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Title	The role of the classroom teacher in supporting bilingual primary pupils in the learning of mathematics
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Publication date	2017-02-01
Original Citation	Ryan, M. and Ní Ríordáin, M. (2017) 'The role of the classroom teacher in supporting bilingual primary pupils in the learning of mathematics', 10th Congress of European Research in Mathematics Education. Dublin, Ireland, 1-5 February.
Type of publication	Conference item
Link to publisher's version	https://keynote.conference-services.net/programme.asp?conferenceID=5118&action=prog_titles
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Download date	2026-11-03 01:49:22
Item downloaded from	https://hdl.handle.net/10468/4006



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The role of the classroom teacher in supporting bilingual primary pupils in the learning of mathematics.

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This paper examines some of key messages in the mathematics and multilingualism in mathematics literature and relates them to opportunities for the development of a development of a focus on the teacher's role in maximising opportunities for learning arising from the bilingual mathematics classroom. Insights will be drawn from the literature on socio-cultural learning, in particular that of situated and discourse perspectives. The implications of these perspectives will be discussed in light of classroom practices and the literature on multilingual learning of mathematics. A proposed project in the teaching of mathematics in Irish Gaelscoileanna will be discussed in light of these discussions.

Keywords: Immersion programmes, teacher role, opportunities for learning.

Introduction

In this paper an examination of literature relevant to the teaching and learning of mathematics for understanding in the bilingual classroom will be conducted, and a rationale for a proposed focus on the pedagogical actions of primary school teachers as they support bilingual learners to make use of opportunities for learning inherent in mathematics classrooms will be presented. It is intended that this focus will begin to address a paucity of empirical research in the mathematics classrooms of Irish-language immersion classrooms at primary level, and will contribute to the growing body of knowledge informed by the notion of language-as-resource in contributing to the generation of opportunities for learning in mathematics.

Theoretical Frameworks

Situated perspectives conceptualise learning to arise from and be dependent on the activity in which knowledge is developed, and reject traditional notions of knowledge as comprising a separate and discrete substance which can exist independently of context or activity (Brown, Collins & Duguid (1989). Discourse perspectives consider learning to be the gaining of access to a certain discourse (Sfard, 2000). While these two perspectives are not directly analogous, there are some commonalities and areas of intersection which might usefully be discussed. Gee (1997) defines Discourse (which he capitalises to differentiate from the everyday understanding of the term) quite broadly as encompassing very many practices that allow for membership, identification and recognition of socially significant identities and alignment with these communities. These communities may be characterised by distinctive, dynamic and evolving discourses, though these qualities can make them difficult to identify, map, or define, and in particular to be definitive in

describing them. The term discourse foregrounds the importance of communication to the extent that to some, the study of mathematical communication has come to be seen as equivalent to the study of mathematical understanding (Sfard, 2000). Something of merit in this approach is that it allows for the concretization of abstract knowledge, which is then located in a social rather than an individual setting. However discourse can be seen to be more comprehensive than knowledge – it is not solely concerned with the 'those propositions and rules that constitute the immediate content of the specific discourse' (Sfard, 2000 p. 161). Situated perspectives hold that, in order to learn best, students must adopt the culture of a practice or domain, use the tools to engage in the concept and engage in a process of enculturation, which is what they understand learning to be. In day-to-day life, people very quickly pick up the norms and practices of a culture, and can quickly adapt to the language, practices and norms of situations in which they find themselves. There is a difficulty however where children are exposed to the tools of a domain but the prevailing culture in which they are immersed is that of the school. Successful participation in school culture does not guarantee and may inhibit successful participation in the domain culture. 'Dependence on...school-based cues make the learning extremely fragile.' (Brown et al., 1989, p. 36). In the case of bilingual education, situated perspectives have also been found to provide a useful analytical lens for engaging with the research, or querying assumptions, seeing bilingualism not as an individual phenomenon, but also social, political, an cultural (Moschkovich, 2007, 2009). Adopting this lens guards against narrow or deficit view on bilingualism, and encourages a wider perspective on what mathematical communication entails allowing for a broad view of competence in mathematical activity across all the languages and registers of the learner.

Role(s) of the teacher

Creating mathematical and classroom discussion norms

Encouraging and enabling children to access the practices of the discipline of mathematics rather than more traditional school activities will no doubt lead to a more satisfying and motivating experience for children, and has been seen to promote learning for conceptual understanding. Unfortunately it does not follow that these practices are straightforward or simple for teachers to set up and children to adapt to, nor that they are automatically maintained once established. Tensions exist between the nature of the discipline of mathematics, for example in terms of what constitutes an argument or a proof, and that of school mathematics. The pedagogical implications of constructivist principles would suggest that children benefit from constructing and accessing concrete or real-world representations of mathematics encountered, which is not always easily aligned with the abstract field of mathematics (Sfard, 2002). Negotiating and reconciling these tensions presents a challenge to the primary teacher, who may have little personal experience in the discipline of mathematics and is attempting to develop norms and practices encountered at second hand. Sociocultural and situated theories themselves suggest that the ways teachers would best acquire these practices – by participating in a community of mathematicians engaged in mathematical work, are rarely accessed by, or indeed available to, these teachers. Some professional development approaches, for example Lesson Study, demonstrate a focus on the collaborative engagement of teachers in interrogating the mathematics they will be presenting to the children

(Lewis, Perry & Hurd, 2009). Of course, teachers may take it upon themselves as collaborating practitioners to deepening their own understanding of the mathematics they teach (Ma, 2010), however these practices are neither widespread nor systematic, and it may be that they are influenced by the cultures of the school and teaching community as much as the practices of mathematics. As such, there is no clear or typical path to support teachers in developing these practices, and it may be that teachers themselves are not aware of or do not accept the need to develop skill in fostering these practices in the classroom. Children are typically well socialized in the classroom culture, which is often based around acceptance of the teacher as the source of authority, the routine completion of routine tasks, and the tacit acceptance that following the steps of standard algorithms equates to mathematical understanding, and they may be reluctant to move away from or quick to move back to these familiar routines (Cobb, Wood, Yackel & Mc Neal, 1992).

The role of the teacher in setting up, supporting and maintaining productive and high quality mathematics and discussion norms in the classroom is addressed by many scholars. Mercer and Sams (2006) point to the significance of the teacher as a 'discourse guide' and support the view that 'that the teacher of mathematics can play an important role in the development of children's awareness and use of language as a tool for reasoning.' (p. 1.). They describe an intervention in which primary age-children can be supported to move away from non-productive talk and discussion practices which comprise a combination of small-group discussion and strong explicit support by way of teacher guidance in productive discussion practices. Whole class approaches have also been successfully supported, such as Math-Talk Learning Communities (Hufferd-Ackles, Fuson & Sherin, (2004)), again with clearly developed and supported roles for the pupils and teacher and with a strong role for the teacher in supporting the pupils as they become accustomed to the new norms and practices. In a bilingual context, a further challenge for teachers and pupils arises in striking the balance between a focus on language development versus mathematical development, as well as attending to the overlap between these two areas (Barwell, 2009). Planas (2014) introduces the notion of language-specific mathematical learning opportunities. The suggestion is that the bilingual learner has additional or other resources to the monolingual learner, related to being a bilingual, upon which they can draw to support their mathematical learning. This draws on language-as-resource stance that recognises the creation and exploitation of opportunities for learning mathematics which arise in the specific context of the bi- or multi-lingual classroom and are specific to these contexts. Even language learning difficulties, which might traditionally have been seen as a barrier to the development of mathematical understanding for the bilingual learner, have been shown in Planas' data to have the potential to generate mathematics learning opportunities, provided a mathematical focus is maintained. In all of these contexts, the teachers under observation have either undergone or are receiving as part of the research professional development support in terms of creating and facilitating reform-oriented classrooms, and there is a commitment to the teaching mathematics for conceptual understanding.

Constructivist and inquiry principles make clear that the kind of traditional, text-book type tasks that children often encounter in the mathematics classroom offer neither the opportunity to approximate the practices of the discipline, nor to engage with the content in a manner that is likely

to lead to a deep understanding of the concepts. The challenge for the teacher therefore is to source or create better quality tasks which might help children achieve both goals. This presents the teacher with no small task, as it is neither possible nor appropriate to import mathematical problems from the field of mathematics, ready packaged for the primary classroom. For some (e.g. Lampert, 1990), the choice of problem is the domain of the teacher alone, a choice to be carefully made, monitored and revised by the teacher, who has oversight on the mathematics and the pedagogical aims of the work. These broad considerations are integrated with a running assessment of the pupils' progress and understanding, which feeds into choices of extension and future problems. Others, among them Yackel, Cobb and Wood (1991), see the child take a more central role in identifying and responding to problems or problematized situations '…Problems arise for children as they attempt to achieve their goals in the classroom. In this approach, children are seen as having a strong role in judging and choosing what they find to be problematic. They hold that '…genuine mathematical problems can arise in the course of social interactions as well as from an individual child's attempts to complete the instructional activity' (p. 395). While both approaches are likely to have many practical features in common in their enactment in the classroom, they arise from different beliefs in the role of the teacher, and perhaps, the agency of the pupil. For either approach, the level of planning, assessment and evaluation places high demands of expertise and ingenuity on the teacher in choosing and steering the mathematical direction of the classroom activity. Challenges arise at this stage, as tendencies have been identified of both pupils and teachers to act in ways which serve to prevent the maintenance of high quality mathematical work, even in reform-oriented classrooms (Stein, Grover & Henningsen, 1996). Often this arises from a tendency for either the pupils or teacher to routinize the task, either through the student seeking a reduction in task complexity, or the teacher taking over some of the complex work. Many instances were also influenced by the inappropriateness of the task, either in content or challenge level.

Supporting opportunities for learning.

The above examples show some of the complexity of the task facing teachers in supporting children's mathematical learning, and some of the competing considerations which vie for attention and focus. The work of Moschkovich and Planas in focusing onto the potential of the bilingual context to offer opportunities to enrich mathematical learning offers new, broader theoretical perspectives to researchers in the area. There is scope to move beyond descriptive tools and frameworks in the case of language contexts, and to build on or develop frameworks for intervention as Hufferd-Ackles, Mercer and Sams, and others have done in the realm of mathematical talk and discussion, but with an eye to the bilingual learner and bilingual classroom.

In many ways, the concerns of learning mathematical discourse, mathematical register and appropriate norms of mathematical argumentation are common to both the bilingual and the monolingual learner. However there are particular issues unique to the multilingual or bilingual learner where the context of having more than a single language to draw on gives rise to learning opportunities. For those of us interested in these particular contexts, these issues demand examination and research, and place imperatives on the researcher to advance what is known about these contexts. In particular, there are opportunities to examine the role of the teacher in creating favourable climates orchestrating and supporting these learning opportunities in formal ways

analogous to the approaches described above in setting pupils up for success through the choice and maintenance of small and whole class discussion practices, and the careful selection and management of tasks. Many concerns of monolingual mathematics learning intersect or are common with multilingual contexts, but multilingual contexts also require a consideration of the intersection of mathematics and language learning from the perspective that combines current thinking from the fields of mathematics learning and discourse with that of language learning and bilingualism. There is a current focus on the opportunities for enriching mathematical learning through the specific contexts of bilingualism, much of which work has looked at the practices of learners as they engage in pair or small group learning (Planas, 2014, Moschkovich, 2009), and which are bounded and contextualised by the social and political practices and constraints of each context, both at a micro and macro level.

Context of the study

My work is located in the Irish language immersion context which caters for a small but significant and growing minority of children who access their education through the language of Irish. Irish is a Celtic language which was the majority language of the population up to the 19th Century where it went into decline due to a variety of socio-political factors. (Hindley, 1990). About 12% of primary age children attend Irish language schools, though about five per cent of these are living in areas in which Irish is the first language. The remaining seven percent of children attend Gaelscoileanna, where their school grounds represents an Irish language enclave, where the use of Irish is the socially and politically approved practice and the use of English is restricted. As such, it may be considered to be an example of maintenance heritage language education. These children live in areas which are predominantly or exclusively English-speaking, and may not conduct other parts of their lives through Irish. Gaelscoileanna represent a parent-led, bottom-up addition to the state education system, which has gained strength since its inception in the 1970s, and though initially the pupils were as likely as not to come from households where Irish was spoken, and where it was spoken at least 'often' almost one quarter of the time, (Cummins, 1974, Cited in Coady & O Laoire, 2002) more recent indications are that this is the case for less than ten per cent of Gaelscoil pupils (Coady & O Laoire, 2002). While research has been conducted on achievement levels of primary school children (Gileece et al., 2012) and on mathematical success related to language competence (Ní Ríordáin, 2011), and on the practices, dispositions and time allocations of various curricular areas in Gaelscoileanna compared to other schools (McCoy Smith & Banks, 2012), there are very few studies which look at classroom practices, how they may be characterised or how they may influence learning. An apparent discrepancy in achievement in mathematics between Gaelscoil children at 6th class (the final grade of primary school, children are typically about 12 years of age) and those in other schools, which emerged from the national comparative studies of attainment (Gileece et al, 2012). In much of the literature on the bilingual mathematics classroom, there is a focus on the learner, on their practices and language use (E.g., Wyn Evans, 2007; Clarkson, 2007; Planas, 2014).

I propose to design and conduct a study, using multiple case study methodology (Stake, 2006), to explore the following questions.

•How might the practices and discourses of the senior Gaelscoil classrooms be characterised in relation to the roles played by the teacher regarding the interaction between supporting language learning and mathematical thinking?

•How might the mathematical conversations in senior Gaelscoil classrooms be characterised regarding the nature, content and outcome of these conversations?

•In considering the CPD needs of Gaelscoil teachers, what might be an effective intervention to improve the mathematical thinking and communication of the pupils?

These questions, in particular the first one, will draw heavily on ideas presented above around developing theoretical and empirical ideas in this area, with a particular focus on the possibilities offered in the field of pedagogical practices to help to generate and support the opportunities for learning inherent in bilingual communication. I hope to add to what is known in the context of Gaelscoil education and to the learning of mathematics through the Irish language, and to the wider field of bilingual and multilingual teaching and learning of mathematics.

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