

A SURVEY OF RESEARCH ON THE MATHEMATICS TEACHING AND LEARNING OF IMMIGRANT STUDENTS ¹

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This paper presents key themes that emerged from a review of the literature and from solicited contributions from researchers around the world on the teaching and learning of mathematics of immigrant students. Researchers strongly suggest the need for schools to look at the different kinds of mathematics that immigrant students bring with them and to use this knowledge as a resource for learning. There is a clear need for teachers to gain a better understanding of their immigrant students' and their families' knowledge and experiences. The emphasis on language as "the problem" promotes approaches that segregate immigrant students and raise issues of equity in the mathematics education they are receiving. Little research documents experiences that center on diversity and multiculturalism as a resource for learning.

This paper presents the key themes that emerged from a review of the literature on the topic of the mathematics teaching and learning of immigrant students. This topic was one of the four areas that ICME 11 Survey Team 5 addressed as part of our task to examine the research topic of mathematics education in multicultural and multilingual environments since ICME 10 in 2004. One of my main sources of information for my part of the survey team was the work of researchers actively involved in CERME's working group on Cultural Diversity and Mathematics Education.

The purpose of this paper is to highlight the main findings, advances, challenges, and indicate topics for further research in the area of mathematics teaching and learning of immigrant students. Much of this work is actually centered on research in Europe, hence the role of CERME papers. I also draw on the different contributions received from researchers across the world in response to our survey team's call for contributions. Finally, I also looked at aspects of research in the mathematics education of Latino/a students in the U.S. These three sections (proceedings, contributions, and research with Latino/a students) are discussed at length elsewhere (Civil, 2008b). For reasons of space, in this paper I am only highlighting some of the main ideas with special attention to those that relate to CERME research, as a way to encourage further discussion of this topic, the teaching and learning of mathematics of immigrant students, during the working group sessions.

Different forms of mathematics

Several studies address issues related to everyday mathematics, critical mathematics, community mathematics, school mathematics, and so on. Researchers in Greece have been looking at Gypsy / Romany students' use of mathematics in everyday contexts, in particular computation grounded on children's experiences with their involvement in their families' business (Chronaki, 2005; Stathopoulou & Kalabasis, 2007). These

researchers note that schools and teachers seem to show little interest in what knowledge minority students (in this case Gypsy) bring with them and thus, in how to build on this knowledge for classroom teaching. It may be little interest on the part of the teachers, or it may be due to an unawareness on how to build on this knowledge. Elsewhere I have argued for the complexity of the pedagogical transformation of community knowledge into modules for the classroom setting (Civil, 2007).

In Civil (1996) I raised two questions that still seem relevant today: “Can we develop learning experiences that tap on students’ areas of expertise and at the same time help them advance in their learning of mathematics?” and “What are the implications of critical pedagogy for the mathematics education of ‘minority’ and poor students?” More recently Powell and Brantlinger (2008) discuss some of the tensions around their own work with Critical Mathematics (CM) and write, “CM educators should not be satisfied with engaging historically marginalized students in politicized investigations of injustices (e.g., wage distributions) if they do not have access to academic mathematics” (p. 432). As we consider different forms of mathematics and whose mathematics to bring to the foreground, issues of power and valorization of knowledge become prominent. Abreu has written extensively on the concept of valorization of knowledge (Abreu & Cline, 2007).

Teacher education

Much of the research I reviewed for this topic addressed teachers’ attitudes and knowledge of immigrant students. This body of research presents a rather grim picture and thus opens the door to several possibilities for further research. Reports on an European project that is looking at the teaching of mathematics in multicultural contexts in three countries, Italy, Portugal and Spain, point out that teachers feel unprepared to work with immigrant students. César and Favilli (2005) report that teachers in this study underscore the issue of language as being a problem and do not seem to recognize the potential for richer learning grounded in different problem solving approaches and experiences that immigrant students may bring with them. They also note that teachers seem to have different perceptions on immigrant students based on their country of origin. Overall, these reports point to a deficit view by teachers of their immigrant students.

Abreu (2005) reports that most teachers in the studies she examined tended to “play down cultural differences” arguing for general notions of ability and equity, as in treating everybody the same. Gorgorió (personal communication, April 28, 2008) writes, “teachers tended to make invisible the cultural conflict that would arise in their classrooms as a result of the discontinuities between different school cultures and different classroom cultures.” Abreu points out the need for teacher preparation programs to pay more attention to the cultural nature of learning.

Gorgorió and Planas (2005) discuss the role of social representations in teachers’ images and expectations towards different students. In particular, they write, “unfortunately, too often, ‘students’ individual possibilities’ do not refer to a

cognitive reality but to a social construction. Teachers construct each student's possibilities on the basis of certain social representations established by the macro-context" (p. 1180). Researchers are critical of the public discourse that frames immigration as being a source of problems rather than a resource for learning since this discourse is counter-productive to the education of immigrant children (Alrø, Skovsmose, & Valero, 2005). Unfortunately, as Gorgorió and Planas (2005) point out, some teachers use this public perception as their orientation to assess immigrant students in their classrooms, rather than a direct knowledge and understanding of their individual students and families.

There is a clear need for teachers to understand other ways of doing and representing mathematics (Abreu & Gorgorió, 2007; Moreira, 2007). As Abreu and Gorgorió (2007) write in relation to a teacher's reaction to differences between representations of division in Ecuador and in Spain, "the relevant question is not whether there are any differences in the representation of the algorithm of the division, but how teachers react to the differences" (p. 1564). Related to the need for teachers to know about others' ways of doing mathematics, is a need for an expanded view of what mathematics is. Teachers tend to view mathematics knowledge as culture-free and universal (Abreu & Gorgorió, 2007; César & Favilli, 2005). This relates directly to the previous section on different forms of mathematics. Teacher education programs should address this view of mathematics as being culture-free. Moreira (2007) brings up the need for teacher education programs to prepare teachers to research this locality of mathematics (e.g. everyday uses of mathematics).

Issues related to educational policy

Researchers from different countries are critical of educational policies that push towards assimilation of immigrant students. These policies convey a deficit view on immigrants' language and culture, instead of promoting diversity as a resource for learning (Alrø, Skovsmose, & Valero, 2007). Anastasiadou (2008) writes,

The de facto multiculturalism (...) which now describes the Greek society, ... [which] continues to function with the logic of assimilation (...). In the field of education the adoption of the policy of assimilation means that it continues to have a monolingual and monocultural approach in order that every pupil is helped to acquire competence in the dominant language and the dominant culture. (p. 2)

The work of Alrø et al. (2005) is particularly relevant here as these authors take a socio-political approach to the discussion of the teaching and learning of mathematics with immigrant students. They write about the influence of public discourse and in particular of the view of immigration as a problem rather than a resource:

In Denmark, the sameness discourse has spread into a variety of discourses, which highlight that diversity causes problems – it is not seen as a resource for learning. And this idea brings about a well-defined strategy: Diversity has to be eliminated. (p. 1147)

Then, as researchers in other parts of the world have noted, these authors point to the

emphasis in educational policy on students' acquisition of the Danish language as the priority. The idea that mathematics education is political is particularly true when studying the mathematics education of immigrant students.

Language, mathematics, and immigrant students

Many of the contributions I received from across the world were on this theme. Here I can only give snippets of some of those. Most of them point to a clear concern among researchers for restrictive language policies that limit the use of home languages in the teaching of mathematics. For example, Clarkson (personal communication, May 25, 2008) writes,

Mathematics teaching, like all the teaching that occurs in a school, normally is mandated to be carried out in the dominant language of the society. The use of other languages is normally proscribed. For immigrant children this may be an important matter. If they are from homes that speak a language different to the dominant societal language, then much of their formative early learning undertaken before schooling has begun will be encoded in their home language. Hence for schools to take no or little notice of these extra hurdles that such students have to leap is to simply not be realistic.

Staats (personal communication, June 8, 2008) brings another language-related issue emerging from her work with Somali immigrant students in the U.S. She wonders what happens when students do not really know their home language. She writes,

With the educational history of Somalis they do not know their math vocabulary. It is a point of sadness, in fact, for many young people that they feel they do not know any language well, they might know parts of Somali, Swahili, Arabic, Italian, or English but feel insecure speaking any of these.

Elbers provided thought-provoking comments on the situation of mathematics education in the Netherlands. His comments relate to both the prior section on issues related to educational policy and this section on language:

Realistic Mathematics was also criticized as being not real math (also by leading mathematicians in the Netherlands), and being based more on semantics and interpretation of assignments than on math knowledge and skills. They claim that the Dutch good achievement in math in the PISA studies is because the PISA studies do not test real math. Many plead for a return to transmission of knowledge in classrooms. The bad results of minority children in schools, in the recent debate, was partly explained with a reference to educational methods such as students learning by collaboration and investigation. These methods, the argument runs, depend on students' skills in Dutch and therefore these students, because of their language gap, can never be successful in math. (E. Elbers, personal communication, May 14, 2008)

As we can see, once again, language is singled out as the obstacle to immigrants' learning of mathematics. Elbers' comment is even more pointed as it is focusing on a critique of discussion-rich approaches to teaching mathematics that could be problematic for students for whom Dutch is not their first language. Moschkovich

(2007) addresses this topic in her research with English Language Learners in the U.S. She writes,

The increased emphasis on mathematical communication in reform classrooms could result in several scenarios. On the one hand, this emphasis could create additional obstacles for bilingual learners. On the other hand, it might provide additional opportunities for bilingual learners to flourish (p. 90).

As we have seen, in the eyes of education policy-makers and many teachers, not knowing the language of instruction is seen as a major (and in most cases the main) obstacle to the teaching and learning of mathematics of immigrant students. Hence, the push is for these students to learn the language(s) of instruction as quickly as possible. As Alrø et al. (2005) point out, the emphasis on learning the language of the receiving country may occur at the expense of these students' learning of mathematics. Gorgorió and Planas (2001) have documented a similar situation in Catalonia. In my local context there is long history of changes in language policy for education, with some states now having banned or severely limited bilingual education. In Civil (2008c) I present the case of one student who was Spanish-dominant and had a good command of mathematics (she had already learned much of what she was being currently taught in Mexico), but was in a context in which English was the language of instruction. I raise questions about equity and the opportunities for participation and further learning of mathematics for this student.

What about immigrant parents' views on issues of language policy and mathematics education? This is a less researched topic, but one that is quite prominent in our Center CEMELA (Center for the Mathematics Education of Latinos/as)². For example, in Acosta-Irqui, Civil, Díez-Palomar, Marshall, & Quintos-Alonso (2008), we look at two CEMELA sites (Arizona and New Mexico) that have different language policies (in Arizona, bilingual education is extremely restricted, while in New Mexico it is endorsed in their state constitution). This allows us to contrast the effect of such different language policies on parents' participation in their children's mathematics education. An interesting theme emerging from our research with immigrant parents is that for many of them the language also seems to be the main obstacle to their children's learning of mathematics (this parallels what teachers think as we have illustrated earlier). This is the case in our research with mostly Mexican parents in the U.S. (Civil, 2008a) but is also the case with immigrant parents in Barcelona (Civil, Planas, & Quintos, 2005). As immigrant parents focus on the language as being the main obstacle, I wonder whether they are aware of the actual mathematics education that their children are receiving. In particular, I am referring to issues of placement: are the students placed in the appropriate mathematics classroom (based on their knowledge and understanding of the subject) or are schools basing their placement on their level of proficiency in the language of instruction? I wonder about the thinking behind these placement policies. Not only are parents not aware of the implications of this policy on their children's learning (or not) of mathematics, but also teachers often are not either (Anhalt, Ondrus, & Horak, 2007).

Research with immigrant parents

Most of the research I found on immigrant parents and their views of mathematics education was done by Abreu and her colleagues in the U.K. (Abreu & Cline, 2005; O'Toole & Abreu, 2005) and by Civil and her colleagues in the U.S. (Civil & Bernier, 2006; Quintos, Bratton, & Civil, 2005). Civil, Planas, and Quintos (2005) look at immigrant parents' perceptions about the teaching and learning of mathematics in two different geographic contexts, Barcelona, Spain, and Tucson, U.S. Besides these studies in U.K., U.S., and the one study with immigrant parents in Barcelona and in Tucson, I found one study with immigrant parents in Germany by Hawighorst (2005).

There are three related themes that emerged and that cut across all immigrant parents in these studies. Overall, immigrant parents in the four geographic contexts shared a concern for a lack of emphasis on the "basics" (e.g., learning of the multiplication facts) in the receiving country, a perception that the level of mathematics teaching was higher in their country of origin, and a feeling that schools are less strict in their "new" country. Abreu and colleagues as well as Civil and colleagues have looked at these themes in some depth, thus providing an analysis related to issues of differences in approaches, issues of valorization of knowledge, and potential conflict as children are caught between their parents' way and the school's way.

The research with immigrant parents on their perceptions of the teaching and learning of mathematics underscores the need for schools to establish deeper and more meaningful communication with parents. Parents tend to bring with them different ways to do mathematics that are often not acknowledged by the schools, and vice versa, parents do not always see the point in some of the school approaches to teaching mathematics. Although this may be the case with all parents (e.g., in the case of reform vs. traditional mathematics), the situation seems more complex when those involved are immigrant parents and their children. As the research of Civil and colleagues shows (Civil, 2008a; Civil, Díez-Palomar, Menéndez-Gómez, Acosta-Irqui, 2008) differences in schooling (different approaches to doing mathematics) and in language influence parents' perceptions of and reaction to practices related to their children's mathematics education.

Implications for further research

My hope is that this paper will serve as a starting point to hear from other researchers who are working in mathematics education and with immigrant students. There are several implications that this review points to and that I want to briefly mention here. Abreu, César, Gorgorió, and Valero (2005) raise two important questions that should frame, I think, further research in this field. They write, "Why research on teaching and learning in multiethnic classrooms is not a bigger priority? Why issues of teaching in multicultural settings are not central in teacher training?" (p. 1128)

Based on the research reviewed, there seems to be a clear need for action-research projects with teachers of immigrant students engaging as researchers of their own

practice to counteract what appears to be a well-engrained deficit view of these students and their families. Through a deeper understanding of their students' communities and families (e.g., their funds of knowledge), maybe teachers can work towards using different forms of doing mathematics as resources for learning instead of the current trend that seems to view diversity as an obstacle to learning (there are of course exceptions to this view and I address those in Civil, 2008b). Related to this idea of understanding immigrant students' communities, there is very little research looking at the sending communities. That is, what do we know about the teaching and learning of mathematics in the countries / communities that these immigrant students come from? We have recently started one such project in CEMELA, in which we look at the mathematical experiences of the students who are recent immigrants to the U.S. by studying the teaching and learning of mathematics in some sending communities. Specifically, we are looking at mathematics instruction at one school in Mexico across the border from Arizona to gain a better understanding of Mexican teachers' conceptions about the teaching and learning of mathematics. I argue that there is a need for more research along these lines to gain a better understanding of the background experiences of immigrant students.

There is also a need to analyze the learning conditions in schools with large numbers of immigrant students. What Nasir, Hand, and Taylor (2008) write in reference to African American and Latino and poor students is likely to be the case with immigrant students in many countries:

African American and Latino students and poor students, consistently have less access to a wide range of resources for learning mathematics, including qualified teachers, advanced courses, safe and functional schools, textbooks and materials, and a curriculum that reflects their experiences and communities. (p. 205)

Issues of valorization of knowledge and different forms of mathematics need to continue to be explored, as there are still many open questions. Related to this is the idea of non-immigrant students' views of immigrant students. This topic has received little attention (a notable exception is Planas, 2007), yet it seems important to understand how all the students see and understand the experience of being in a multicultural classroom (Alrø et al. (2007) address this topic to a certain extent).

Another area that needs further research is that of immigrant parents' perceptions about the teaching and learning of mathematics. Furthermore, an important and under-researched area is that of interactions between immigrant parents and teachers and perceptions of each other's in terms of the children's mathematics education. Civil and Bernier (2006) address this to a certain extent, but much more work is needed in this area.

Language is a prominent theme in the research with immigrant students and mathematics education. More research is needed that focuses on multiple languages as resources for the teaching and learning of mathematics, once again to counteract the deficit perspective, particularly in the public discourse that sees the presence of

other languages and not knowing the language of instruction as obstacles to the mathematics education of immigrant children. Issues of placement based on language proficiency and the impact that these decisions have on students' learning of mathematics also need to be studied further.

Finally, a clear implication from the research reviewed on this topic is the need for interdisciplinary teams with expertise in different areas including mathematics education, immigration policy, linguistics, socio-cultural theories, anthropology, just to name a few. There is a need for this interdisciplinary expertise, as well as for the development (or refinement) of theoretical and methodological approaches. I find Valero's (2008) comment on this (in the context of mathematics education in situations of poverty and conflict, which are often the norm in immigrant contexts) very insightful:

The theories that have been used to study mathematics learning build on a fundamental assumption of continuity and of progression in the flow of interactions and thinking leading to learning. (...) When [these theories] are simply applied without further examination the result has often been the creation of deficit discourses on the learners or the teachers. (...) The question then becomes how can (mathematics) "learning" be redefined as to provide a better language to grasp the conditions and characteristics of thinking in situations where continuity and progression cannot be assumed. (p. 161)

I leave the reader with the challenge Valero raises in the last sentence.

Notes

[1] This paper is adapted from a longer paper (Civil, 2008b) prepared for ICME Survey Team 5: Mathematics Education in Multicultural and Multilingual Environments, Monterrey, Mexico, July 2008.

[2] CEMELA is a Center for Learning and Teaching (CLT) funded by the National Science Foundation under grant ESI-0424983. The views expressed here are those of the author and do not necessarily reflect the views of the funding agency.

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