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Mathematics learners' behaviour in CLIL bilingual lessons within L2 external setting

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This classroom-based study discusses the language behaviour of 12-15-year old mathematics learners in introductory CLIL bilingual lessons within L2 external setting. Based on qualitative analyses of audio-records of three lessons in grades 7-9, the argument made is that learners tend to use L2 whenever they are able to. The extent of their L2 use, mostly involving short utterances and phrases rather than long sentences, is much dependent on their L2 proficiency, CLIL experience and the teacher's immediate performance in the classroom. CLIL seems to have a positive impact on learners' alertness and engagement in the lesson. Moreover, the more requirement of mathematical thinking, the less L2 use by both teacher and learners.

Keywords: CLIL, bilingual mathematics education, language use, alertness, engagement.

Introduction

Currently bilingual education catches attention of researchers in various aspects, involving all educational levels and school subjects, including mathematics. One of the most popular and also controversial approaches in bilingual education is CLIL, i.e., *Content and Language Integrated Learning*. New approaches bring about initial enthusiasm as well as worries and dubiousness. As for CLIL in mathematics education in Slovakia, it seems to be still in its infancy, though the several related empirical researches carried out in the past years (Guffová, 2014; Lengyelfalussyová, 2013; Naštická, 2016; Páleníková & Naštická, 2017). Mathematics teachers who are eager to start using CLIL report lack of hands-on teaching materials, which is a critical point, especially when they feel inexperienced in implementing any innovative approach. Having started practising CLIL, they encounter many challenging educational situations. Our effort is to analyse such situations and devise recommendations that might facilitate CLIL mathematics teachers' practice. Below, we present insights from a qualitative study of three lessons taught in a village school where bilingual education is *not* a daily practice. We investigate the learners' behaviour, regarding their use of two languages (Slovak as their first language, and English as CLIL language, henceforth L1 and L2 respectively), learners' alertness and engagement in the on-going mathematical activities.

Theoretical background, research sample and methods

Data from the lesson and learners are analysed within a sociolinguistic view of bilingualism that considers bilinguals as members of social groups using their languages for various functions in their everyday lives (Grosjean, 1994; Valdés-Fallis, 1978; particularly for mathematics education, Moschkovich, 2002; Planas, 2014). The teacher-researcher planned the lessons and designed the applied worksheet following CLIL principles (Mehisto, Marsh & Frigols, 2008). From the many CLIL principles, emphasis was put on inducement of mathematical communication and on integration of language and content educational objectives, such as active vocabulary acquisition and practising question forms (e.g., How many vertexes/faces does a shape have?), while discussing elementary geometrical concepts, distinguishing between two- and three-dimensional shapes, as well as hypothesizing and providing mathematical arguments. Since English is perceived by the learners as a foreign language, and is neither a minority language in Slovakia,

nor a dominant language in any of the neighbouring countries, the analysed learners are cases of Slovak-English bilingual mathematics learners in external L2 sociolinguistic setting (Siegel, 2003; Barwell, 2005).

The three 45-minute lessons in grades 7, 8 and 9 were attended by classes involving four girls and ten boys aged 12-13, eight girls and six boys aged 13-14, and eight girls and five boys aged 14-15 respectively. The lessons were taught in a village school as extraordinary mathematics lessons on St Nicholas celebration, when Slovak teachers often prepare unusual lessons. This is an important note since the school is not bilingual and its students rarely attend CLIL events. The learners are not cases of any continual bilingual education, their estimated L2 proficiency being or approaching A2 level (by Council of Europe, 2001) as required by the national curriculum. The lessons were the learners' very first experience with bilingual or CLIL mathematics education. This brings about consequential perspective to the analysis. The learners' regular mathematics teacher, who had invited the researcher to the classes on the initiative of the school authorities who ask for more frequent CLIL events, was present in the lessons, assisting the researcher, especially in calling the learners by their names, maintaining as normal flow of the lessons as possible. The teacher had already had some experience with CLIL environments and had been consulted previously so that the activity was well suited to the learners' mathematical and language abilities. Although the lesson was not in the learners' current flow of mathematics learning, the content of the lesson was in accordance with national curriculum across all the three grades. This experience was chosen for study as a case of introductory moments of CLIL implementation in mixed classes with learners who had not previously been selected and re-grouped according to their mathematical and/or language proficiency, as it is normally done in bilingual schools.



Figure 1. Shadows of a tea candle on the paper screen of the projecting box






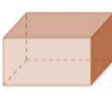




In order to stimulate and develop spatial imagination and argumentation skills in elementary geometry, learners were asked to watch projections of various objects put in a hand-made projecting box and back-lighted so that the objects cast two-dimensional shadows on the paper 'screen' (see elements of the teaching experiment in Figure 1). Then, they were asked to name the planar figures by means of mathematical terms in both L1 and L2 and complete a fill-in-the-gaps exercise in the CLIL worksheet (see Figure 2). Based on the shadows, learners' task was to deduce what objects were projected, i.e., to name the shapes of the objects by mathematical terms denoting solid figures and think of everyday objects which might be hidden behind the screen.

The lessons were audio-recorded and orchestrated following a whole-class discussion structure. Based on the researcher's participant observation and on the qualitative analysis of the transcribed records, this paper discusses what the learners' observable responses were to the CLIL activity and the bilingual nature of the mathematics lessons. We phrase the research question as follows: *How did the bilingual nature of lessons and CLIL approach affect learners' speech, alertness and engagement in the mathematical activities during the introductory stage of CLIL implementation?*

Alertness is considered as the learners' state of active attention enabling them to perceive and response to external stimuli. By the learners' *engagement* in the mathematical activities, we mean their active participation in the whole-class mathematical discussion and/or conversation with their classmates related to the mathematical activities. Although the mutual relation between alertness and engagement is not investigated here, we assume that learners are not necessarily engaged when they are alert, yet, they could hardly become engaged in activities if they were not alert. Alertness is, thus, only partially observable in the audio-records, and more information

would be obtained by video-records. On the other hand, learners' engagement in the activities is reflected in their participation in the discussion, which is detectable in the transcripts. Frequent change of interlocutors in a discussion means that negotiation of meanings takes place, which reflects their engagement in the activity. By contrast, if the teacher becomes the only interlocutor, the discussion changes to a monologue, scarcely allowing learners' active engagement.

Fill in the missing English terms under the pictures (the first letter is stated) and add the right Slovak terms from the list below.

				
S _ _ _ _ <i>Štvorec</i>	R _ _ _ _	T _ _ _ _	C _ _ _ _	C _ _ _ _
				
C _ _ _ _	P _ _ _ _	S _ _ _ _	C _ _ _ _	C _ _ _ _

List of the Slovak terms:
ihlan, kocka, ~~štvorec~~, guľa, kváder, trojuholník, valec, obdĺžnik, kužeľ, kruh

Figure 2. Task from the CLIL worksheet

Qualitative analyses and results

In the following analyses, the classes where the situations emerged are not distinguished as they arose similarly in all the three grades. Interlocutors' utterances originally spoken in L1 (Slovak) are typed in *Arial Narrow italics*, while additional comments describing the interlocutors' actions are typed in *(round brackets, italics)*. We show three of the emerging themes that came out of the qualitative analyses of lesson data with focus on the use of L1 and L2 throughout the activity. The illustrative pieces of data are only some of the pieces linked to the same theme.

Learners wish to use their L2

Learners in the study tend to use L2 whenever they are able to. This is demonstrated in high frequency of their language-switch, surprisingly also in utterances as short as three words, as shown in this transcript:

Researcher: What are the names of the two purple shapes?
Student: *Pyramid and circle.*

Their L1 and L2 speech acts –mostly responses to the researcher's questions– involve rather short utterances, denoting numbers, colours, planar and solid figures, and expressing confirmation or rejection of preceding proposals:

Researcher: *The figure of the cone in the worksheet, what colour is it?*
Student(s): *Yellow.*
Researcher: *It's yellow. So, the yellow one is called cone --- in English (writing CONE on the blackboard). It's a cone. Have we completed the first line?*
Student: *Yes. Maybe (meaning to express "It seems so.")*

The reason for learners' short utterances in L2 is clear – their L2 proficiency, but also the type of the questions the teacher asks; 'why' questions would surely elicit longer responses, regardless of the language. However, the reasons for learners' L1 short speech acts are not that obvious. We assume that learners are somehow 'caught unawares' by the bilingual nature of the lesson. They wish to be able to express their ideas in L2, to show off and flaunt their abilities, which slows down their (audible) reactions. This is but an obscure assumption and might be relevant only to

learners who have just started learning bilingually. Learners need certain amount of time to understand that in CLIL lessons usage and switching of both languages are accepted.

Learners' mathematical activity is not hindered by the bilingual setting

Despite learners being slowed down by the bilingual setting, especially by their personal unnecessary focus on L2 use, their mathematical activity is not hindered. As shown in several transcripts here, learners were alert, obviously focused on and engaged in the lesson activities. Learners' alertness and engagement in the activities were reflected in their frequent involvement in the whole-class discussion. All interlocutors regularly took turns. Also, learners discussed various mathematical questions in pairs, i.e., not addressing the teacher-researcher directly.



Figure 3. The 'suarish' shadow of a playing dice

The following transcript captures a short talk starting with the researcher's question about the 'suarish' shadow cast by a playing dice (see Figure 3) and leading to a deep mathematical talk between two learners, which, unfortunately, was not clearly audible in the record, and was only noticed by the regular teacher taking field notes.

- Researcher: How many sides are there in a square?
Student 1: One.
Student 2: Four. *They are four (addressing his classmate, Student 1)*
Student 1: *But now they are not four (inaudible record of his explanation to Student 2 follows)*

Student 1 was actually right. The shadow was not a square, and the playing dice was not a cube, not having the proper 'spiky' vertices. Student 1 was aware of this, and that is why he considered the whole perimeter of the shape to be the only one side of it, being un-interrupted by any vertices which would divide the perimeter in line segments. As noted by the regular teacher, the learners were highly alert and they perceived very critically the fact that the shadow was not a square. The whole-class discussion continued, again with intervention of the researcher:

- Researcher: How many sides are there in a rectangle?
Student 2: Three.
Researcher: What is a rectangle?
Students: Four.
Researcher: *Rectangle, right?*
Students: Mm-hmm.
Researcher: So how many sides?
Students: Four.
Researcher: Four. And also in a square there are four sides. What's the difference? *What is the difference between square and rectangle?*
Student 1: *That there --- that --- the rectangle is somehow longer than ----- than the --- cube.*
Student 2: *That-----it is longer --- wider ---*
Researcher: *In other words?*
Student 1: *That it is bigger ---*
Researcher: *In a square the sides are ---*
Student 1: *Longer---*
Students: *Equal.*

The researcher's and learners' speech took turns regularly and frequently, indicating learners' immediate alertness and engagement in the activity. As discussed below, the more the mathematical thinking was required, the more both the teacher-researcher and the learners used their L1 (compare the extent of L2 use in the first half of the transcript and in its second half).

We assume that the learners' alertness and engagement resulted from several factors. First, the researcher's presence was unusual, which made the learners behave in a slightly different manner than usual. Second, the use of two languages in mathematics lesson, the idea of learning mathematics bilingually was novel for them, and, as it seems, positively challenging. Third, the atmosphere of the lesson and the CLIL activity naturally demanded learners' alertness and, thus, kept them engaged in the mathematical discussions.

Teacher's and learners' L2 use decreases with the increase of mathematical activity

A closer look in the situations captured in the records suggests that the more requirement and activation of mathematical thinking, the less L2 use by teacher and learners. The following transcript shows one of the discussions in which all interlocutors used only L1, despite other (mathematically less demanding) discussions having occurred in L2 in great extent and frequency.

- Researcher: *The shadow you can see is two-dimensional.*
Students: *Yes.*
Researcher: *It is planar.*
Student 2: *In fact, it must be a cylinder (the other students giggling)*
Researcher: *It can be a cylinder. If it were a cylinder and now I stood it on its circular base and back-lighted it, what would you see?*
Student 2: *A pillar. A column.*
Researcher: *(smiling) What would you see? If the object was a cylinder and I stood it on its circular base?*
Student 1: *A rectangle.*
Researcher: *You would see a rectangle, not a pillar. A pillar is not a mathematical term for any shape, it's a real-life object. But the shape (paused) a pillar is in the shape of a cylinder, that is right, with that I do agree. Anyway, there is something inside the box and I have already turned it.*
Student 1: *Oh, then it is a sphere (the student asserted, seeing a circular shadow again)*
Student 2: *A cylinder, definitely (the rest of the class gave a loud giggle)*
Student 1: *It's a sphere, P*** (calling Student 2 by his first name) How could a cylinder (paused) I mean, a cylinder does (paused, unable to communicate his thoughts in any language)*

Not only learners, but also the teacher-researcher used exclusively L1 in the previous discussion. This seems to be a natural consequence of the learners' level of L2 proficiency as well as the researcher's effort not to put emphasis on languages at the expense of decreased mathematical activity. In other words, the researcher did not dare to use L2 in that situation, being aware that learners' active engagement in the discussion was at stake.

Final discussion

Bilingualism in mathematics thinking and education has been subjected to both qualitative and quantitative research for decades. So far, many authors have reported that bilingual settings, usually requiring language-switching, might slow down one's mathematical, especially arithmetic processes (McClain & Huang, 1982; Marsh & Maki, 1976; Saalbach et al., 2013). On the other

hand, these authors concede that laboratory experiments have only limited implications for classroom settings as well as for bilingualism in relation to other forms of mathematical processes (e.g., problem solving). It seems that although knowledge is not represented in a 'language-independent' way, certain amount of training in required language might lessen the 'bilingual costs' in relation to response times and accuracy of solutions. The findings of our study, not contradicting any of the above-mentioned studies, have direct implications for teaching and learning in bilingual mathematics classrooms. Given our preliminary results, we believe that unnecessary focus on language in CLIL mathematics lessons is a hindering factor in relation to learners' mathematical activity. Our preliminary findings are, however, limited to classes where CLIL as a bilingual education approach is novel for the learners who, in addition, were not selected by their mathematical and/or language proficiency.

This study is part of an on-going dissertation research. The data and results will be subjected to further analyses and comparisons with data obtained in standard CLIL classrooms, i.e., where learners have already been exposed to CLIL approaches for longer periods and are not mixed in terms of specific language and mathematical skills. On the other hand, our empirical experience so far includes the interpretation of pieces of information provided by mathematics teachers who have been practicing CLIL in standard CLIL classrooms for several years, and whose students were once in such a position that CLIL mathematical lessons were novel for them –not in mixed groups, though–. At this stage and in anticipation of further evidence, we assume that the influence of students' personal unnecessary focus on L2 use decreases over time. This fact subsequently clears the way for the emergence of merits of CLIL teaching in bilingual mathematics education.

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References

- Barwell, R. (2005). A framework for the comparison of PME research into multilingual mathematics education in different sociolinguistic settings. In H. L. Chick & J. L. Vincent (Eds.), *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education* (vol. 2, pp. 145-152). Melbourne, Australia: PME.
- Council of Europe (2001). *Common European framework of reference for languages: Learning, teaching, assessment*. Cambridge, UK: Cambridge University Press.
- Grosjean, F. (1994). Individual bilingualism. In K. Brown (Ed.), *Encyclopedia of language and linguistics* (pp. 1656-1660). Oxford, UK: Pergamon Press.
- Guffová, D. (2014). *Integration of teaching mathematics and English language using CLIL method at lower and upper secondary levels of education*. PhD dissertation. Matej Bel University in Banská Bystrica, Slovakia.
- Lengyelfalusyová, D. (2013). *Inovácia obsahu a metód vyučovania matematiky v bilingválnych (slovensko-anglických) gymnáziách* [Innovation of the content and methods for mathematics teaching and learning at bilingual Slovak and English comprehensive secondary schools]. PhD dissertation. Constantine the Philosopher University in Nitra, Slovakia.

- Marsh, L. G., & Maki, R. H. (1976). Efficiency of arithmetic operations in bilinguals as a function of language. *Memory and Cognition*, 4, 459-464.
- McClain, L., & Huang, J. Y. S. (1982). Speed of simple arithmetic in bilinguals. *Memory and Cognition*, 10, 591-596.
- Mehisto, P., Marsh, D., & Frigols, M. J. (2008). *Uncovering CLIL: Content and Language Integrated Learning and multilingual education*. Oxford, UK: Macmillan Education.
- Moschkovich, J. N. (2002). A situated and sociocultural perspective on bilingual mathematics learners. *Mathematical Thinking and Learning*, 4, 189-212.
- Naštická, Z. (2016). Intercultural features and the theme of travelling in bilingual mathematics lessons. *Problems of Education in the 21st Century*, 72, 76-88.
- Páleníková, K., & Naštická, Z. (2017). Getting started with CLIL: Game-like warm-ups in mathematics education. *Online Journal of Primary and Preschool Education*, 1(1), 30-37.
- Planas, N. (2014). One speaker, two languages: Learning opportunities in the mathematics classroom. *Educational Studies in Mathematics*, 87, 51-66.
- Saalbach, H., Eckstein, D., Andri, N., Hobi, H., & Grabner, R. H. (2013). When language of instruction and language of application differ: Cognitive costs of bilingual mathematics learning. *Learning and Instruction*, 26, 36-44.
- Siegel, J. (2003). Social context. In C. J. Doughty & M. H. Long (Eds.), *Handbook of second language acquisition* (pp. 178-223). Oxford, UK: Blackwell.
- Valdés-Fallis, G. (1978). *Code switching and the classroom teacher. Language in education: Theory and practice*, 4. Wellington, VA: Center for Applied Linguistics.