Cultural and linguistic problems in the use of authentic textbooks when teaching mathematics in a foreign language

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Abstract: This paper is a part of a longitudinal study focusing on qualitative aspects of learning in a foreign language in the development of cognitive processes in mathematics. The aim of the paper is to present a more complex analysis of textbook-based obstacles to communication. These obstacles originate in the process of vocabulary and grammar acquisition within a particular multicultural and sociocultural context. The study was carried out using mathematics textbooks from English-speaking countries which are used when teaching mathematics in English to Czech students.

1. Introduction

In the past decade, the Czech Republic has been undergoing significant changes. Since 1989, when the "iron curtain" broke down, it has gradually changed into a multicultural country which has opened its border to a significant number of newcomers, both from developing and developed countries. At the same time, it has undergone a process whose outcome was to join the European Union. Our membership of the EU naturally puts pressure on our citizens to learn foreign languages. Thus, educators and teachers are looking for new and effective methods to ensure their students' fluency in languages. One of the fast developing methods is Content and Language Integrated Learning (CLIL), which can be employed both for Czech students to learn a foreign language (in this study English) and immigrants to learn Czech (this aspect of CLIL needs further research).

Content and Language Integrated Learning refers to the teaching of a non-linguistic subject such as mathematics through a foreign language. CLIL suggests an equilibrium between content and language learning. Both are developed simultaneously and gradually, depending on the age of students and other variables. The students enrolled in the programme are often highly motivated, intelligent, and have positive attitudes towards the target language culture.

In CLIL, the subject understanding and thinking manifested by the language of the subject are developed through the foreign language (L2). Conversely, the L2 is developed through the non-language content, such as mathematics. CLIL provides plenty of opportunities for incidental language learning which has been shown to be effective, deep and long-lasting (Pavesi et al. 2001). The learners' attention is focused on the non-linguistic subject content and thus the foreign language acquisition can become non-conscious.

This article is a contribution to research in this area, and is based on the following questions:

- How does the use of authentic, foreign textbooks and teaching materials influence Czech students' learning of mathematics?
- How should the teacher overcome the obstacles caused by the use of authentic textbooks?
- What can the teacher trainer do to prepare student teachers to overcome these obstacles?

The main focus in this paper is on the field of problem solving. Before focusing our attention on this domain, the role of textbooks and language aspects of teaching mathematics are summarized.

2. Starting points of our research

2.1 Culture, language and mathematics

"There are many other modes of meaning, in any culture, which are outside the realm of language. These will include both art forms, such as painting, sculpture, music, the dance, and so forth, and other modes of cultural behaviour that are not classified under the heading of forms of art, such as modes of exchange, modes of dress, structures of the family, and so forth. These are all bearers of meaning in the culture. Indeed, we can define culture as a set of semiotic systems, a set of systems of meaning, all of which interrelate." (Halliday; Hasan 1985, p. 4)

Drawing on Halliday and Hasan's perspective, we see mathematical symbols, formulae, etc. as integral components of the world's cultural heritage. Given that there are ways of turning these international symbols into natural languages and vice versa, one may view these 'translations' as delivering a culture through a culture. Moreover, if natural languages are involved in teaching mathematics, one can expect a host of interlinked and interlocked 'code-switching' activities, linking mathematical representations with natural language. In terms of teaching mathematics through CLIL, teachers should, therefore, bear in mind that not only linguistic but communicative competence (i.e. knowledge of both the language and the culture) are necessary.

In the case of problem-solving, for example, Mestre (1988) argues that the language proficiency of the students mediates cognitive functioning. He identifies four forms of language proficiency influencing problem solving in mathematics (p. 215): language proficiency in general, proficiency in the technical language of the domain, proficiency with the syntax and usage of language in the domain, and proficiency with the symbolic language of the domain[1]. Various ways in which the language of the textbook can influence problem solving are presented. But no reference to the target culture is made and thus a very important aspect of teaching mathematics in a foreign language is disregarded. It is not enough to be proficient in the target language, to understand syntax and have rich vocabulary. For successful use of L2 when learning, one must also understand the concepts of the culture and thus link appropriate linguistic representations to appropriate images and thoughts, as with a native speaker. As Gorgorió and Planas (2002) have stated, "even if the mathematical language can be considered universal, i.e. shared by all those doing mathematics, then the language of 'doing mathematics within the classroom' is far from being universal" (p. 30). This lack of universality arises

from the fact that mathematical communication is not culture free. Our mental images are culture-bound and rarely identical to those of a person from a different country (and cultural background).

2.2 Language and mathematics

Language factors influencing mathematics education have been investigated for more than forty years, in areas ranging from psycholinguistics and sociolinguistics to the discourse of school instruction and the teaching of mathematics in bilingual classes. Our research contributes to sociolinguistic aspects of mathematics education.

Hejný (Hejný et al., 1990, p. 26) defines the *language of mathematics* as an arbitrary system of signs by means of which thinking and communication is realised. For the teaching of mathematics, it is important to investigate the relationship between images and thoughts and their linguistic representations. This investigation should be from the standpoint of both the genesis of linguistic representations (the processes of abstraction, specification, systematisation, and formalisation), and their possible deficiencies. The question here is how different the images and thoughts of children brought up in different cultural backgrounds are. If these images and thoughts are widely different, learners will face obstacles in the textbooks and mathematical language of a different country.

According to Pirie (1998, p. 8), mathematical communication can be classified under six headings:

- *Ordinary language*: the language current in the everyday vocabulary of any particular child (varying for students of different ages and stages of understanding).
- *Mathematical verbal language*: "using words", either spoken or written.
- *Symbolic language*: mathematical symbols.
- *Visual representation*: not strictly a "language", but a powerful means of mathematical communication.
- *Unspoken but shared assumptions*: not strictly a "language"; means by which mathematical understanding is communicated and on which new understanding is created.
- *Quasi-mathematical language*: this language, usually, but not exclusively, that of the pupils, has, for them, a mathematical significance not always evident to an outsider (even the teacher).

The language of mathematics can also refer to language used in aid of an individual doing mathematics alone (and therefore include, e.g., "inner speech"), as well as language employed with the intent of communicating with others. Language can be used both to conjure and control mental images in the service of mathematics.

In this paper, we focus on the language of texts, particularly text books. We aim to get insights into how the mathematics register represented in the textbooks is related to language more generally. If images and thoughts are linked with students' mother tongue, and they are taught mathematics in L2, how will the process of translating images into linguistic representations work? What will the spoken language of the classroom be? And what about inner speech? At what stage will the student switch into L2 even during his/her thinking processes? Moreover, how will the fact that the student must overcome numerous extra difficulties connected with the language influence his/her performance in mathematics and his/her understanding of the subject matter? To answer at least some of the questions listed, we decided to analyse textbooks published for native English speakers in English-speaking countries which we refer to as "authentic textbooks" (in contrast to "non-authentic textbooks" written in a foreign country for non-English learners of mathematics in English).

2.3 Mathematics textbooks

Haggarty and Pepin (2002) show that students spend much of their time in classrooms exposed to and working with prepared materials, such as textbooks, worksheets and computer programmes. Therefore, such materials are an important part of the context in which students and teachers work. It is also commonly assumed that textbooks (with accompanying teacher guides) are one of the main sources for the content covered and the pedagogical styles used in classrooms. However, in practice it is not just the textbook itself but how it is actually used in the classroom that matters.

Harries and Sutherland (2000, p. 42) claim that:

> "within a particular country textbooks reflect the dominant perspectives about what mathematics is, the mathematics which citizens need to know, and the ways in which mathematics can be taught and learned…Mathematics text books provide a window onto the mathematics education world of a particular country"

We assume that textbooks do not only open a window onto mathematics but also reflect a nation's socio-cultural values. As Castell, Luke and Luke (1989, p. vii) argue:

> "the school textbook holds a unique and significant social function: to represent to each generation of students an officially sanctioned, authorised version of human *knowledge and culture*" (original emphasis)

In the Czech context, it is still a strongly held belief that all problems of school mathematics can be remedied by a good textbook. Reliable mathematical knowledge can be taught, and students can even learn from a good textbook regardless of their teacher. Underlying this belief is a naïve assumption that the textbook will use the optimal teaching and learning strategy for mathematics (this reveals a belief about the nature for mathematics). If we can discover this optimal strategy and build it into a textbook, it will be possible to teach all students mathematics (Kubínová; Mareš; Novotná 2000). It can happen that teachers restrict the teaching to a simple delivery of contents fixed in teaching curricula and textbooks, and that they support the development of their pupils' creative abilities very little or not at all. Furthermore, teachers often choose their textbooks with respect to mathematics only and are unaware of their socio-cultural contents. As we will show in the following sections, a teacher's lack of concern for the cultural, extralinguistic content of the textbook may cause considerable difficulties and changes in perception of mathematical problems (Kubínová 1999, Kubínová; Barešová; Hanušová 2000).

3. Our research[2]

In this paper, we focus in detail on the ways in which mathematical ideas are influenced in authentic textbooks from English-speaking countries. For the purpose of this paper, attention is restricted to the influence on problem solving. The textbooks used were: an American textbook for young learners, *Addison-Wesley Mathematics*; two Australian textbooks for upper-secondary students, *Introductory Calculus* and *Discrete Mathematics*; and an English textbook, *Elementary Mathematical Ideas.* The diversity of analysed materials (geographical as well as age of target student population) enables us to also take age differences into account.

The study used the following methods: analysis of the language of EFL textbooks (English as a Foreign Language) and teaching materials used in Czech schools; study of TEFL (Teaching English as a Foreign Language) curricula (Charles University in Prague, Faculty of Education); analysis of mathematical textbooks; observation of the milieu of the classroom during EFL and MEC lessons, analysis of video-recordings of MEC lessons, contrasting oral and written forms of the language; comparing linguistic barriers in MEC lessons at schools and in teacher training; the authors' accounts of their own classroom and teacher training experience.

Our analysis was framed by a consideration of the implications of linguistic and cultural differences for problem solving. Using the classification of Pirie (1998), we will restrict our consideration to the ordinary languages (in the CLIL case, L1 and L2), mathematical verbal language and quasi-mathematical language, although we have modified these categories to suit our research aims. We focused on:

1. *non-mathematical vocabulary and realia*: as taught and used in EFL lessons (part of Pirie's 'ordinary language');
2. *mathematical terminology* (Pirie's as 'mathematical verbal' and 'quasi-mathematical language');
3. *grammar* (part of Pirie's 'ordinary language').

Obstacles were identified within each of these areas. In the process of communication, the three groups are not separated, they overlap. However, this division enables us to characterise the nature of the corresponding obstacles more clearly and to indicate possible ways of avoiding them. In the study presented in this paper, we will restrict our attention mainly to the field of posing and solving problems which represents the typical use of textbooks in school mathematical education in the Czech Republic.

In the following sections, we set out the main problems identified in our study and illustrate them with concrete examples from authentic textbooks. In the concluding section we also suggest what the teacher can do to overcome the obstacles indicated.

3.1 Vocabulary taught in EFL lessons versus specialised vocabulary

Vocabulary presented to beginner and pre-intermediate students in EFL lessons covers predominantly everyday life issues. Learners start with real objects that surround them. They learn to speak about their families, school, home, friends and hobbies. Words they are likely to know at relatively early stages are, for example, words connected to food, fruit and vegetables that they are likely to eat (i.e. food that they can buy in Czech shops), items of clothing, colours, school subjects taught in Czech schools, basic housework, time expressions, common household objects, means of transport, etc. It takes time before students get acquainted with realia of the target language culture.

Vocabulary used in authentic textbooks is based on the natural knowledge of English as the mother tongue of the native speakers and the words used refer to everyday objects that surround them in their own country.[3] The groups of words listed below are natural for young American children, but they cause problems to Czech learners. They are either too difficult or they are culture-bound and have no counterpart in Czech culture. In the analysed textbooks in English, we found specialised vocabulary covering e.g.:

- Special parts of clothing (*regular tie, bow tie, ball glove, small bat* – Addison-Wesley Mathematics, p. 9).
- Special packaging (*egg flats, mackerel cases, box of seal food* – Addison-Wesley Mathematics, p. 331, 332); beginner students will only know two words from this list: *egg, box*. If only the word *box* was used in the assignment, it would not change the mathematical content of the problem but would make it much easier for foreign learners.
- Special products or objects used in English-speaking countries but not in the Czech Republic (*geoboard,* Addison-Wesley Mathematics, p. 229, 250, 100).
- Special food (*muffins, batch of bread, rye and wheat bread* - Addison-Wesley Mathematics, p. 87, 88, 100); EFL students will only know the basic terms such as bread, roll, cake but will not be able to distinguish between special varieties.
- Special types of banknotes (*dimes* – Addison-Wesley Mathematics, p. 40). Money is introduced to learners at a relatively early stage of their learning (e.g. New Hotline – Unit 1) as it is used to practise using number words, but the students are only taught official terms such as pounds, pennies, dollars and cents. It would be difficult for the language teacher to make a list of all possible words for money and even more difficult for the students to learn them.
- Special units (*inch, mile, feet* – Addison-Wesley Mathematics, p. 247, 310, 365, *quart, gallon* – Addison-Wesley Mathematics, p. 374). This is a problem that will prove to be one of the most difficult to solve. Either the students must be told to ignore the units and regard them just as variables (but this needs higher degree of abstraction) or they must be taught in advance the differences between miles and kilometres etc. But even if this is explained to the students in advance, they will nevertheless face more difficulties than students who find miles and gallons natural as they have to carry out one extra logical operation (conversion).
- It is not uncommon in authentic mathematical

textbooks that the context of word problems is set in a specific scientific domain, e.g. biology, physics, geography with its specific terminology (e.g. *Douglas fir*, *bamboo, loblolly pine*, Addison-Wesley Mathematics, p. 96; *wingspan, gliders* - Addison-Wesley Mathematics, p. 123 etc.). This usually does not represent any obstacle for native speakers who have learned the terminology in the lessons of the corresponding school subjects but it represents a major obstacle for those who do not study geography, biology, physics etc. in English. Vocabulary used in these sciences is far from everyday and foreign students will not know the terms.

Our observations in CLIL lessons and analyses of solutions of Czech students show that the above presented obstacles are much more important with younger students who are not able to separate reality from the mathematical structure. Students able to generalise are often not disturbed by the lack of understanding of the real meaning of the context terms used. They are able to replace them by general expressions or symbols. Instead of worrying about what a *loblolly pine* or *muffin* is, they simply take it as a variable (x) and continue in the solving process. Also, the higher the level of mathematics taught, the less everyday life context is present in the assignment as the subject of mathematics moves into more general spheres. Thus, the importance of this group of obstacles diminishes with the age of students.

Problems with different ways of expressing basic things can also be included under this heading, such as, for example, the different ways of recording the date in American English and the Czech language,[4] or similar differences in telling the time. In these instances, it is not a problem of unknown vocabulary but a socio-cultural difference (for Pimm, 1987, they are modes of representation). Students are simply used to different standards of recording and saying things. As an example, we would like to point out some of the advantages and disadvantages of expressing time in English and in Czech. In Czech, the usual way of expressing e.g. "5.10 p.m." is "in 5 minutes a quarter past six"; "5.35 p. m." is expressed as "five past half six"; "5.42 p.m." is expressed as "in 3 minutes three quarters past 6". It obviously requires much easier mathematical calculations as it never exceeds adding or subtracting 10. In English, on the other hand, children have to subtract and add up to twenty-nine. Telling the time can therefore be successfully used as the method of teaching English children how to add and subtract. Czech students are taught the English way of telling the time relatively early in EFL lessons. It is presented as a cultural difference, and so the students regard it as something unnatural. Therefore it does not seem the best idea to use it in mathematics lessons as they would have to pay attention to two problems instead of fully focusing on adding and subtracting.

3.2 Mathematical terminology

There is a widely accepted implicit assumption that mathematical notions are culture-free. In their international comparative analysis, however, Harries and Sutherland (2000), concluded: "students from different countries are likely to construct different meanings of multiplication based on their experience of the way in which these notions are represented for them". Our analysis found differences in representation in most of school mathematics domains, not just arithmetic. For example, some terms are known only in a particular language (e.g. the Czech term *central symmetry* is not used in English, the English mathematical term *barrel*[5] is not used in Czech for a special type of solid). When preparing a lesson it is necessary to conduct a conceptual analysis of the corresponding mathematical area. Furthermore, we found that it is sometimes more convenient to use the terminology of L2 than that of L1 because the latter is more precise.

3.3 Grammar

The structures of the English and Czech languages show basic differences. It is obvious that the influence such differences diminish with the developing language proficiency of the particular student; some might influence even high-level mathematics. Differences include:

- Word order: e.g. *What number times 2 equals 8?* or *7 times what number equals 14?* (Addison-Wesley Mathematics, p. 99) uses a word order utterly alien to native Czech speakers who are used to the following two questions: *How many times two equal six* (the number we are looking for is at the beginning of the question) or *Two times how much equals 6?* The English question will, therefore, at first require the child's attention as it is not natural. Nevertheless, Czech students will get used to it quite easily as the question uses the expression *what number* and thus gives a better clue to what the pupil is asked to look for.
- Use of different expressions: e.g. *What is 66 divided by 8?* (Addison-Wesley Mathematics, p. 193); in Czech the question is expressed by *How much is 66 divided by 8?* The presence of the word *what*, instead of the usual *how much*, can be misinterpreted.
- *How many 30s are in 270?* (Addison-Wesley Mathematics, p. 99, p. 319); in Czech the plural is not formed by the ending –s, it has its own form (singular *třicítk**a***, plural *třicítk**y***) and in the written symbolic form in both cases only number *30* is written; *30s* can be either misunderstood or misinterpreted as an algebraic expression.
- There are typical forms of expressing relationships in English, e.g. *three times as long as* (Addison-Wesley Mathematics, p. 170); in Czech this is expressed as *three times longer than*. This different way of expressing the same thing is often the source of misunderstanding.

3.4 Example [6]

To illustrate all of the above points, we have chosen an example from Hull and Haywood (1965, p. 225) in which we present a detailed analysis of the obstacles that non-native students of mathematics will have to face when solving this mathematical problem[7]:

Assignment: Put the following into algebra:

1. There are more people in York than in Exeter.
2. There are not so many people in Exeter than in Bristol.
3. There are roughly four times as many people in Bristol as in York.
4. The population of York exceeds that of Exeter by about 30,000.
5. The total population of York and Exeter is less than half that of Bristol.
6. There are at least 350,000 more people in Bristol than in Exeter.
7. The population of Bristol exceeds that of York by more than that of York exceeds that of Exeter.
8. If York were five times as populous as it is, it would have more inhabitants than Bristol.
9. The total number of people in the three cities is 623,000.
10. The populations of Exeter and Bristol differ by about 363,000.

Mathematical and linguistic analysis of the text

All the items involve *comparing*. 1 and 2 are the easiest tasks, 5 and 7 the most difficult, because the mathematical relations are more complicated. Formulas representing the relations cover, for example, $<$, $=$, $\cong$. A linguistic analysis shows that the tasks contain several comparative forms, including adverbs (less, more, etc. in 1, 5, 6, 7, 8), some specific verbs (exceed, differ, etc. in 4, 7, 10), correlative conjunctions (as … as in 3, 8), prepositions ([exceed] by, [differ] by, etc. in 4, 7, 10).

The following table gives results of a detailed analysis of the content of EFL textbooks and of the wording of the mathematical problem:

Task No.	English expression	Taught in EFL	
		Vocabulary	Grammar
1	more	Yes	Yes
2	not so many	Yes	Yes
3	roughly times as many as	No Yes	No Yes
4	exceeds by about	No	No
5	total populations less than half that of	Yes Yes	Yes No
6	at least more than	No	No
7	exceeds … by more than … exceeds	No	No
8	five times as … more than	Yes	No
9	total number of … 3 …	Yes	Yes
10	differ by about	No	No

The table illustrates what impact inadequate knowledge of L2, its grammar and lexis may have on the process of solving a mathematical problem. A student who does not understand the wording of the problem usually cannot solve it successfully. The presence in the mathematics texts of types of comparison that are not taught in the EFL, as shown in the table, may result in a decrease in success in students' mathematical answers.

The analysis of the tasks therefore gives evidence of potentially greater difficulty in mathematics, in English, or in both domains. There are tasks that have the same level of difficulty of L2 and a more difficult mathematical structure; others with equal mathematical difficulty are more difficult in L2; and some have increased difficulty in both mathematics and L2.

Apart from vocabulary and grammar difficulties, Czech students face the difficulty connected with the geographical data involved in the assignments. Most of them are not familiar with the names of all towns. Thus, the concrete data (names of towns) transform into abstract ones; the names have the same abstract meaning for them as if the towns were labeled A, B, and C. For the English student, the names will have some affective connotations (family ties, friends, holidays, visit) and thus they will feel "happier" or more motivated when solving the question.

4. Reflections

The research presented in this paper is expressed in terms of teaching mathematics in English to Czech students. The results are valid for a range of CLIL situations regardless of the foreign language and the non-linguistic subject.

As already mentioned, the list of items influencing the comprehension of authentic English texts is not complete. Deliberately, well-known facts such as different ways of recording decimals and natural numbers in USA and many European countries were not highlighted. It must be concluded from our analysis, that the higher and more difficult the mathematics that is used, the fewer ordinary language problems the students will have to face. Firstly, as they mature their language competence increases, but more importantly higher level mathematics uses much less everyday language and many more terms and formulas.[8]

What can the teacher do to help the class? We see two main possibilities: the teacher can modify the context of problems presented in the textbooks to more comprehensible areas for Czech students (to replace unknown objects, unfamiliar units, money etc. by more common or in Czech culture existing items), or to present and to use the necessary vocabulary items several times before using them in a mathematical context: either in the MEC lessons or in EFL (if such co-operation is enabled by the EFL teacher). New vocabulary or terminology can be presented in a text and practised through a game, competition, crossword etc. Illustrations accompanying the text are also very helpful. General vocabulary should be revised before the students start solving mathematical problems. Thus it will be ensured that students take real objects as real objects and their solving process of the mathematical problem is not further complicated by having to work with unknown words as with variables. Mathematical terminology will have to be paid much attention. The teacher must ensure that the students understand the words in the context of mathematic and much attention must be paid to grasping them. In this case, MEC lessons will be the appropriate place to get acquainted with them and learn them.

However, if too much attention is paid to the learning

of new vocabulary, less attention can be paid to mathematics itself. The teacher should always bear in mind what they want to achieve in a lesson. A balance between language and mathematics learning must be sustained. Cooperation with EFL teachers may prove to be very difficult under usual school conditions. If the students should be prepared by EFL teacher for every mathematics lesson, EFL and MEC teachers would have to spend hours closely analysing each mathematical assignment. Therefore it seems to be more effective to analyse and reword the existing mathematical problems and to reduce teaching of new (non-mathematical) vocabulary.

The obstacles of the above mentioned type can be overcome only by longer practice of with doing mathematics in English. The repeated attention paid to these difficulties helps students to understand the formulations naturally without being disturbed by the language differences. Suitable activities for giving students more practice in expressing and understanding the English formulations correctly include games. Examples of such games adapted from EFL teaching are presented in Novotná, Hofmannová and Petrová (2002).

What can the teacher-trainer do? Research such as that presented in this paper has important consequences for CLIL teacher training. Since the school year 1999/2000, the Department of Mathematics and the Department of English language and literature of Charles University in Prague, Faculty of Education, has run a special optional course whose aim is to give students involved in pre-service teacher education insight into both theoretical and practical aspects of CLIL, i.e. to extend teacher education and provide its graduates with enhanced qualifications – teaching mathematics in English. The course covers language and cultural preparation, classroom observations, microteaching of peers with the use of innovative teaching methods and approaches, and a variety of related activities (Novotná; Hadj-Moussová; Hofmannová 2001). The course encourages the interaction of L1, L2 and L3, and pays attention to the differences in the teacher's work, i.e. teaching mathematics in the L1 and in the L2 (Hofmannová; Novotná, 2002).

As a consequence of the findings presented in this paper, the course programme was enriched by participants' work with a variety of textbooks and teaching materials for CLIL in comparison with similar materials in the mother tongue (L1); the aim is to get awareness of the specificity of expressing the subject matter in L2 with regard to the age and language competence of the students, and possible obstacles based partly on L1 and L2 interference and partly on the relation of the subject matter and background knowledge of the target language community.

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Notes

1. The second and fourth proficiencies are domain dependent.
2. In the following section we will use mathematics as the non-linguistic subject and English as the foreign language.
3. This was especially the problem of the textbook for young children.
4. The problem with recording dates either as dd.mm.yy common in the Czech Republic or yy.mm.dd common in the USA can represent an obstacle if not clearly explained to students and experienced enough with them.
5. Barrel = a bulging cylindrical shape; hyperonym cylinder (English-Czech Lexicon 2002, Lingea).
6. The original problem is an authentic material, see (Hull; Haywood 1965).
7. Looking at mathematics textbooks from different eras we see that the basic problems are similar in all of them. More information about this issue is presented in Novotná (2000).
8. Both Australian upper secondary school textbooks (Byfield, 1990a, b) represent further evidence for our findings.

References

Castell, S.; Luke, A.; Luke, C. (Eds.) (1989): Language, authority and criticism: readings on the school textbook. - London: Falmer Press.

Haggarty, L.; Pepin, B. (2002): An investigation of mathematics textbooks and their use in English, French and German classrooms: who gets an opportunity to learn what? – In: British Educational Research Journal 28(4) p. 567-590.

Halliday, M.A.K.; Hasan, R. (1985): Language, context, and text: aspects of language in a social-semiotic perspective. - Oxford: Oxford University Press.

Harries, T.; Sutherland, R. (2000): The representation of mathematical concepts in primary mathematics textbooks: a focus on multiplication. - In: A. Rogerson. (Ed.), Mathematics for living: The mathematics education into the 21st century project. Amman, Jordan, p. 142-146.

Hejný, M.; Beneová, M.; Bereková, H.; Bero, P.; Hrdina, Å.; Repá, V.; Vantuch, J. (1990): Teória vyučovania matematice. (Theory of Mathematics Education.) - Bratislava: SPN.

Hofmannová, M.; Novotná, J. (2002): Implementing CLIL: Teaching mathematics in English to Czech learners. Paper presented at the Multilingual Mathematics Meeting, Norwich, UK.

Gorgorió, N.; Planas, N. (2002): Teaching mathematics in multilingual classrooms. – In: Educational Studies in Mathematics 47 p. 7-33.

Kubínová, M. (1999): Moji žáci a já (a matematika). (My students and I.) - In: M. Hejný, D. Hrubý, H. Lišková, N. Stehlíková, V. Sýkora (Eds.), Sborník Jak učit matematice žáky ve věku 10-15 let. Praha: Prometheus, p. 42-57.

Kubínová, M.; Barešová, M.; Hanušová, J. (2000): How teachers' beliefs influence mathematical lessons? - In: A. Ahmed, J.M. Kraemer, H. Williams (Eds.), Cultural diversity in mathematics (education): CIEAEM 51. Chichester: Horwood Publishing Limited, p. 265-270.

Kubínová, M.; Mareš, J.; Novotná, J. (2000): Changing teaching methods in school mathematics: an analysis of some episodes from classes. - In: T. Nakahara, Tadao and M. Koyama (Eds.), Proceedings of PME 24, Volume 3. Hiroshima: Hiroshima University, p. 183-190.

Mestre, J.P. (1988) : The role of language comprehension in mathematics and problem solving. - In: R.R. Cocking and J.P. Mestre (Eds.), Linguistic and cultural influences on learning mathematics. Hillsdale, NJ.: Lawrence Erlbaum, p. 201-220.

Novotná, J. (2000): Analýza řešení slovních úloh. - Praha: UK-PedF).

Novotná, J.; Hadj-Moussová, Z.; Hofmannová, M. (2001): Teacher training for CLIL – Competences of a CLIL teacher. - In: M. Hejný and J. Novotná (Eds.), Proceedings of SEMT 01. Praha: Univerzita Karlova v Praze, Pedagogická fakulta, p. 122-126.

Novotná, J.; Hofmannová, M.; Petrová, J. (2002): Using games in teaching mathematics through a foreign language. - In: L. Bazzini and I. Whybrow (Eds.), Proceedings of CIEAEM 53. Verbania: Ghisetti e Corvi Editori, p. 353-358.
Pimm, D. (1987): Speaking mathematically: communication in mathematics classrooms. - London: Routledge and Kegan Paul.
Pirie, S. (1998): Crossing the gulf between thought and symbol: language as (slippery) stepping-stones. - In: H. Steinbring, M. Bartolini Bussi and A. Sierpinska (Eds.), Language and communication in the mathematics classroom. Reston, VA: NCTM, p. 7-29.

Textbooks

Byfield, S. (1990a): Introductory calculus. - Perth: Mathematical Association of Western Australia.
Byfield, S. (1990b): Discrete mathematics. - Perth: Mathematical Association of Western Australia.
Eischolz, R.; O'Daffer, P.E.; Fleenor, C.R. (1985): Mathematics. Addison-Wesley Publishing Company.
Hull, L.W.H.; Haywood, F. (1965): Elementary Mathematical Ideas. - London: Chatto & Windus.
Hutchinson, T. (1998): New hotline – starter. - Oxford: Oxford University Press.

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