

Unpacking “Language as Resource”– the case of mathematics education in Sweden

Ulrika Ryan, Petra Svensson Källberg, Lisa Björklund Boistrup
Malmö University

In this paper we unpack epistemological aspects of language and mathematics potentials embedded in the “language as resource” discourse. We use research literature, policy, and interviews with a mathematics teacher and a multilingual student to illustrate the potentials and how they are realised in the material. We identified a ‘lever potential’ and ‘one new whole’ potential. To consider the potentials in a nuanced way, we propose an analytical model which contributes with theoretical conceptualizations that allows for grasping a relation between epistemologies of language and mathematics from the perspective of the language as resource discourse.

Introduction

To consider multilingual students’ first *language as resource* (from now LAR) is nowadays a prevailing discourse in mathematics education research (see for example Adler, 2006; Planas & Setati-Phakeng, 2014) and policy (Norén & Källberg, 2018) in Sweden and elsewhere. Over the years it has been possible to identify displacements in LAR discourses (Ryan & Parra, 2019).

Recent displacements, referred to as waves by Ryan and Parra (2019), connect to today’s increased diversified migration patterns that complexify students’ cultural, social and language identities (Barwell, 2016), which is reflected in contemporary Swedish mathematics classrooms. Hence, the notion of LAR appears to encounter new arenas at schools in Sweden, which calls for new theorisations and conceptualisations of language use and mathematical knowing. In this paper, by unpacking epistemological aspects of multilingual language use and mathematics in two waves (see below) of LAR discourses, we illustrate how these aspects may be realised in multilingual mathematics activities.

Our aim is to provide theoretical conceptualizations that allow for grasping a relation between epistemological aspects of language use and mathematics in mathematics activities from the perspective of LAR. In this empirically driven theoretical paper, we capture activities in a broad sense, including for example attitudes, experiences and the practical doing of mathematics.

Our first step is to locate epistemological aspects of language use and mathematics in two waves of LAR in the research literature to illuminate embedded potentials. By *potentials* we mean the possibilities of becoming realised in practical activities. In the second step, our endeavour is to explore how the

potentials are realised in practice. We use empirical examples from different types of data to illustrate how potentials of LAR may be realised. In the third step, we offer an analytical model based on the outcomes in the first two steps.

Our guiding questions are: a) how are epistemological language and mathematics potentials of LAR realised in Swedish educational policy documents on multilingualism (and mathematics learning)? b) how are those potentials realised in teachers' and students' multilingual mathematics activities? and c) how may possible realisations be conceptualised?

Identifying potentials of language as resource

In this first step we locate epistemological aspects of language use and mathematics in the two waves of LAR identified by Ryan and Parra (2019) in the literature to illuminate embedded potentials.

The first wave of language as resource and its potentials

The first wave of LAR originates from a language planning in the US in the 80's. LAR was introduced as an alternative stand to the conflicting positions between minority groups' right to their languages and minority languages as a problem to the dominating society (Ruiz, 1984). Norén and Källberg (2018) analysed official Swedish policy texts concerning newly arrived students. They found that although policy texts were framed within the notion of LAR, newly arrived students were conceived of in deficit ways. For instance, according to Norén and Källberg (2018) newly arrived students need to develop proficiency in the Swedish language and in school mathematics to succeed in the Swedish school system, which resonates with Swedish as the legalized official public language and therefore the language of learning and teaching in Sweden (SFS, 2009:600).

In the first wave of LAR (as described by Ryan & Parra, 2019), learning mathematics in multilingual mathematics classrooms are directly related to students' opportunities for communication and participation in mathematics (see for example Planas & Setati-Phakeng, 2014). This entails, for instance, flexible switching between named languages such as for example Arabic and Swedish, *code-switching*, which is intended to support multilingual students' participation in learning opportunities (Planas & Civil, 2013; Planas & Setati-Phakeng, 2014). In this wave, dilemmas are addressed, such as whether to be concerned with students' learning the dominant language of instruction necessary for them to proceed to higher education or for students to use informal mathematical talk in their first language to learn formal mathematics (Adler, 2001; Planas & Setati-Phakeng, 2014). According to Prediger and Zindel (2017), communicative aspects of language use are highlighted, while epistemological ones are usually downplayed in research on multilingual mathematics activities. Further, Ryan and Parra (2019) showed that socio-cultural nuances of languages and mathematics (as a plural noun) inherent in multilingual students' language use are usually not

considered in the literature. However, recently, Prediger, Kuzu, Schüler-Meyer and Wagner (2019) explored these inherent nuances in Turkish and German speaking students' mathematical activities. They identified two bilingual modes, that multilingual students use, which contributed to deepening their conceptual understanding of fractions (further elaborated in the next section).

Although flexible views on language use are advocated for in this wave, we conclude that named languages are treated as separate language practises. The main goal of the first wave of LAR appears to be proficiency in the language of instruction. The epistemological target in this wave, is students' reproduction of formal school mathematics that is universal and culture-free (see Chronaki & Planas, 2018). The wave resides in the separation of formal and informal mathematics. Thus, in the first wave of LAR, multilingual students' first language has the potential to move them from informal mathematics talk in their first language to access formal school mathematics in the language of instruction.

The second wave of language as resource and its potentials

Presently a second wave of LAR is emerging in mathematics education research (Ryan & Parra, 2019). Research in line with the second wave of LAR has begun to consider that diversified migration patterns have complexified student cohorts in multilingual mathematics classrooms (Barwell, 2016). Consequently, pedagogical tools and research approaches from the first wave of LAR have become insufficient for understanding multilingual mathematic activities of today. To meet the new conditions and arenas the second wave offers theorisations of LAR that attempt to move away from separations of named languages (see for example Barwell, 2018; Planas, 2018) and considers students' production of mathematical knowledge as a multifaceted cultural activity (see for example Chronaki & Planas, 2018). Ryan and Parra (2019) note two major displacements that have been made in the second wave of LAR.

One displacement is to recognise the resolution of distinct national languages that students (and teachers) may code-switch between, through the introduction of the notion of *translanguaging* (from now on TL). According to García and Wei (2014), TL is the “enaction of language practices that use different histories, but that now are experienced against each other in speakers' interactions as one new whole.” (p. 21). Thus, TL is not a linguistic hybridity but a new language practice. From a TL perspective there is no such thing as first and second languages, merely languaging. TL differs from the notion of code-switching in that it does not refer to a shift between two languages, but to the speakers' construction and use of new original and complex language practices that cannot easily be assigned to one or another traditional definition (García & Wei, 2014). Hence, multilingual language use is not a matter of separate named language systems, but of dynamic synthesising of language varieties. Bagga-Gupta and Messina Dahlberg (2018), who scrutinised the political and pedagogical functions of TL in Swedish

education, wrote that TL “is framed in terms of a teacher’s professional competence for the purposes of dealing with educational practices where many language-varieties are used” (p. 398) and as such has become somewhat of a slogan which appears to preserve multilingualism as something beyond ‘the normal’.

Another displacement is that pluralities in epistemological aspects of mathematics are addressed (as opposed to a focus on students’ move from informal to formal mathematics). Chronaki and Planas (2018) emphasized that a focus on students’ production of mathematics as cultural activities is necessary, in order to recognize the connections between mathematical epistemologies and cultural aspects of language use.

According to Ryan and Parra (2019) this is a crucial contribution to the discussions on multilingualism in mathematics classrooms, while multilingual students do not merely bring diverse languaging into the classrooms, but also the mathematical knowledge systems embedded in their languaging (Knijnik 2012). Hence, in multilingual mathematics classrooms, language is not merely a matter of communication but also of ways of knowing mathematics. Prediger et al. (2019) noted a difference between synthetic and analytic language rationalities in German and Turkish that seems to impact on students’ conceptualisations. In German the meaning of for instance $\frac{2}{3}$ moves from the parts to the whole, while in Turkish it moves from the whole to the parts. The example illustrates two nuances in ways of knowing fractions. Another example is demonstrated by Knijnik (2012), who showed that cultural activities, such as measuring the area of land, uses mathematical knowing that addresses the mathematical need within particular culturally situated activities and that partly shares resemblance with school mathematics. Thus, multilingual students may need to handle culturally related epistemological aspects of language use and mathematics, both on micro and macro levels.

In terms of step one, locating potentials of the second wave of LAR, we conclude that the potentials of the second wave incorporate multilingual language use in terms of TL and mathematics as cultural activities. The second wave embraces the production of ‘one new hole’ that comprise new ways of languaging and consequently students’ production of new ways of knowing mathematics. Thus, we conclude that the potentials reside in knowing mathematics as an activity of synthesising a plurality of mathematics, among which one is school mathematics in the language of instruction.

Theoretical framing and methodology

In the second step of the process of unpacking the potentials of LAR, we identified theories of TL and epistemological aspects of mathematics when analysing the empirical material. We use Gee’s (2011) work with “Big D” Discourses and “little

d” discourses to understand how the potentials we identified in step one may be realised in our material.

Big D *Discourses* are widely known in society and recognised by many people. They guide what is generally taken to be ‘the normal’. For instance, either wave of LAR can be viewed as a Discourse in which it is ‘normal’ that students’ languages are viewed as resources, and not deficits, in their mathematics learning. In its broad sense, a D/discourse contains all types of interaction, formal and informal speech, and all kinds of written texts (Gee, 2011). In contrast to Discourses, *discourses* refer to language in use, that is related to the everyday activities of the individuals. In people’s everyday activities, discourses, are influenced by Discourses at the same time as these discourses influence Discourses (Gee, 2011). Thus, there is a mediation between D/discourses. The mediation takes place due to people’s often unconscious *taken-for-granted theories* (from now on *TFGTs*) in action “about how the world works that we use to get on efficiently with our daily lives” (Gee, 2011, p. 76). In this study TFGTs constitute the mediation between the potentials embedded in LAR Discourses and the discourses realized by policymakers, teachers and students’ texts, speech and actions.

Potentials embedded in LAR Discourses are realised as people speak and act based on (their) TFGTs of multilingual mathematics activities. Thus, we searched for TFGTs on epistemological aspects of language and mathematics in empirical material. This enabled us to interpret how TFGTs underpin actual or suggested mathematics activities and thereby make real the potentials of LAR that we unpacked in step one. Therefore, to illuminate those realisations we analysed illustrative empirical material by emphasising the mediation between D/discourses based on a) how language use emerges within the TFGTs, b) how mathematics emerges within the TFGTs, and c) what the TFGTs accomplish.

The empirical material has the role of supporting, illustrating and driving our theoretical conceptualizations and conclusions. Hence, we follow Labaree (2012) who claimed that the role of empirical material is not necessarily to *be* the research result, but rather to support it. Thus, the empirical material is selected on those grounds. We chose two different types of empirical material since multiple types of empirical material enabled us “...to open up a more complex, in-depth, but still thoroughly partial, understanding of the issue” (Tracy, 2010, p. 844): policy documents and interviews with a multilingual secondary mathematics teacher and a multilingual Grade 5 student.

We based the selection of the policy text on the following criteria; it was issued by the Swedish National Agency for Education (Skolverket), hence guiding teaching, it deals with LAR, and it addresses mathematics. We chose; *Studiehandledning på modersmålet* [Supervision in the mother tongue] (Skolverket, 2015).

The interviews were selected since they comprise epistemological aspects of language and mathematics in multilingual contexts. The interviewed mathematics teacher, whose mother tongue is Arabic, participated in a school development project on TL. The interviewed student was a fifth-grade second-generation immigrant student who spoke Persian and Swedish at home.

Analysis of the empirical material

The analyses (also step two) of the empirical materials are separately presented. All excerpts are translated from Swedish into English by the authors.

In Sweden, a student whose language proficiency in Swedish is considered impeding the student from meeting learning requirements has the right to subject specific supervision in her mother tongue. The selected policy text is a support material for principals, teachers and supervisors for organising and implementing student tutoring activities in the mother tongue. The policy clearly builds on LAR Discourses, promoting multilingualism for learning Swedish and subject specific contents. This is in line with theories of TL, thus there is a potential for a new language practice:

Multilingualism is in many ways a resource for both the individual and society. Therefore, it is important that teaching in the school affirms the students' multilingualism and that teachers in all subjects take responsibility for the students' language development. Multilingualism may involve anything from mastering two or more languages as good as a native to only being able to use their different languages in certain situations or for certain purposes. (Skolverket, 2015, p. 8)

Multilingualism is a resource for the individual and for society. However, the TFGTs on language use suggest separation of named languages. This Discourse indicates potentials of the first wave of LAR, multilingualism as a potential for developing Swedish language skills, which is explicitly expressed in the quote above. The TFGTs for supervision in mother tongue also refer to potentials of the first wave, since the goal is to learn Swedish. Swedish is the desirable and *the* language to know mathematics in.

Another purpose is to provide support for the students to develop knowledge in school subjects. In the selected policy text, created fictional examples illustrating different ways of organising supervision in the mother tongue are presented. It is not explained why the examples in the policy text concern school mathematics. However, they make the TFGTs on teaching and learning mathematics visible. Since there is a focus on teacher led instructions and solving (textbook) tasks, a 'task-solving focused school mathematics' Discourse (Andersson & Wagner, 2018) emerges: "The supervisor was in the lessons to help understand teacher led instructions held in Swedish and as a support when Natakan worked on tasks on his own" (Skolverket, 2015, p. 19). This quote shows how

TFGTs imply that mathematics is learnt through teacher led instructions and by individual task-solving and reproducing formal school mathematics. Thus, the realisations of LAR in mathematics specific supervision are to accomplish the disposition of students from knowing informal mathematics in their mother tongue to knowing formal (school) mathematics in Swedish. Potentials for new ways of knowing mathematics are not visible in the policy text.

Interviews with a Mathematics teacher and a student. The interview with the mathematics teacher took place after an observed mathematics lesson, in which the teacher attempted to use TL as pedagogy. Below he talks about what happened when the students were encouraged to use their mother tongue in class:

Teacher: It might be that it gives results for them, the group with the same language, it may help. You saw the boy, he does not know Swedish he has been in Sweden for four months. He was up at the white board and talked (in Arabic) since he saw others talking with the same language. It is the first time he is up and talks.

The TFGTs promote TL and the potentials of LAR can be realised as new language practices in the mathematics classroom. However, in the teacher's talk, mathematics potentials appear to reside in traditional textbook task-solving. "It [TL] takes a long time to, instead they did three, four tasks or something in the lesson that lasts an hour, they should do at least 20 tasks...". The teacher's strong focus on students solving textbook tasks indicates a that textbook mathematics is at heart. Andersson and Wagner (2018) found that textbook tasks offer "one" way of knowing mathematics, and activities that account for epistemological plurality are rare. Thus, in this case, since only one way of knowing mathematics is present, other ways of knowing mathematics are silenced. This results in a separation of different ways of knowing mathematics.

In the interview with the multilingual student Aldrin, he shared that his mother, who liked mathematics, used to bring him additional mathematics tasks in Swedish that she printed from the internet.

Ulrika: Why do you think that is?

Aldrin: I don't know. So that I will learn more Swedish.

Ulrika: OK. Does she think that it is important for you to learn more Swedish?

Aldrin: I don't know. I think it is because the tests I take here at school are in Swedish. That is why.

Aldrin's mother and Aldrin himself appear aware of Discourses on Swedish as the desired. Therefore, Aldrin needs to practise Swedish while doing mathematics. The TFGTs in the excerpt relates to separate named languages. Above, we described separation between formal and informal mathematics and recognition of mathematics as universal and culture-free as additional characteristics for

realisations of the first wave of LAR. From an epistemological perspective we find this excerpt contradictory. On the one hand, if mathematics is universal and culture-free, practicing mathematics would be the same thing in any language. Hence, Aldrin should be able to practice mathematics at home in Persian and still succeed at mathematics tests in Swedish, while it ought to be same mathematics that are at play. On the other hand, it is possible that Aldrin's mother has noted that world views and mathematical knowledge systems are embedded in languages (Ryan & Parra, 2019) and inferred that doing mathematics in Persian is different from doing mathematics in Swedish. Consequently, to succeed at school Aldrin must do mathematics in Swedish, since it is Swedish mathematics that is tested.

Conclusion and presentation of an analytical model

Here, in the third step, the outcome of the two first steps of this study constitute our theoretical conceptualization of the potentials of LAR on which we base the analytical model that we present below.

We conclude that when epistemological aspects of mathematics and language potentials of the first wave of LAR are realised they are utilised as a *lever*. A '*lever*' *potential* whose realisations move the students from informal mathematics talk in their first language to formal mathematics talk in Swedish. When epistemological aspects of mathematics and language potentials of the second wave of LAR are realised they constitute prerequisites to produce new ways of languaging and knowing mathematics. We use García and Wei's (2014) wordings as we name this potential the '*one new whole*' *potential*.

We noted that TFGTs do not necessarily fully adhere to the lever or to the one new hole potential. For instance, in the mathematics teacher's talk about the TL project we found indications of synthesising languages while at the same time constituting school mathematics as separated from other ways of knowing mathematics. In Aldrin's talk we found indications of awareness of mathematical plurality silenced by separating epistemological Discourses on mathematics.

To consider the potentials of LAR in a more nuanced way, we suggest the analytical model in figure 1. The two axes move from separating towards synthesising language use (y-axis) and ways of knowing mathematics (x-axis). Together they make up a surface on which the potentials may be located. We have located the lever and one new whole potentials in the lower left corner and the upper right corner respectively. The model allows us to understand how realisations of the LAR Discourse such as the ones articulated in the policy text, by the teacher and by Aldrin, are mediated by TFGTs of dynamic epistemological potentials of language and mathematics.

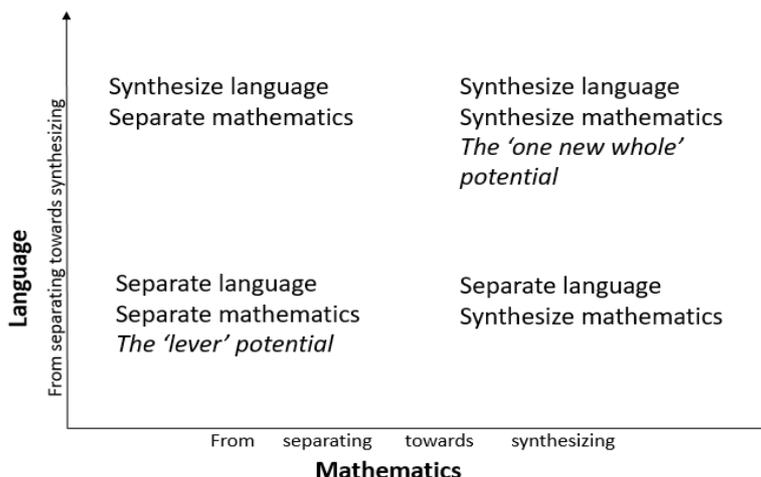


Figure. 1. Analytical model for potentials of LAR D/discourses.

We supply the model to conceptualize such understandings, and thereby illuminate and format awareness of different potentials. However, since research and practice are situated, it is not relevant to evaluate different locations in the model without taking context, purpose et cetera into account.

Bagga-Gupta and Messina Dahlberg's (2018) critique of TL pedagogy sensitised us to the risk of TL pedagogy becoming "a discourse of 'good' language pedagogy for a particular pupil population" (p. 403). Thus, our purpose of the analytical model is to provide means for critical questioning of potentials realised, to illuminate TFGTs in the practice under scrutiny. We find that adding an epistemological focus to discussions on multilingual mathematical activities, allows for avoidance of separating mathematics learning and language learning issues, as articulated by for instance the mathematics teacher in this paper.

We hope that the proposed model will invite scholars to pay attention to the relationship between the epistemological aspects of mathematics and language when analysing multilingual mathematics activities from the perspective of LAR. We realise that LAR Discourses hold many other potentials. We hope that future research will develop the proposed model to include additional potentials of LAR Discourses.

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@inproceedings{Lembr2015SocialisationAM, title={Socialisation and mathematics education in Swedish preschools}, author={Dorota Lembr{\e}r}, year={2015} }. Dorota Lembr{\e}r. Published 2015. View PDF. Save to Library. Create Alert. Cite. Socialisation Tensions in the Swedish Preschool Curriculum - The Case of Mathematics. Dorota Lembr{\e}r, Tamsin Meaney. 2014. VIEW 2 EXCERPTS. Att f{\o}rst{\a} barndom : Till fr{\a}gan om barndom som tillblivelse (becoming) eller vara (being). Mats Trondman. 2013. The language of maths consists mostly of signs and symbols, and, in a sense, is an spoken language. There can be no more universal or more simple language it is the same throughout the civilized world, though the people of each country translate it into their own particular spoken language. In some cases the symbols are abbreviations of words, but often they no such relations to the thing they stand for. We cannot say why they stand for what they do, they mean what they do by common agreement or by definition. SOPHIA KOVALEVSKAYA. So she went to Sweden in 1883 and worked at the University in Stockholm. In her numerous scientific works Kovalevskaya solved the problems which many scientists had failed to solve during many years. foreign languages " in the Swedish educational milieu. It is based upon the following main. assumption: an investigation into the position of these languages in education highlights the. new trends observed in the educational sphere since the 1990s. These new trends themselves. echo the various changes Sweden has been experiencing lately in several domains. Keywords: language-in-education policy, Sweden, English, Swedish as a second language, second foreign. languages, minority languages. 1. Educational studies. RESEARCH ARTICLE. Language-in-education issues: Sweden as a case study. Abstract: From the beginning of the 1990s, the Swedish society has been affected by various. changes at various levels.