Assessment Approaches to Teaching Mathematics in English as a Foreign Language (Czech Experience)

Marie Hofmannová, Jarmila Novotná, Renata Pípalová
Charles University in Prague (Czech Republic)

Abstract

For many centuries the concept of linguistic diversity has been well established in Europe as a result of natural development and socio-cultural interaction. More recently, multilingualism has been adopted as a leading concept facilitating European integration. In 1995 the European Commission adopted the document on education “Teaching and Learning. Towards the learning society”. It declares proficiency in three Community languages as a prior objective.

Multilingual education brings about many issues to be addressed, e.g. changes of curriculum, teacher education, teaching methods and assessment instruments. Despite the large number of existing pilot projects such as Content and Language Integrated Learning, there is a lack of valid and reliable assessment approaches that should reflect the interaction of both internal and external factors in the cognitive and linguistic development of bilingual students. The paper strives to examine some of the aspects of testing integration both within and across the domains of mathematics, linguistics and language proficiency.

Keywords: Assessment instruments; cognitive and linguistic development of bilingual students; integration within and across mathematics, linguistics and language proficiency; multilingual education; teaching mathematics in English

1. Introduction

For many centuries the concept of linguistic diversity has been shaping Europe, and subsequently has been firmly established in Europe as a result of natural development and socio-cultural interaction. Not surprisingly, multilingualism has been recently adopted as a leading concept facilitating European integration.

It should be noted that a multilingual community’s verbal repertoire consists of a number of codes, languages, dialects, accents, styles, registers, varieties, etc. spoken in the particular territory. However, the verbal repertoires of the individual speakers frequently differ considerably. Indeed, each speaker of a language, whether native and non-native, develops only such commands and skills that are relevant for his/her communicative needs (according to their various eruditions, qualifications, experience and backgrounds). Thus, his/her verbal repertoire is determined by the range of speech events in which he/she can participate. As a result, particular speakers differ e.g. in the number of the codes they have mastered, in the way they have picked them, in the degree of proficiency they have achieved, in the range of registers they can exploit, etc.

In multilingual communities it comes as a natural thing that there are many speakers of various codes and that these codes are employed for interaction. This, in turn, can facilitate awareness of multiculturalism, the co-occurrence of many cultures in one and the same area. In the context of the many co-existing codes available at a particular well-distinguished multilingual territory, various types of code-switching take place. Naturally, those who master more codes can engage actively in more kinds of cross-cultural interaction.
Nevertheless, for various practical purposes, the codes frequently switched to and exploited more extensively in cross-cultural interaction have been known as lingua Franca, working/negotiation languages, etc. Thus, whether we like it or not, there are languages, including English, whose mastery facilitates a greater range of cross-cultural interaction and that is why their command appears rather desirable and almost expected.

2. Content and Language Integrated Learning (CLIL)

The Council of Europe has repeatedly voiced the importance of running educational programmes in both national and foreign languages for a number of individual and societal reasons, such as achieving students’ higher academic standards, or otherwise promoting positive relationships between people. The recognition of the world-wide role of English as a lingua franca, and more specifically as a language of international scientific and technical communication, lends itself easily to the idea of using English as a foreign language for the teaching of content subjects.

In 1995, the European Commission published the document “Teaching and learning. Towards the learning society”. It suggests teaching content in a foreign language as one of the methods that might contribute to the objective of European multilingualism. Both the subject matter and a foreign language are to be developed simultaneously and gradually. The third goal is to promote an additive form of bilingualism through the development of thinking skills.

Whereas in the European context, Content and Language Integrated Learning (CLIL) constitutes a new, innovative approach to education, in the global perspective, examples of curricular integration have existed for several decades and can be represented by educational programmes introduced overseas, such as Content-based instruction, bilingual programmes, or immersion (cf. Ellis, 1999). These programmes, however, are often viewed as compensatory (Irujo, 1998) as the learning outcomes are likely to have features of subtractive bilingualism. Therefore European educators wishing to implement CLIL in their school curricula need to consider whether bilingualism has positive or detrimental psycho-social effects on the learner’s development.

The distinction between additive and subtractive bilingualism was first made by Paivio and Lambert (1981), and Lambert (1990). Also Cummins and Swain (1998) reported both negative and positive association between bilingualism and cognitive functioning. On the one hand it is said that “bilingual students suffer from a language handicap when measured by verbal tests of intelligence or academic achievement,” on the other hand linguistic studies prove that “bilingualism can promote an analytic orientation to language and increase aspects of metalinguistic awareness.”

The process of learning and teaching is primarily communication, regardless of the subject. “The hypothesis is that mutual interference between the bilingual child’s two languages forces the child to develop particular coping strategies which in some ways accelerate cognitive development.” (Ben-Zeev, 1977). In CLIL, with regard to cognitive processes, the foreign language becomes an instrument for processing and storing of information. The use of a foreign language requires a different, deeper way of information processing and leads to enhanced acquisition of both the language and the non-linguistic content matter. Due to the differences of “mental horizons” reflecting the work in a foreign language, CLIL also influences the formation of notions, and thus literally shapes the way we think. Bilingual learners are better at analyzing ambiguities in sentence structures, etc., they show significantly higher levels of verbal and non-verbal ability, and do better on measures of concept formation, on rule discovery tasks, etc. Bilingual learners perform better on variables which measure cognitive flexibility. The many learners that have already experienced CLIL all around Europe have proven the approach non-detrimental and successful as regards both language and content (Pavesi et al., 2001).
These results seem to be consistent with Vygotsky who saw the ability to express the same thought in different languages as an advantage enabling the learner to see his/her language as one particular system among many, and to view its phenomena under more general categories. Code-switching, i.e. alternative use of two languages was noted as a valuable educational resource, and as a means to foster learners’ mathematical understanding (Adler, 1998; Setati, 1998).

European CLIL seems to be an approach fundamentally different from bilingual programmes implemented overseas as it is aimed at a different type of student. Young Europeans in general have pragmatic goals, similar to instrumental motivation. They want to make themselves understood when they travel, seek new friendships and acquire knowledge. CLIL constitutes a new, intrinsic motivating force. In the Czech Republic, bilingual programmes of the 1990s were designed for relatively small groups of carefully selected upper secondary school students with high ambitions whose characteristics differed in terms of cognitive, psychological and social factors. Students learned several curriculum subjects in a foreign language. The first year of the 6-year programme stressed the language preparation. The content curriculum was worked out in cooperation with foreign partners and university specialists. The final year offered optional seminars for mastering the subject terminology in Czech.

The present article deals with assessment in mathematics taught through the medium of English as a foreign language in the Czech Republic. The authors attempt to examine a “minimum competence standard” both in mathematical content and the foreign language. The results of the project (GACR 406/02/809) run from 2002 to 2004 proved that teaching mathematics through English is not parallel with teaching mathematics through the mother tongue, nor is it a direct translation of the Czech text into English. In both cases, students’ cognitive processes are different. They involve mental manipulations with different types of symbols – in the former case linguistic ones, meaningful and related to the child’s experience from the real ones, in the latter, mathematical symbols that cover only one side of the child’s life, describe the reality in another form.

In the learning/teaching process, CLIL is dual-focused. But is it also possible to carry out integrated assessment? It is increasingly recognised that valid assessment requires the sampling of a range of relevant types of discourse. Rather than contemplating conflicting ideas on assessment approaches for this type of education, the paper presents an experiment where the mathematical problem is shown as a goal-oriented cooperation task providing a sample of communicative activity in the mathematical classroom for the purposes of oral assessment done by the teacher.
3. Mathematics teaching/learning as communication

The traditional belief about teaching mathematics was that it represents transmission of rules and definitions and the language use is less important. However, the contemporary perception of teaching mathematics is much broader, it covers not only pure mathematical issues, but it also instigates such mental and cognitive processes as problem solving, development of strategic thinking and information processing. (Novotná, Hofmannová and Petrová, 2001).

Such range of tasks calls for adequate communicative tools. In this context we may recall Pirie (1998) who states six means of mathematical communication and classifies them as follows:

- **“Ordinary” language.** Here the term *ordinary* denotes the language current in the everyday vocabulary of any particular child, which will, of course, vary for pupils of different ages and stages of understanding.

- **Mathematical verbal language.** *Verbal* here means “using words”, either spoken or written.

- **Symbolic language.** This type of communication is made in written, mathematical symbols.

- **Visual representation.** Although not strictly a “language”, this is certainly a powerful means of mathematical communication.

- **Unspoken but shared assumptions.** Again, these do not really fall within the definition of “language”, but they are a 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).¹

What implications does this variety of means of communication hold for the understanding of mathematical concepts that pupils build? It could be contended that mathematics has a unique communication problem that arises because the language used when talking about mathematics and that used when writing mathematics (as opposed to writing about mathematics) are completely different.”

Needless to say that all of the foregoing categories (perhaps to the exclusion of the last but one) call for adequate encoding and decoding. In other words, in efficient communication, both receptive and productive skills are presupposed.

---

¹ The authors believe that quasi-mathematical language corresponds to a range of registers ultimately reflecting a particular interim stage of foreign language development, i.e. Interlanguage.
4. Assessment in bilingual mathematics classrooms

In order to plan the next steps in their learning, learners need information and guidance. Much of what is done in classrooms can be described as assessment (QCA, 2003). Through assessment, learners become as aware of the 'how' of their learning as they are of the 'what'. Assessment that encourages learning fosters motivation by emphasizing progress and achievement rather than failure and therefore it should be recognized as central to classroom practice. For the interdisciplinary subject to be successful, both the instruction and assessment should be beneficial to both domains, i.e. mathematics and English as a foreign language.

For the teacher, assessment involves reaching a conclusion on the presence or absence of an intrinsic or an extrinsic cause for the learning problem in the bilingual learner. Assessment is a part of teacher’s decision making process.

In Czech bilingual mathematics classrooms, one of the major concerns nowadays is how to assess or test (accurately in an integrated way) the ability of the students’ development in both mathematical thinking and a foreign language. (Cline and Shamsi, 2000) state the following problems related to assessing content in an additional language: “Should a special test be developed to overcome the problems of assessment in this field as cultural bias?” “Should children learning English as an additional language be assessed in their L1 or in English or in some combination of both?”

As regards the assessment of learners’ foreign language proficiency, the document of the Council of Europe (Modern Languages, 1998) states a number of approaches. The students’ progress must be also measured through ongoing assessment of achievement in the content area – mathematics. Unlike the traditional view of assessment, which highlighted the learning product, the contemporary approach emphasizes learning and consequently its assessment as a dynamic process.

Thus the integrative approach seems to be an ideal intersection of mathematics and foreign language testing. For mathematical content taught through the medium of English as a foreign language achievement tests can be seen as most suited to measure both the areas of development as they can be used for diagnostic purposes. For the teacher, they are a useful means to get feedback for teaching. Achievement assessment is oriented to the content of the course. Moreover, it is close to the learner’s experience.

For a CLIL classroom, the assessment should concern both the content and the language. The analysis presented in Section 3 aims to show the richness of aspects that have to be taken into consideration as influencing students’ performances when doing mathematics through a foreign language.
5. CLIL episode and research findings

Since 1999, the authors have been running a CLIL course integrating mathematics and English teaching at the Faculty of Education, Charles University in Prague. Observing classes of mathematics at bilingual schools is an inseparable part of the course content. It was repeatedly evidenced that no matter that the teachers integrate content and language while teaching, they stop integrating when assessing. The problem was discussed on theoretical level with researchers from abroad. Diverse opinions have been presented. In most countries the assessment only concerns the content and not the foreign language. That was the starting point for the hypothesis that integration is possible even during the assessment procedures. An example of a set of graded problems enabling differentiation between the content and language components was published in Hofmannová, Novotná, Pipalová (2004).

The following text presents the analysis of a versatile task. Depending on the way it is assigned to learners it offers a variety of assessment procedures. The authors believe that the task enables to detect possible language and mathematical problems and to assess them in an integrative way.

**Problem assignment²**

Czech
Amfiteátr má kruhový půdorys s průměrem 50 m. Největší šířka pódia je 25 m. Pod jakým zorným úhlem vidí pódiu diváci sedící na obvodě?

A. Všichni ho vidí pod zorným úhlem 30°.
B. Všichni ho vidí pod zorným úhlem 45°.
C. Všichni ho vidí pod zorným úhlem 60°.
D. Všichni ho vidí pod zorným úhlem 90°.
E. Zorný úhel závisí na poloze diváka v amfiteátru.

---

² A cultural aspect (explained by the teacher during the oral test): The Greek and Roman amphitheatres traditionally placed spectators in a semi-circle, and they sat between two concentric circles (one being the outer ring, and the other being some distance from the centre). The principal action of the play often took place near to the centre of the circle. When you stand in the centre of a classical amphitheatre you can easily be heard by the furthest spectator, and there are clearly acoustic advantages of this design.
English

An amphitheatre has a circular plan with a diameter of 50m. The maximum width of the stage is 25m. What is the visual angle whereby the spectators at the circumference can see the stage?

A. All of them see it under the visual angle 30°.
B. All of them see it under the visual angle 45°.
C. All of them see it under the visual angle 60°.
D. All of them see it under the visual angle 90°.
E. The visual angle depends on the spectator’s position.

In the assignment, “ordinary” and mathematical verbal languages are combined. The visual representation is used as a means for making the assignment more comprehensible for the learner.

**Task analysis**

**i. Written test**

**a) Language difficulties:** Understanding the instructions (reading comprehension task)

Students show the varying level of understanding of the following:

<table>
<thead>
<tr>
<th><strong>Vocabulary</strong></th>
<th><strong>Grammar</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific – mathematical</strong></td>
<td><strong>General – non-mathematical</strong></td>
</tr>
<tr>
<td>English</td>
<td>Czech</td>
</tr>
<tr>
<td>circular</td>
<td>kruhový</td>
</tr>
<tr>
<td>plan</td>
<td>půdorys</td>
</tr>
<tr>
<td>diameter</td>
<td>průměr</td>
</tr>
<tr>
<td>visual angle</td>
<td>Zorný úhel</td>
</tr>
<tr>
<td>circumference</td>
<td>obvod</td>
</tr>
<tr>
<td>spectator</td>
<td>Divák</td>
</tr>
</tbody>
</table>

**b) Mathematical difficulties:** Cannot be identified since each student will solve the problem on his/her own. The teacher will assess the final result: Only the answer A is correct.
ii. Oral test

a) Language difficulties:
- understanding the instructions (reading comprehension task)
- describing the solution (production task)

Compared to the written test, students might show additional language competence:

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific – mathematical</strong></td>
<td><strong>General – non-mathematical</strong></td>
</tr>
<tr>
<td>English</td>
<td>English</td>
</tr>
<tr>
<td>radius</td>
<td>poloměr</td>
</tr>
<tr>
<td>points</td>
<td>Body</td>
</tr>
<tr>
<td>triangle</td>
<td>trojúhelník</td>
</tr>
<tr>
<td>interior angle</td>
<td>vnitřní úhel</td>
</tr>
<tr>
<td>exterior angle</td>
<td>vnější úhel</td>
</tr>
<tr>
<td>equilateral</td>
<td>rovnostranný</td>
</tr>
<tr>
<td>isosceles</td>
<td>rovnoramenný</td>
</tr>
<tr>
<td>base</td>
<td>základna</td>
</tr>
<tr>
<td>angle at the circumference</td>
<td>obvodový úhel</td>
</tr>
<tr>
<td>angle at the centre</td>
<td>středový úhel</td>
</tr>
<tr>
<td>half-plane</td>
<td>polorovina</td>
</tr>
<tr>
<td>angle bisector</td>
<td>osa úhlu</td>
</tr>
<tr>
<td>perpendicular</td>
<td>kolmice</td>
</tr>
<tr>
<td>erect a perpendicular</td>
<td>věst kolmici</td>
</tr>
<tr>
<td>supplementary angles</td>
<td>styčné úhly</td>
</tr>
<tr>
<td>arc</td>
<td>oblouk</td>
</tr>
</tbody>
</table>

b) Mathematical difficulties:

For all solutions, the pieces of (available and ready to be used) knowledge needed to perform the adequate solution are listed in the order from the most advanced mathematical ideas to those simpler ones included in the primary/lower secondary mathematics curricula.

Solution 1

Let \( S \) be the centre of the circle representing the amphitheatre, and \( A, B, C \) the points on the circumference as labelled in the figure. The radius of the circle is 25 m (half of the diameter). Therefore the triangle \( BSC \) is equilateral and \( \angle BSC = 60^\circ \).

It follows that the angle at the circumference is equal to one half of the angle at the centre of the circle where both angles are subtended by the chord \( BC \). Therefore \( \angle BAC = 30^\circ \).

The answer A is correct.
Let $S$ be the centre of the circle representing the amphitheatre, and $B, C$ the points on the circumference as labelled in the figure, $A$ the endpoint of the diameter perpendicular to $BC$. The radius of the circle is 25 m (half of the diameter). Therefore the triangle $BSC$ is equilateral and $\angle BSC = 60^\circ$. Then $\alpha = 30^\circ$, $\beta = 150^\circ$ ($\alpha, \beta$ are supplementary angles), $\gamma = 15^\circ$ ($\beta + 2\gamma = 180^\circ$). Therefore $\angle BAC = 2\gamma = 30^\circ$.

It holds that the size of all angles of the circumference subtended by the chord $BC$ in the same half-plane is equal. The answer A is correct.

Solution 3

Let $S$ be the centre of the circle representing the amphitheatre, and $A, B, C$ the points on the circumference as labelled in the figure. The radius of the circle is 25 m (half of the diameter). Therefore the triangle $BSC$ is equilateral and $\angle BSC = 60^\circ$. The triangles $BSA$, $CSA$ are isosceles (two sides equal the radius of the circle). Therefore $\angle BSC = 180^\circ - 2\beta$, $\angle CSA = 180^\circ - 2\gamma$. It holds that $\alpha = \angle BSA = 360^\circ - (180^\circ - 2\beta) - (180^\circ - 2\gamma) = 2(\beta + \gamma)$. It follows that $\angle BAC = 30^\circ$.

The answer A is correct.

Possible mathematical difficulties

Solution 1

Facts:

- The angle at the circumference equals one-half of the angle at the centre subtended by the same chord.
- The interior angles of an equilateral triangle (all sides are of the equal length) are all $60^\circ$.
- The sum of all interior angles of a triangle equals $180^\circ$.

Use of facts:

- The triangle $BSC$ is equilateral ($|BC|$ equals one half of the diameter, i.e. the radius).
- $\angle BSC$ is the angle at the centre of the circle subtended by the same chord as the angle at the circumference $\angle BAC$ for all positions of $A$ on the arc $BAC$.
- $\angle BSC$ is the interior angle of the equilateral triangle $BSC$.

The three solutions are virtually identical. They all rest on the crucial recognition that forming the triangle $BSC$ is the way to proceed and recognising that this is an equilateral triangle and therefore $\angle BSC = 60^\circ$. Mathematical theorems used in solutions 2 and 1 can be proved using the ideas of solution 3. The three types of reasoning use a different terminology, e.g. angles subtended by a chord, half-plane.
Solution 2

Facts:
- All angles at the circumference subtended by the same chord in the same half-plane are equal.
- The angles of an equilateral triangle (all sides are of the equal length) are all 60°.
- In an isosceles triangle (two sides are of the equal length), the angles opposite to equal sides are equal.
- The sum of all interior angles of a triangle equals 180°.
- The exterior angle of a triangle is equal to the sum of the two opposite interior angles.
- In an isosceles triangle, the line perpendicular to the base and passing through the vertex opposite to the base is the bisector of the corresponding interior angle.

Use of facts:
- $\angle BAC$ does not depend on the position of $A$ on arc representing the amphitheatre.
- The triangle $BSC$ is equilateral ($|BC|$ equals one half of the diameter, i.e. the radius).
- The triangle $BSA$ is isosceles with the base $AB$ ($|BS| = |AS| = 25$ m).
- $\angle BSC$ is the interior angle of the equilateral triangle $BSC$.
- $\alpha = \frac{1}{2} |\angle BSC| = 30°$.
- $\beta = 180° - \alpha = 150°$.
- $\gamma = \frac{1}{2} (180° - 150°) = 15°$.

Solution 3

Facts:
- The angles of an equilateral triangle (all sides are of the equal length) are all 60°.
- In an isosceles triangle (two sides are of the equal length), the angles opposite to equal sides are equal.
- The sum of all interior angles of a triangle equals 180°.

Use of facts:
- The triangle $BSC$ is equilateral ($|BC|$ equals one half of the diameter, i.e. the radius).
- The triangle $BSA/CSA$ are isosceles with the base $AB/AC$ ($|BS| = |AS| = |CS| = 25$ m).
- $\angle BSC$ is the interior angle of the equilateral triangle $BSC$.
- The size of a complete turn is 360°.
6. Considerations for assessment: socio-linguistic perspective

In order to throw some more light on the distinctions existing between these two forms of tasks, it appears useful to adopt the concept of linguistic register, i.e., “a variety of language corresponding to a variety of situation” (Halliday and Hasan, 1985:38).

Applying the concept of register to the topic in question, as regards the field, in both tasks we have a specific occupational variety, a technical register of mathematics, in the latter case more clearly overlapping the language of the classroom. The most obvious parameter in which the two tasks differ is the mode of discourse. In the former case the mode is written, in the latter written to be spoken aloud and explained. The oral task performance may involve monologue and dialogue parameters in varying degrees. From the learner’s perspective it is a public act, should be persuasive, rationally argumentative, highly textured. The tenor appears to differ considerably as well. Although both the tasks are executed in an institutionalized, socially defined asymmetrical relation between the teacher and pupil, the task is set by the authority. It follows that the teacher is allowed to give commands, whereas the student is expected to use mostly declaratives. In the first case the authority has pre-defined the options, thus restricting considerably the range of variation in both content and form, is in full control of the activity as well as its potential solutions, whereas in the second case the student is much more independent, is expected to be active, more creative, selecting appropriately various strategies in order to persuade and is given the chance to display his/her mathematical and linguistic erudition and consequently to reach a particular status.

It follows that the students exposed to various multiple-choice written tasks will face a more closed register variety than those giving an oral presentation of the same, expounding the procedure leading to a particular desirable solution. It also follows that it is the latter, i.e. the more open sub-variety of the register that is considerably more demanding and calling for an increase in share of the language performance with all its implications for the assessment and diagnosis of the potential problems.

Moreover, in the written task, a relatively restricted range of communicative competence is required and a limited scope of a learner’s verbal repertoire is depended on. To a considerable extent, the latter is more or less presupposed rather than actively demonstrated and tested. Conversely, in the oral task, a much wider range of communicative competence is called for. A much richer scope of the learner’s verbal repertoire is demonstrated and actually displayed for testing.
7. Summary: Implications for assessment

The task characterisations are processed employing the tables published in Ellis (1999).

i. Written task
Each student needs to have some knowledge of vocabulary and grammar to understand the instructions. The focus will be on meaning, rather than on form. Input is unlikely to be modified. The type of exercise is multiple-choice, the activity is subject-centred, and testing is done by recognition.

ii. Oral task
Students need more sub-skills (vocabulary, grammar, pronunciation). Furthermore, they need oral production skills, listening comprehension skills and writing skills. The focus will be mixed: sometimes on form, sometimes on meaning. Input is very likely to be modified. The type of exercise is spoken and written description, teaching is learner-centred, and testing is done by production.

We may conclude that the second type of exercise is more complex, more difficult, and thus it requires different approach on the part of the teacher. During the lesson s/he might have to pre-teach some vocabulary, and revise some grammar to prevent students from making mistakes of meaning. Negotiation of meaning is very likely. It might be done in English which will resemble exposure in natural settings.

As regards assessment within the method of Content and Language Integrated Learning, the authors find it necessary to develop analytical scales assessing carefully both the mathematical content and the foreign language. In this connection, (Pavesi et al. 2001) holds that “content and language both contribute to the learning experience”. In assessment, however, content should be given priority over language accuracy”. Each assessed component contributes to the overall grade in its own right. Developing an overall framework will involve the long-term process of consultations with the respective professionals internationally.

In the former, written (multiple choice) test, assessment is based on checking the correct answer. The teacher has no access to monitoring the students’ thought processes. S/he does not know how the students reached the solution. In the latter, oral test (interaction task) the assessment is more complex dealing both with the product and the process. It should be dual-focused, taking into consideration both the mathematical correctness and language appropriateness. Presumably, for the teacher the extreme grades, i.e. grade A on the one hand and Fail on the other hand, cause little or no problems as follows from the following description:

Grade A: the student is able to solve the problem and has excellent command of English.

Fail: a) the student is not able to solve the problem and has poor command of English,
     b) the student is not able to solve the problem and has good, very good or excellent command of English.
However, identification of the minimum requirements for a pass-mark appears to be much more difficult. The teacher should take into consideration both the delicate degrees of mathematics and the foreign language command:

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student’s varied ability to solve the problem.</td>
<td>The student’s limited English proficiency compensated by other means of mathematical communication, e.g. quasi-mathematical or symbolic language and/or the student’s limited familiarity with the mathematical content domain in English (compensated for by the inappropriately employed ordinary language); and/or idiosyncratic use of mathematical terminology and constructions in English, etc.)</td>
</tr>
</tbody>
</table>

Admittedly, the border-line cases show in oral tasks exclusively. The assessment of the written task is only absolute, i.e. either a fail or a pass.

The oral task is considerably more demanding both for the student and the teacher. From the student’s point of view it appears that the verbal execution of the problem solving procedure prevails over the non-verbal substitute. From the teacher’s perspective, both the degree of mathematical task success and the level of the corresponding linguistic proficiency should be appreciated. Since the level of mathematical competence is ultimately a limiting factor, it will be critical to elaborate the degrees of mathematical competence to the format comparable to the Language Proficiency Assessment Grid published e.g. in (Modern Languages, 1998) in order to set the pass-fail boundary more accurately.

As a matter of fact, merging of actual scales of qualitative categories for language proficiency has been developed by many projects. Regrettably, relatively few of them deal with content based foreign language proficiency assessment, e.g. Eurocentres/ELTDU Scale of Business English 1991 or the assessment standards proposed by the International Baccalaureate Organisation (IBO): A continuum of international education: the PYP, MYP and Diploma Programmes, Geneva, 2002.
8. Concluding remarks

In CLIL, task success (solution of the mathematical problem) has generally been given the priority over qualitative categories relevant to oral assessment of communication in a foreign language, e.g. fluency, accuracy and range, interactive communication, etc. Nevertheless, in light of the foregoing we suggest that the criteria for assessment should be more carefully weighted. It is in the oral type of tasks that much more attention to the language proficiency should be generally paid and therefore, assessment should be virtually dual-focussed.

More specifically, in the first task form, the teacher can only assess the students’ receptive skills in English, and the correctness of the mathematical product. The assessment of multiple choice written tasks is only absolute, i.e. either a fail or a pass. Purely theoretically, the tasks might be solved by mere chance/guessing without any decoding taking place at all.

By contrast, in the second task form, the students will indeed combine receptive and productive skills in English with their mathematical thinking (and possibly even resort to Czech.) Therefore, in the latter, assessment can follow their thought processes and should be much more complex.

At this point it appears worthwhile to recall Pirie (1998) again (here 3 above). Unlike in the written task, in its oral counterpart a complete range of Pirie’s modalities of the mathematical language may be exploited. Moreover, the task involves both, adequate decoding and encoding. Since the latter may include coding the solution also in quasi-mathematical language and/or, given the type of bilingual teaching, in various stages of students’ interlanguage, the assessment should indeed be dual-focussed. That is why it is much more demanding, and naturally should be much more comprehensive.

The above oral test is an example of formative assessment instrument. Its aim is to improve learning. Discussing samples of work is an important technique used for awareness training. The learners are encouraged to develop a metalanguage on aspects of quality in order to formulate a self-directed learning contract. This way they develop social, cognitive and metacognitive strategies of learning.

Integrative approach seems to be an ideal intersection of mathematics and foreign language assessment. Due to traditional and rather conservative approach to assessment in the Czech Republic, we believe that achievement tests could be seen as most suited to measure both the areas of development. Moreover, they can also be used for diagnostic purposes.
References


