

BILINGUAL LESSONS AND MATHEMATICAL WORLD VIEWS – A GERMAN PERSPECTIVE

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With the globalization of human activities, profound foreign language skills are of increasing importance. Bilingual lessons are a promising opportunity to enable pupils to acquire greater foreign language competence within the school context. In Germany, however, a foreign language is rarely used as a learning and working language in mathematics lessons. This paper presents the results of research on subjective convictions of teachers about mathematics as a bilingual subject which underline the central role of mathematical world views in this context.

MOTIVATION

Even though any discussion on mathematics lessons cannot really ignore the socio-cultural context of this school subject, this is even more the case for bilingual mathematics lessons. In the book “The Two Cultures” from Charles Percy Snow, published 1959, the core thesis is propagated that the intellectual world is split into two polar groups. At one pole, there are the literary intellectuals, at the other the scientists, and „between the two a gulf of mutual incomprehension, [...a] lack of understanding” (p. 4). This view is still today – more than forty years later – commonly expressed. Schwanitz (1999) patronizingly remarks in his recently published book “Bildung” (Humanistic Education) on the theme mathematical-scientific knowledge that one may confidently display it but that it is neither a part of humanistic education nor does it represent a part of our cultural heritage. This view sparked off an open, widely-recognized debate in Germany, which also motivated a book by Fischer (2001) called “Die andere Bildung” (The Other Education). The internationally acclaimed Germanist Enzensberger also stresses cultural deficits of mathematics, as expressed in the title of his lecture: “Drawbridge Up: Mathematics – A Cultural Anathema“ (1999) on the occasion of the 50th International Congress of Mathematicians in Berlin in 1998. Furinghetti (1993) also points in a similar direction.

This polarization is increased by the common belief that people are either mathematical-scientifically or linguistically interested or talented. Such beliefs generally have a massive effect on the implementation of bilingual lessons, which is the concrete motivation for this paper. First, general features of bilingual lessons are presented, followed by particular aspects of bilingual mathematics lessons. A short excursion on my approach to world views is presented to enable the presentation and interpretation of the data of the interviewed teachers. Finally a concise conclusion is reached as to which degree mathematics and a foreign language can be combined in

mathematics lessons with the objective of changing world views as expressed, amongst others, by Snow.

BILINGUAL LESSONS

International context

In the last years bilingual teaching and learning programs have more or less established themselves in school education in many countries. Depending on the particularities of the various countries, there exist different forms of realization of bilingual teaching. If one takes a look at the Canadian context, for example, then the conditions in that country are quite different to those of most European countries in the sense that Canada is a bilingual country and that bilingual lessons mean lessons in the two official languages of this nation, denoted in the literature under the term “Immersion Programs” (Swain, 1998).

Besides official bilingual and multilingual conditions, we are as a matter of fact living in multicultural societies worldwide in which more than one language coexist. The desire for integration has led to a multitude of bilingual programs (Ellerton & Clarkson, 1996) – this will however not be dealt with in this paper.

Beyond this, there are in monolingual classrooms other approaches towards the implementation of a foreign language in mathematics lessons (Hofmannová, 2003; Moschkovich, 1996; 2002) – what will be discussed in this paper.

German context

In the following I restrict my elaborations on this theme to Germany, which is officially monolingual but in reality features a number of multilingual characteristics. The discussion of bilingual lessons in Germany is last but not least conducted on the background of an ever faster changing Europe under the so-called “growing-together” of Europe and of a “Europe without borders”. Thus foreign language skills are evidently of increasing importance. In the Federal Republic of Germany bilingual lessons are viewed as a promising chance – not only in academic and professional circles, but also in the public in general – to more effectively increase foreign language learning within the school context.

Features of bilingual lessons

In Germany there exist various didactic approaches to bilingual lessons featuring differing objectives. Without going into details about various objectives, the definition of bilingual lessons employed here is of the utilization of *two* learning and working languages in a non-language subject – in this instance mathematics. In this case one learning and working language is German – the native language of the majority of the pupils – and the other one a foreign language: in Germany overtly English or French. Even though in bilingual lessons the native language is occasionally referred to – for example for comprehension checks or to allow pupils to express affective or emotional moments – the increasing use of the foreign language

is a central objective of bilingual lessons to enable the pupils to acquire greater foreign language competence.

The terminology “Fremdsprache als Arbeitssprache” (foreign languages as working languages) – an expansion of the concept “Englisch als Arbeitssprache” (English as a working language) developed in Austria (Abuja, 1999) – entails a fitting metaphor. Through this approach of using a foreign language one stresses it as a tool – for example for conveying information. In contrast to conventional foreign language lessons the foreign language itself is insofar not the prime topic of lessons here but serves as a medium of communication for the various non-language subjects. Therefore, grammar plays a more minor role in this kind of bilingual lesson.

Eventually the goal is mediation of cultural knowledge and intercultural aspects of the countries and nations in which the foreign language in question is dominant.

Foreign languages in mathematics lessons

Traditionally, in most Federal German States (“*Bundesländer*”) the subjects geography, history, political and social studies are taught in bilingual lessons. In the last years one can note a trend to implement bilingual didactics in mathematics lessons, which is only being executed reservedly on the school level. One must hereby concede, however, that the use of a foreign language is temporally quite limited and usually realized within the framework of small lesson modules or projects.

When realistically viewing the use of a foreign language in mathematics lessons one automatically faces the problem of finding teachers qualified to teach both mathematics *and* a foreign language. Here is where Germany is at an advantage in comparison to some other countries, as in this country you have to be qualified in two school subjects to be employed as a secondary school teacher, which means that the combination of mathematics with a foreign language is principally possible. Regretfully, this subject combination is quite rare in Germany.

This however leads in my opinion to a fundamental question: Even if there were enough teachers with a mathematics-foreign language subject combination – should according to the interviewed teachers these two subjects be extensively combined in mathematics lessons? The attitudes of the interviewed teachers on this will be presented in the following. Concerning opinions of pupils, I refer to Hofmannová, Novotná & Hadj-Mousová (2003) where pupils treat this theme of foreign language in mathematics lessons uninhibitedly and stress the practical use of a foreign language in this kind of lesson: „Instruction in a foreign language will definitely make me use the language in practice.“ (p. 72)

The reserved acceptance concerning the use of a foreign language in mathematics lessons seems to be rooted in the subjective convictions (world views) of teachers – for this reason I will briefly explain the term “mathematical world views”.

MATHEMATICAL WORLD VIEWS

Subjective views on mathematics are generally called “mathematical beliefs” (compare the extensive discussion in Leder, Pehkonen & Törner, 2001). If the case is a comprehensive system of beliefs – for example on mathematics as a school subject on the whole – then it appears to me that the term world views employed by Schoenfeld (1985) expresses metaphorically more content. I therefore give preference to this term in the following. In accordance to Schoenfeld I understand under world views subjective beliefs and personal theories related to a context that can on the one hand be a single (isolated) terminological object, or on the other hand can also encompass a whole field of mathematics.

As substantiated by a number of research projects already in the 1980s (Köller, Baumert & Neubrand, 2000; Leder, Pehkonen & Törner, 2001), mathematics is typically viewed in the traditional static mode as mechanical calculation and as a field in which numbers and formulae as well as memorization of formulae and results are of central relevance. It is not surprising that such a world view of mathematics allocates language only a marginal role. Bauersfeld (1995) employed the term “language games” to underline to which residual level the role of language can degenerate in the context of specific subject matter. In contrast, a process-oriented understanding of mathematics viewing language as a tool for description, presentation, elaboration, explanation, argumentation, communication and discussion allocates great relevance to language in mathematics. This view is also central when learning is understood in the constructivistic sense and oriented towards this approach.

EMPIRICAL RESULTS

Within the framework of a research project conducted in and around Duisburg, ten teachers were interviewed on their views concerning the use of a foreign language in mathematics lessons. Four teachers conducting bilingual lessons (not mathematics but another non-language subject) and a further six mathematics teachers, of which two teach at a bilingual school, were interviewed. These interviews were video-recorded and transcribed. For the sake of brevity I limit myself in the following to the presentation of the three major argumentation lines of the interviewed teachers without naming their personal identities. This paper is not the place to go into detail on theories of language in mathematics; for this general discussion I refer to Brown (1997); Durkin & Shire (1991); Maier & Schweiger (1999); Niederrenk-Felgner (2000). However, more than one of the interviewed teachers repeatedly mentioned the relevant arguments.

The role of language in mathematics

Our interviewees teaching in a bilingual context describe certain subjects as suitable for bilingual lessons in which pupils and teachers discuss and debate issues offering numerous opportunities for verbal communication. In relation to mathematics lessons, however, one teacher expresses the following: “*In the case of mathematics*

lessons we are confronted with reduced language processes. This subject is about numbers, formulae and calculation. Language hardly plays a role.” Language in mathematics lessons is thus allocated a marginal role, as discussion and debate can hardly occur within this understanding and practice of mathematics. Another teacher sharpens this view by stating that there is only true or false in mathematics; one can implicitly infer here that this teacher may feel he is in possession of the truth – thus discussion and debate are superfluous. A further teacher states the following concerning the role of language in mathematics lessons: *“When I think of traditional mathematics lessons with their countless exercise parcels for silent seat work or homework – you really don’t need language for that!”* A further facet of mathematics is implied here that goes beyond the aspect of being calculation, namely of mathematics as a solitary occupation rendering communication between individuals simply unnecessary.

In opposition to this, a mathematics teacher working at a bilingual school views reduced language processes as an asset by pointing out that in mathematics lessons a high level of language competence is not necessary; thus grammar plays a subordinate role in bilingual lessons: *“One does not need good grammar knowledge in mathematics lessons and therefore pupils can start relatively early with bilingual lessons, possibly already in the 5th class (10-11 year-olds).”* Both argumentations embody reductionistic views on the role of language in mathematics lessons and lead to differing consequences for the suitability of mathematics as a bilingual subject.

A positive exception is a mathematics teacher who teaches German as a second subject and intentionally promotes language activities of her pupils, e.g. in the form of journals.

Possibilities for culture mediation

Teachers working in bilingual schools underline that intercultural learning is practised in bilingual lessons, i.e. that cultural content related to those countries in which the foreign language is dominant plays an important role. In relation to mathematics one bilingual teaching interviewee pointed out: *“I can hardly imagine intercultural learning occurring in mathematics lessons. Mathematics is an internationally neutral science.”* Another mathematics teacher also takes up this aspect and emphasizes: *“This is not possible in mathematics lessons.”*

Effects for mathematics lessons

Eight of the interviewed teachers cannot imagine that the effort involved in incorporating a foreign language into mathematics lessons will lead to worthwhile results. They cannot see anything being gained by bilingual lessons. Without having the space to discuss the advantages of utilizing a foreign language in particular in mathematics lessons in detail here, the two teachers will nonetheless be quoted here who – in particular in view of Snow’s core thesis mentioned at the beginning of this paper – offer arguments for the use of a foreign language in mathematics lessons. One mathematics teacher in a bilingual school presents his pupils with tasks in

English justified as follows: “I’d like to keep my pupils from pigeon hole thinking that English is only important in English lessons and not in mathematics. At university all academic and scientific texts are in English anyway, so what I do is a good preparation.” One teacher added as a motivation for the use of a foreign language in mathematics lessons the following: “Maybe the pupils will develop another approach to mathematics. Maybe pupils can be reached who are not so interested in mathematics.”

CONCLUSION

For both mathematicians and non-mathematicians interviewed in this paper the fundamentally expressed world view on the role of language in mathematics lessons is equally the decisive argument against (or in one case for) the use of a foreign language in mathematics lessons. Behind these statements one finds various reductionistic world views towards mathematics. The academic discussion on the role of language in mathematics lessons also does not seem to have reached school reality in Germany yet (Brown, 1997; Durkin & Shire, 1991; Maier & Schweiger, 1999; Niederdrenk-Felgner, 2000).

In relation to the second presented argument – the possibilities of culture mediation in mathematics lessons – one can state that all interviewed teachers do not see any implementation possibilities in these lessons. This points to deficits concerning world views on mathematics in society, science and technology. There are however fields involving mathematics which can certainly be interculturally represented, for example when one considers the overtly disapproving position of Germany in the atomic energy debate on the one hand, and the overtly approving position of France on the other hand. To a certain degree such themes can be explored mathematically, thus initiating discussion and debate, also illuminating intercultural aspects of mathematics lessons. Only at a first glance is mathematics culture-free. In another context Presmeg (1998) explicitly points out that mathematics lessons simply cannot be culture-free.

Altering world views of individuals is a difficult task, last but not least also when the theme is mathematics and mathematics lessons. Bilingual lessons entail potential for this urgently needed venture – yet one encounters a vicious circle here: in particular the aforementioned world views stand massively in the way of incorporating foreign languages into mathematics lessons.

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