audio-taped sessions of the teachers' study group discussions and one video-taped class session with a group of immigrant students. We first examine comments from the teachers during some group meetings. We then explore students' and the teacher's comments from one classroom where immigrant students were engaged in a mathematical task that had been designed within the teachers' group discussion. Although we focus on the teachers' processes of empowerment, the experience of these processes need to be confronted with their impact on the students' experiences in the classroom. We transcribed the video-taped class session (including the study in one small group of students). We chose to videotape one class session taught by one of the teachers who attended all the group meetings. He has a bachelor's degree in mathematics and has been teaching mathematics for 12 years, the last two in special classrooms with immigrant students.

In order to analyze our two sets of data (teacher group meetings and class session), we use a constant comparative method. This process leads to the development of themes that tend to be highly interrelated. As Van Manen (1990) writes, "theme is the form of capturing the phenomenon one tries to understand. Themes describe an aspect of the structure of lived experience" (p. 87). The analysis of data was done in several stages. Núria listened and transcribed most of the data and did a preliminary analysis; she then involved some of the teachers for clarification and confirmation or refutation of some of her analysis; finally, she shared parts of the data and analysis with Marta for further discussion.

From the first set of data, the teacher group sessions, we discuss two themes: (1) Questioning perceptions (concerning what it means to teach mathematics to immigrant students); and (2) Reconstructing teaching practices. The double focus on perceptions and teaching practices was thought of as a way to inform about the teachers' empowerment, this being characterized by practices of change and perceptions that make these practices possible. By showing data from these two themes, we draw out some of the changes made by teachers in perceptions and actions. From the second set of data, the implementation in one classroom and follow-up discussions, we focus on further two salient themes: (3) Learning Mathematics; and (4) Reconstructing perceptions. The data from these two themes show how one of the teacher's views turn into action within the classroom and have an influence on both the students' learning and his process of professional development. While the first two themes refer to shared aspects of the teachers' empowerment processes, the other two are expected to give a deeper insight of these processes as experienced by one

of the teachers and also from the perspective of his students. These four themes contribute to clarify the “order” followed during the research process which was: (i) Identifying perceptions; (ii) Designing classroom practices; (iii) Implementing teaching practices; and (iv) Revising perceptions.

We use excerpts from the transcripts from the group discussions to illustrate the teachers’ perspectives and show comments concerning ways of interpreting their role as teachers and their behavior in their classrooms. Núria was both the facilitator and a participant in the group. We met at a location away from each teacher’s school as we thought this could provide for a safe space to facilitate the development of discussions. All the teachers had taught mathematics in high schools for at least eight years, and they all worked in the same school district but in different schools. This is important because when they talked they did it with people with whom they did not have direct work contact. They had started their career without having immigrant students in their classes, and their assignment to special classes was a new situation for them. They were interested in developing classroom strategies and resources to transform their teaching practices into more inclusive ones. Although the initial purpose of the group was to design tasks, we all agreed that we would first begin with some sessions (October–December 2005) dedicated to exchange information concerning each other’s perceptions about teaching mathematics in special classes. From January to June 2006, we focused on the design of tasks in a sort of Lesson Study (Fernández and Yoshida 2004) meetings: we first developed activities, then implemented them in one classroom, and met again to decide what revisions were needed and talk about that particular teaching experience. We considered the curriculum planning and design as an empowerment strategy, but we also wanted to study on issues of collaboration, responsibility, and professional knowledge.

Findings

In the next two sections, we comment on findings concerning the process of the group’s development. Our data show important and rather quick changes in most of the teachers’ public discourses on their teaching in special mathematics classrooms, as well as a joint construction of criteria for the design of “empowering” tasks. In the last two sections, we partially summarize one the teacher’s development during his engagement in the project. In the case of this teacher, we characterize his process of empowerment through his reinterpretation of the value of the immigrant students’ knowledge and the reflective communication of this value to the other participants in the group meetings. His perception of the value makes an important contrast with this teacher’s positioning during the first sessions.

Questioning perceptions

Teachers were encouraged to question their perceptions of what it means to be a mathematics teacher in a special class and, more generally, concerning the views society has about immigrants. They were asked to be reflective about what they did and how they did it. We wanted them to assume that one of their main goals when teaching mathematics is to increase their students’ actual power, that is, to make students achieve mathematical learning that prepares them not only for future classes but also for personal and social life experiences. Such an approach is consistent with that taken by Gutstein (2006) who says:

There is a dialectical relationship between developing mathematical power and teaching students to use mathematics to study, and potentially change, structural inequality. The two processes can facilitate each other, under certain conditions, but there is a tension between them. (p. 108)

In their first comments, most teachers showed a rather pessimistic perception (as if the situation was such that there is nothing that could be done about it), but as the discussions went on and the teachers became more comfortable with each other and started showing signs of collective efforts: they talked about what they considered as shared problems within their community (that of the mathematics teachers in special classes) and tried to formulate the problems together. After some discussion during the first session, they referred to the immigrants' non-participation as an obstacle in their teaching. Some of them said that in the mathematics class the priority was to teach skills and that group work was better left for other subjects.

We've been assigned to the immigrant students. These are students who do not participate, who haven't participated in a long time... the problems that we give them, they are not hard, they've been modified so that they would be easier for them, but the majority does not participate. At least I get along well with them, they are not difficult [students], the difficult part is to find what mathematics is going to make them respond. [Anna, Session 1]

They don't participate for many reasons: they notice that we expect very little from them, they stopped participating a long time ago... that's why it's so difficult to teach them mathematics, because you never know if they are listening. [Cesca, Session 1]

If we were social studies teachers, we could spend time having them working in groups and on real-life issues; that always helps the participation. But we are math teachers and we have to teach lots of skills. [Joan, Session 1]

These teachers express a concern for the lack of participation of immigrant students in the mathematics class, yet at the same time they seem to think that participation is not a goal for this class. They perceive there is a distance between what they view should be taking place in school mathematics (e.g., learning skills) and the method they see as being more appropriate to encourage the participation of immigrant students (e.g., working in groups). This distance can be seen as a dilemma for the teachers between an emphasis on learning mathematical content or learning social skills. This dilemma brought them to talk about participation sometimes in terms of mathematical involvement and other times in terms of empowerment in a social sense. In the following quote, one of the teachers, Oriol, puts the emphasis on the mathematical involvement when he contrasts the search of mathematical activities in which students provide explanations with the need for them to have computational skills.

If we are trying to learn more about the immigrant students and then think about mathematical activities where they have something to explain, we should think that what they have to explain is mathematically important. And all of this without leaving behind their learning of computational skills. [Oriol, Session 1]

In order to question views that focus on the limitations rather than on the opportunities to act is a first step in the teachers' empowerment process. One of the facilitator's tasks was to move from the initial pessimistic approach to a more complex "problematizing" approach. In order to facilitate the group participation in the analysis of the immigrant

students' reality, at the beginning of the second session, she asked the teachers to think about three questions:

1. In which ways are we¹ contributing to the immigrants' school failure?
2. In which ways are we working against this failure?
3. Who is responsible for working against these students' academic failure?

With these questions, we seek to develop the dialogic approach called for by Knijnik (2007), by pushing the teachers in the study group to look at the different forms of mathematics and their different valorization (Abreu and Cline 2003). In this approach, there is no static dominant group whose power is assured. There is always some kind of struggle involved in retaining power, and there are always ways in which the dominated groups resist the power of the dominant group. By reflecting on these questions, we wanted the teachers to think about their co-existing roles of dominants and dominated—"dominants" because their status of teachers gives them some power; "dominated" because they face institutional constraints (e.g., teachers felt that the idea of special classes limited their options as to what they could do). We also wanted them to move from complaining about the local school system toward exploring how power is reconstructed by means of different actions. When first attempting to answer the questions, we found patterns of resistance to change:

In the classroom, there will always be students who participate and those who don't, no matter what we do, because we always favor those who are more like us. If we changed our approach in the classroom, maybe we would favor other students, for a change. [Oriol, Session 2]

They already come in feeling different; I am not sure whose responsibility is to fight against that. I suppose that we could make it so that they don't feel that way, but our task is to teach mathematics. (...) Yes, of course, to teach mathematics is also to make it so that they don't feel different. [Miquel, Session 2]

These comments point to a back and forth between positions from "This is the way things are and it is not our role to change them" [Anna] to "Maybe things could be different and it is our role to make that happen" [Raquel]. Collective empowerment opportunities emerged when teachers supported one another during peer interaction in trying to face the three questions presented earlier. Collaboration was an important part of what happened when teachers interacted with one another. It resulted in conversations where teachers reflected on the discourse they were producing in their classrooms. Teachers supported each other by finishing each other's sentences and introducing new comments. Assistance was also provided when a teacher made a pause, giving a colleague time to introduce ideas. This type of collaboration created a discourse that can be seen as a collective effort. In the fourth session, Anna had difficulty enumerating ways of working against the immigrants' non-participation. In response, Cesca, Raquel and Oriol offered some suggestions:

In other subjects the immigrant students are mixed with the students from here. They talk, participate, and make decisions, just like some of the local students. They are asked for their opinion, and they give it. Why is it that we do not consider their opinion in the mathematics class? [Cesca, Session 4]

¹ The "we" refers to different groups in society: teachers, researchers, administrators, politicians, families, etc. In our sessions, we often looked at the different groups involved in students' schooling and their roles.

It is important that they talk but for that to happen we have to pose tasks for them to talk. We need to stop participating so much ourselves, stop giving so many answers. [Raquel, Session 4]

If they give their opinion they participate, that's clear. But not all the opinions are going to have the same value, and that's where participation may break down again. How are we going to make sure whether we value the opinions or the people who give the opinions? [Oriol, Session 4]

Oriol's comment relates to the notion of valorization of knowledge (Abreu and Cline 2003). His comment points to the notion of status in the classroom and the idea that not all participations are going to be given the same value. It is not clear whether he thinks of the teacher as the only one who may value the opinions differently or if he is also including the students in the class as playing a role in this valuing, but in any case, he is aware of this notion of valorization. On the other hand, Cesca and Raquel suggest the need for new ways of working with immigrant students. In a previous session, Cesca had said that she felt she had been doing a good job teaching until she started working with immigrants. As the group continued to meet, Cesca pointed to the possibility of being able to do a good job also when working with immigrants. In the quote above, Cesca raises the question of how come we do not ask for the opinion of immigrant students in the mathematics class, while for other subjects these students do give their opinion. She is beginning to question the dynamics of her own teaching. At the end of the sixth session, a collective move had been produced from focus on the teaching difficulties to focus on obstacles to the students' participation. From some of the teachers' comments, it was inferred that there was a need for designing tasks that looked at factors other than the level of difficulty and that tried to connect more with these students:

It shouldn't surprise us so much that they don't participate; we spend too much time adapting the math activities that we had from other classes to be used with other students, and in fact, the only adaptation that we make is that we lower the level of difficulty. [Berta, Session 6]

We should understand the concept of adapting in a different way. Adapting the level of difficulty also means that the activities should make sense to these students. [Oriol, Session 6]

There was also consensus concerning possible ways of overcoming and even preventing non-participation. Some of the teachers outlined the need for technical changes such as designing alternative tasks, while some others highlighted the need for interactional changes such as organizing different class dynamics. Changes were seen as complicated because they require taking into account the varied cultural patterns, values and aims of the different groups of immigrants as well as an awareness of individual differences within these groups. They did not feel capable of thinking of mathematical tasks that reflected situations that were familiar to immigrant students because they said they did not know how these students lived and what they are like. Some of the institutional constraints were seen as an obstacle when trying to know more about these students. In their words, there was not adequate teacher support to let them participate in working groups. The participation in our group was put as an example: the administration had not recognized it as official professional development experience, and consequently teachers had not been given release time. The issue of time was a common concern for the teachers. We always met late in the evening, after a long school day.

Reconstructing teaching practices

During the second part of our sessions (January–June 2006), teachers moved from talking to action. The role of Núria also changed, from providing feedback to proposing different criteria to be considered in the design of “critical” mathematical tasks. We call them critical because they are designed to reduce the immigrant students’ powerlessness in the local school system. Teachers decided that the task type was of crucial consideration if they wanted to promote the participation of all the students. They all agreed that the usual tasks in their special classes were not communicative tasks. For example, Anna said:

The homework we assign is to be done, not to communicate. The class is not conceived as a place for communication among ourselves. Sometimes, they work in pairs or in small groups, but that is not enough, especially if we don’t give instructions to the groups so that they know that they have to collaborate and not to each take a question to work on it individually...Each has a notebook and writes his/her work. We do not ask them to write what they have discussed among several of them, because this does not make sense in closed tasks. It is hard to ask students to do something for which they have not been prepared. [Anna, Session 8]

By the end of the second meeting of this period, we had established four criteria that had to be present in the tasks: (1) to have more than one final outcome; (2) to promote interaction; (3) to allow for the presence of personal and group experiences; (4) to require the use of mathematical concepts. The first three criteria were expected to generate opportunities for all students to participate. The teacher’s interventions were planned as a way to promote, compare, and value the different interpretations given to the mathematical task. All teachers agreed that communication was more important than conforming to specific forms of doing mathematics, which at the beginning appeared to be a rather difficult point of consensus.

It’s hard to find a balance between activities that contribute toward the learning of mathematics and those that promote participation. This means looking for a way to participate that is not counter productive to the mathematical conversations. [Berta, Session 8]

We all have to be better prepared so that there is more communication. We, as teachers, have to accept that there are other experiences that are valid and they, the students, have to learn how to talk about mathematics in the classroom. [Anna, Session 8]

In the quote below, Anna expresses a concern that for tasks that call for critical thinking and may lead to more discussion, teachers need to spend more time thinking about what they are willing to allow the students to do:

We have to understand that the teacher now not only has to prepare the task by just reading the wording of the problem, but also that we have to prepare in advance, taking into account everything that will allow the students to do the task. [Anna, Session 8]

The work with critical tasks was thought as a way to confront the academic mathematics with the everyday mathematics of different social groups, and facilitate the visibility of the various ethnomathematics. We are aware of some obstacles linked with “real context” problems in the mathematics classroom, as the idea of “real context” is differently understood by different groups of people. The teachers themselves pointed out some of

these obstacles. It is especially controversial, for instance, to interpret “realistic” school mathematics as an approach only for excluded groups (Cooper 2007). Although it was a matter of discussion during the meetings with teachers, and we established a theme for it (*Reconsidering real context problems*), we do not address this issue in this article.

Next, we discuss an example of a critical task that was implemented in Oriol’s classroom by June 2006. The goal of this task, as presented by the teachers, was for students to represent their ideal flat by using a scale drawing and applying the notion of proportionality. This idea of “representing their ideal flat” has been used successfully with working-class students of Mexican origin in the Southwest. In that experience, students (ages 12 and 13) engaged in a series of mathematical explorations connected to their design of their “dream home” (Ayers et al. 2001). In the case of Oriol’s classroom, we had a similar experience in terms of students’ engagement, including mathematical engagement. In order to promote the discussion, students were given a blueprint of a real flat (see Fig. 1) and were asked to talk about it within their groups. In order to help students focus on the task and promote sharing of ideas, each of them was given a card containing information that the others in the group did not know. Each card showed one of four advantages (as determined by the teachers) (the flat has two bathrooms; it has a rectangular form; the kitchen and the dining room are separate; and the balcony is 8 square meters) and one of four disadvantages (again, as determined by the teachers) (the flat has only two rooms; it does not have an entrance hallway; the bathrooms do not have windows; and the total area is 65 m^2) (see Fig. 2).

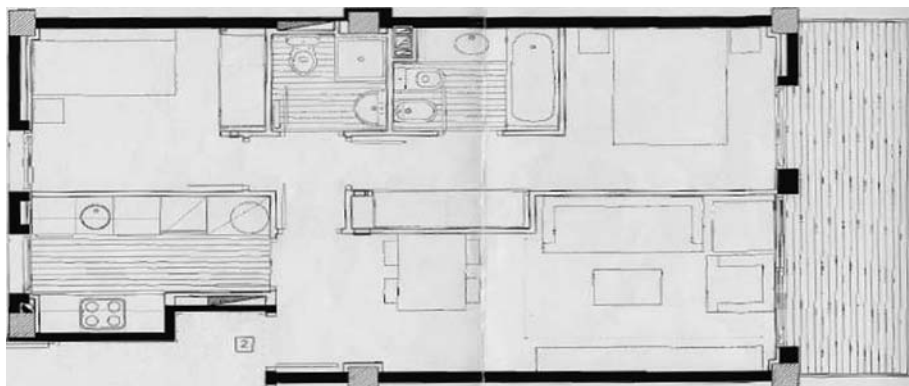


Fig. 1 Blueprint of a flat

Un pis amb...	
avantatges	- Té forma rectangular.
i inconvenients	- La superfície total és de 65 m^2 .
Per a un pis millor: _____	

A flat with...	
advantages	- It has a rectangular form
and disadvantages	- The total area is 65 m^2
For a better flat: _____	

Fig. 2 Example of information card

The blueprint does not contain the scale, and students can know the flat's extension only if they read one of the cards. The need to exchange information is thought as a way to encourage communication. After having shared the information, the group has to agree on how to improve the conditions of the given flat to construct a flat that is considered better by all the students in the group. Finally, they have to represent it and defend their flat in the whole class discussion. The process of representing the flat involves geometrical and proportional reasoning when making decisions and creating alternatives. It also provides students the opportunity to produce written texts when explaining their representation of ideal flats. These texts can be understood as the starting point for a mathematical discussion.

During the design process, Oriol expressed many objections against the cards that were being written. He said flats were being discussed from a middle-class perspective ("We are not taking into account the flats they live in"). Raquel responded that they could not reproduce the students' flats because they did not know enough about them, but instead they could project their knowledge and make it easier for immigrant students to project theirs. The task was therefore thought as a way to promote exchange of knowledge. It was expected that teachers and students would access different mathematical knowledge in the process of solving this task as they might have different interpretations of an ideal flat concerning, for instance, mathematical conditions of area and distribution. Oriol was the only teacher who brought up the idea of changing the content of the cards. The others considered that they did not know enough about the reality of their students and that it was better to see how the students would react. As we will see in the classroom example, it turns out that this discussion in the study group resulted in a recognition of opportunities (Popkewitz 2002). By not changing the cards (which for Oriol were limitations), the students in his classroom became engaged in the task as they questioned the cards' content and in fact ended up changing them.

Similar criteria were followed with all the tasks. Teachers realized that in special classes they were likely to encounter other ways of interpreting the world. Within a unit on the mathematics of dieting, they planned to give a list of foods with their nutritional components and a diet based on rather expensive foods in our context such as mussels, artichokes, and pineapple. Although they had some knowledge about food habits in the different communities represented in their classrooms, they did not plan to write diets that would most likely reflect their incomplete understanding of these communities' eating habits. They wanted students to talk about the diets that would be appropriate for their communities. Although all these reflections show changes in the initial teachers' attitudes toward "Making the students' knowledge enter the mathematics class [Anna]," when designing the "critical" tasks most of them expressed concerns about the quality of the mathematical knowledge being developed in such teaching environments. Oriol was especially worried about "the quality of the mathematics with tasks that were too open."

Learning mathematics

We now discuss immigrant students' work while being engaged with the task on the ideal flat (see Fig. 1). We examine the data to get information about one teacher's experience when implementing a "critical" task. Oriol's classroom is in a high-poverty school in an area of Barcelona where the majority of people are of Asian origin. In this class, students were accustomed to being organized in linguistically homogeneous small groups to encourage communication: three Chinese speakers (Jianying, Jiehmin, Woei), three Spanish non-Catalan speakers, one from Colombia and two from Argentina (Joel, Micaela,

Máximo), three Panjabi (Ahmad, Nashoua, Ibrahim), four Urdu (Hafi, Tahin, Sajid, Khati), and four Berber (Ajana, Kholoud, Dib, Khadija). Following the routine in this class, the teacher posed the task, the students worked in their groups, and at the end they all engaged in a whole-class discussion. During the group work time, most students did engage with the task and exchanged information with their peers. Students in Oriol's classroom were not accustomed to dynamics where they were confronted with certain information and they were expected to react to it. Although they were accustomed to problem-solving environments, they were not so much accustomed to open-ended tasks where the starting situation was not totally given (the information cards are not expected to contain all the advantages and disadvantages that students need to take into account) and where there were several possible interpretations and thus, many correct answers as students' groups. Some comments show this confusion:

A better flat for whom? For us? [Micaela]

This one that you are showing us is your ideal flat, right, teacher? [Máximo]

Despite the initial confusion they all became comfortable with the new dynamics and took the opportunities to talk. They showed insights, skills, and initiatives to resolve emergent questions and to pose their own problems within the small groups. Some students suggested that they did not have all the answers to the mathematical task but they might find answers in collaboration with their peers:

I know how to improve the flat and she [Nashoua] knows how to draw it. [Ibrahim]

How did you draw the 65 m^2 so that you got a rectangular shape [to Jianying]? [Woei]

The teachers in the group had designed the information cards (see Fig. 2) based on their knowledge and experience. The cards, therefore, did not represent these students' realities; this led students to reflect on and analyze their own experience, thus generating alternative knowledge:

It's a flat without middle, there is nothing in the middle. [Ahmad]

How come there are no cards talking about the height of the flat? [Woei]

By providing a task such as the one of the ideal flat where students can challenge each other and the teacher, we open the channels of participation in the mathematics classroom. This is a step toward changing both the students' and the teacher's expectations and foregrounds (Alrø and Skovsmose 2004), which is consistent with our understanding of teacher empowerment. The students' comments during the class were the starting point for the modification of the cards and, in turn, a stimulus in the reconstruction of the students' behaviors. In a conversation with the teacher, some students asked about introducing changes in the cards without modifying "the type of mathematics":

The card that talks about the rectangular shape of the flat is still going to be about shapes. [Ahmad]

Some students rejected aspects of their peers' ways of thinking and doing the mathematical task. But most importantly, they rejected contents of the given cards, that is, the information distributed by the teacher. Within the small groups, different students started questioning the idea of having more than one room or having two bathrooms as advantages: they associated the quantity of rooms and baths with the quantity of families sharing the flat. Moreover, most of them regarded having the kitchen and the dining room apart as an inconvenience: they associated the same function to both spaces and found it absurd to

separate the cooking from the eating moments. For many students, especially the Muslim ones, the kitchen-dining room should be placed in the middle of the flat. In all the groups, the total area of the given flat was not considered as a disadvantage but as an advantage for what they saw as rather big dimensions. Many students showed surprise because they had not been informed about the height of the flat:

We should know about the height. The wealthy flats are the highest. [Nashoua]
You need to know if you can put bunk beds. [Máximo]

Most students participated successfully in an activity different from the usual classroom tasks: they reformulated the cards and represented an alternative flat by using mathematical knowledge mostly concerned with proportionality and geometry. Two groups changed from a two-dimensional blueprint to a three-dimensional shape with one rectangle at the top and another at the bottom (as a rectangular prism). Although the new practices problematized their usual behaviors as learners in the mathematics classroom, in that their quiet behaviors were challenged, they quickly became engaged in the task. They were called on by the teacher and they accepted to engage in ways that called into question the teacher's own conceptions concerning what a good flat means. They proposed new kinds of knowledge (the representation of a flat requires considering the volume, a flat should be distributed according to an area in the middle) and social skills (the competence of being a member of a small group, the ability to interact with others). Next, we give a glimpse of one group's discussion. This group spent over half an hour discussing different possibilities for which representation was better, before finally reaching a consensus. They argued which scale to use and some members of the group were concerned about representing the height of the flat:

We have grid paper, we don't need to draw a scale, every nine squares they represent one square meter. [Tahin]
OK, let's do a three meters ceiling. [Hafi]

This group, like the others, communicated mostly in Spanish, although they used Urdu to clear up misunderstandings. They all seemed to find the task stimulating and discussed how to improve the given flat. They were motivated to try to understand what their peers said and to assist each other to express themselves:

In order to see how we draw one square meter, don't we need to see how many squares there are on the page?" and "How do we draw a small rectangle in the middle of a big rectangle? [Hafi]
How do we represent the height if we've done the scale with squares? [Khati]

All members shared the responsibility for negotiation as each of them held and needed information. However, they were not willing to negotiate everything. Khati, the only female student in that group, did not accept deciding on her own the size of the kitchen-dining room, although she was encouraged to make this decision by herself. Finally, Tahin proposed the surface of the kitchen to be half of the bedroom and twice the bathroom, 10, 20, and 5 m², to have round numbers. Oriol made frequent references to this group when later reflecting on this session during the meeting with the other teachers that week. He also referred to the example with the students talking about the center of the flat. He explained how the students drew on the notion of center of a circle, expanded it to the notion of center of a rectangle, and established the condition of equidistance in relation to the four vertices. In this case, the teacher accepted the coexistence of different worlds of experience as an advantage. The initial notion of center led to talk about the relationships between being a

center of a figure and being equidistant to a part of it. Instead, discourses on deficit and non-participation would have led to think that it was not possible to have a mathematical conversation with immigrants about “the middle of a flat”.

Reconstructing perceptions

In one of the group meetings in November 2005, Oriol referred to the immigrant students in the mathematics classroom by saying that these students might participate by “giving their opinion” and gain some social value from it. He related this students’ participation to talking, rather than to mathematical involvement. This section points to significant changes in this teacher’s discourse. We comment on Oriol’s reflections on his students’ learning in the context of one of the group’s meetings in June 2006. Empowerment requires the production of discourse that goes outside the boundaries of common habits and expectations. In the teachers’ meeting right after the class session we just described, Oriol gives some indication of empowerment in the way he talks about the experience. He says that immigrant students have helped him construct mathematical knowledge that he could not have achieved individually. He says to be “happily” surprised about some of the students’ interventions.

I would have never guessed that Ahmad knew how to differentiate between geometric and arithmetic content. He spent a lot of time convincing his group members of how to modify the mathematics in the cards. He wanted to make sure that the different mathematical contents were not mixed together (...). I listened to how he explained it and I wouldn’t have done it any better. [Oriol, Session 17]

Oriol also talks about the different dynamics of students becoming part of a team where new ways of speaking and acting are encouraged. He especially likes the idea of collaboration taking place spontaneously among the students, without him prompting them to do so. Oriol also likes the students sharing their perspectives by projecting their home realities and contradicting the messages in the given cards because he sees this situation as a way to promote “good” mathematical thinking.

Students collaborated among themselves when they sensed their peers were having difficulties. Some of them noticed that the flats in my mind were different from their real flats. Kholoud told me that it was not a disadvantage to have only one bedroom because it means that the whole family is together. Dib also told me that for him the area of a flat is not so important, though for some people it can mean how many children they are going to have (...). Students associated the number of rooms and bathrooms with the number of families that live in a flat. They said that the flat was small if it was for three families, but it was OK for one family. Kholoud said to prefer one bathroom and not have to share the flat with another family. It was the starting point for good mathematical thinking. [Oriol, Session 17]

Oriol said he started the session talking about a small flat with two small rooms and pointing to the size as the main disadvantage of the given flat (“You’ll see that this is a small flat”). He explained to us in the meeting that as the session went on, his perception of the flat changed. At the end of the session, he had incorporated some of the students’ explanations (“It’s possible that in our culture we give too much importance to the idea of area”) and had experienced some conflicts in public (“Wouldn’t you be more comfortable with a room for yourselves?”). He recognized the distance between the statements given by the task and the students’ realities.

I felt awkward because the task had many contradictions for the students in the special class; luckily they modified the cards. They even made me think that we should have included the height of the flat. It was surprising to see how they represented their ideal flat in the shape of a prism. These are students who don't recognize the term "prism" yet they knew how to represent one and furthermore they do it in a context that makes sense. [Oriol, Session 17]

After listening to Oriol's experience, the teachers started making joint decisions concerning the type of classroom activities that should be posed to their immigrant students

We have to persist with activities that encourage them to talk, even if it is to say that the wording doesn't make sense. [Joan, Session 17]

The tasks have to be so that they explain their reality, not for us to tell them how wonderful ours is. [Raquel, Session 17]

Oriol does not make any references to the students who did not participate in solving the problem, nor do the other teachers inquire about them. He does not bring up either the comments from the students who were somewhat perplexed by the change in classroom dynamics. In this sense, this teacher seems to have "idealized" the experience of this class session, which contrasts with his pessimistic attitude in the initial teacher group meetings. Even though the emphasis on opportunities has to come with an awareness of the limitations, it is reasonable to think that in the process of gaining empowerment, the use of freedom in a positive sense makes us deny the limitations since these are seen as belonging to prior stages of the process of empowerment (Gutiérrez 1995).

The session in Oriol's class was part of a unit on proportionality but most students' arguments did not reflect this. Even so, Oriol referred to the immigrant students as having the ability to identify many variables in the context of the mathematical task that he himself had not considered when preparing it. The ability of incorporating a wide range of knowledge and experiences in the process of solving a mathematical problem might have been interpreted as an obstacle in the students' learning of proportionality. It might have been argued that immigrant students do not know how to simplify the situation by excluding a lot of "mathematically unimportant elements". After having listened to Oriol, none of the teachers reminded him of the unit's main topic. It is interesting to note that in the first meetings, Oriol had asked the other teachers to be careful with "real-life" problems because they could become an obstacle for mathematical modeling. Here again, it seems that Oriol made a sort of idealization of the classroom situation. He put the emphasis on having underestimated some of the students' abilities on previous occasions and did not reflect on the adjustment of the students to what they were initially asked. They were not asked in a direct way about applying the concept of proportionality, but the task had been posed in the middle of a specific unit, and students were accustomed to work on "types of activities" depending on the application of certain topics. What was new to them was the openness of the task, the inclusion of manipulatives—the cards—and the idea of others having complementary information for interpreting the task.

Conclusion

We have described some changes in the teachers' perceptions and practices that occurred in a research situation given by a context of professional development. In our study, during the time for group discussion, teachers succeed in creating an environment where perceptions

are opened for questioning. There are moments when new practices may be controversial because they disrupt ways of thinking that were expressed during the initial group's discussions. But, even in these situations, the proposal of change appears as empowering because teachers accept talking about their students' realities. In most cases, building new relationships within the classroom, by means of using the students' realities as a mathematical resource, becomes an opportunity for empowerment. Collective empowerment, however, does not mean a linear and smooth progress from non-participation toward a shared feeling of inclusion and mastery, although most teachers in our research respond positively. By gaining empowerment, conflicts are not necessarily overcome and old practices are not totally eliminated. Instead, the teachers become more reflective on these conflicts and practices so that they are nearer to actions of change by assuming new roles.

Our focus in this article is on the professional development project within the teachers' group. We understand that teachers' empowerment is deeply related to their students' empowerment. We have data from only one teacher's class session and we are aware that is not enough to make claims about students' empowerment. However, even in just one class session, we saw some indication of the possibilities for changing the patterns of participation. We saw students encouraging their peers to participate and pointing to new ways of interacting with the teacher. The students and the teacher gained power in the context of collective practice by reconstructing their identities as learners of mathematics (learning with others, exchanging knowledge, giving and receiving assistance, etc.). We could see the teachers' and students' processes of empowerment being jointly developed when some of the students in Oriol's class were given the opportunity to change the activity by modifying the information cards and by participating in the resolution of the task about the ideal flat. The negotiation processes between Oriol, the teacher, and some students empowered both the teacher and the students. They were also empowered through changes in the ways of understanding the mathematical knowledge when, for instance, looking mathematically at real-life contexts.

The teachers in the group were not accustomed to introducing real-life contexts when teaching mathematics in special classes, and some of them showed resistance and rejection. However, they looked for changes in their teaching approaches and they asked for a seminar on the design of classroom tasks that helped increase their students' participation. The process of designing tasks led them to explore ways in which the mathematical knowledge can be understood in the classroom. They talked about the use of the mathematics in the interpretation of real-life situations. Oriol made a distinction between "knowing" the term prism and "using" a representation of a prism in the real-life context of the flats problem. When Ahmad, a student in Oriol's class, changed mathematical contents in some of the cards so that they made sense within the context of the problem, Oriol emphasized the arithmetic/geometric distinction made by Ahmad, but also pointed to Ahmad being able to modifying the mathematics in the cards, which is a way of seeing the student as capable of "producing" mathematics to make a situation look more real. The idea of "mathematics as sense-making" (e.g., a prism being something other than an object taken from geometry) was at the core of many discussions within the group of teachers as we went on with the second period of meetings.

The teachers started to think about mathematical knowledge as something beyond logical reasoning and came to explore the students' experiences as a way to arrive at such knowledge. We do not know, however, whether they would have accepted this approach to mathematical knowledge with other groups of students. Joan said in October that he could not spend time in his mathematics classes to work in groups and talk about real-life issues. We wonder whether he was referring to students in special classes or to all students. With all the teachers, we have evidence of important changes in their views on teaching

mathematics, and in the case of Oriol we have evidence of new actions. In order to conclude about a more complete process of empowerment, we should look for issues of responsibility. We should explore whether teachers understand this new approach to mathematical knowledge as a benefit for all the groups of students or if they think of it more (or only) as appropriate for excluded groups.

We finish by sharing some suggestions for how to incorporate a vision of social justice when working with immigrant students. How can we contribute with our teaching to a more equal access to participation and learning opportunities? Does it make sense to think that a different mathematical curriculum and specific materials should be prepared for teaching to minority groups? We believe in an emphasis on participation, communication, and culturally responsive mathematical tasks for all students, not only for some groups of students. Our main recommendations, however, are based on more subtle issues concerning ways of supporting teachers' discourses that convince students who are not from the dominant culture that what they have to say is mathematically relevant.

The teachers in this study acknowledged that they tended to lower the level of difficulty of the mathematical tasks to have them ready for the special classes. During the group meetings, we focused the discussions on deficit perspectives about immigrant students, and on how we needed to reexamine our discourse about students and our actions to gain an understanding of what may encourage the participation of all students. An immigrant student may be quite competent in the understanding of the mathematics and may be willing to participate in the classroom, yet rarely or never engage in the task. Although the nature of the task and its mathematical difficulty are important issues, the classroom discourses on the different groups of students are also important. It is not enough to introduce culturally responsive tasks—that do not exclude students from the minority groups—and properly choose the mathematical contents for the teaching.

In order to incorporate a social justice perspective has very much to do with changes in teachers' discourses. In our research, we assume that these changes may be favored by having teachers jointly working toward the reconstruction of their perceptions of the special mathematics classroom and their teaching role. Contexts of teacher education need to further reflect on why a student with mathematical competence may not show this competence. Teachers need to reflect on their interactions with students and the projection of certain conditions as being learning disadvantages (e.g., the language and culture of schooling as being different from the language and culture of the home). Instead, we propose a focus in which we turn our attention to the advantages of teaching immigrant students, and how the disadvantages have been socially constructed. An immigrant student brings diverse experiences and in many cases more than one language, which can facilitate his/her construction of different meanings for the same mathematical content.

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