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INDICE

ALICE BARANA*, MARINA MARCHISIO**

TEACHER TRAINING TO THE USE OF CLIL METHODOLOGY IN PROBLEM BASED ACTIVITIES

Abstract

This paper presents and discusses a model of teacher training to the use of CLIL methodology in problem based activities involving different subjects. The model was developed by the Department of Mathematics of the University of Turin and tested during two CLIL training courses with secondary school teachers. The training model includes: the design of the training program, the proper training phase, monitoring teachers' activities and collection of materials, and an evaluation of the course. In particular, the training phase involves problem solving, problem posing and the use of a Virtual Learning Environment both as a student and as a teacher.

1. Introduction

Consider the following situation: there are some workers, living in different countries and employed in several branches of a company, who are all involved in the same project. They have to collaborate, analyse problems and share solutions from all corners of the world, interacting online through a vehicular language. Computer based collaborative working situations are not so unusual in modern workplaces; nevertheless, the communication between workers with different cultures, languages and backgrounds is pointed out as a major difficulty [1].

Communication and problem solving (PS) competences, required by companies and tested in job interviews, can be developed at school through the Content and Language Integrated Learning (CLIL) methodology, which is expressly conceived to educate students to be citizens of the world and to prepare them to get better job opportunities in an international society [2]. Italy is one of the few European countries where CLIL is provided for by the educational system: all students attending the last year of upper secondary school have to learn one non-language subject through a foreign language.

One major obstacle to the implementation of meaningful CLIL activities at school is the shortage of appropriately qualified teachers, who are expected to be expert on their subject, on a foreign language and on CLIL methodologies. On the other hand, teachers complain that there are not many initial and in-service programmes devoted to CLIL, and that suitable teaching materials are not easy to find [3]. The Department of Mathematics of the University of Turin

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proposes an innovative model for teacher training aimed at making teachers independent in designing effective CLIL activities, based on problem solving with innovative technologies. In the following paragraphs the model of teacher training is detailed, the methodology used and the results obtained in two experiences are shown and discussed.

2. State of the art

2.1 Problem based CLIL activities

Modern theories on problem solving claim that the activities of modelling and thinking are conveyed through a variety of media, among which language sticks out, it being involved in group discussions, in the presentation of data and solutions [4]. It is supposed to be a tool for thinking, not just the format we think in. According to recent linguistic theories, language acquisition is facilitated by activities focused on the production and negotiation of comprehensible meanings, which allow learners to raise awareness of the meaning-carrying potential of linguistic structures. Thus, a teaching approach focused on meaning and language should be more effective than one that focuses on the structural aspects of the target language [5].

Teaching approaches based on the integration of language and problem solving fit sociocultural models, mainly because sociocultural theories see language as the primary media for knowledge building, and because of the fundamental role recognised to social interaction in learning [6].

Supported by these theories, the Department of Mathematics of the University of Turin has developed a learning model for CLIL problem solving activities. The model consists of a real-world problematic situation to be discussed in a vehicular language by small groups of students, who are asked to discuss the solution in written form. The disciplinary content emerges from the generalisation of the solving process or the identification of the key points. Technologies for solving the problem and for sharing solutions are recommended during the activity [7].

2.2 Teacher training

Among all the teacher training models discussed in literature - coaching, metacognitive reflection, team working, co-working and many others [8] - there is evidence that the participation in professional learning communities (PLC) helps to improve teaching practice and student achievement. In particu-

lar, it helps to develop a student centred approach and increase teaching culture through collaboration, focus on student learning and continuous learning; these factors have positive effects on student results [9].

The Cultural Historical Activity Theory (CHAT) offers a suitable theoretical framework for analysing teacher activity, given the importance ascribed to the interaction of human activity within the environment as promoter of learning. According to CHAT, the learning outcomes are the results of the action by at least two activity systems, the smallest units of analysis, represented in Figure 1. When the interactions between the elements face some contradictions, the systems modify themselves through expansion and this results in learning [10].

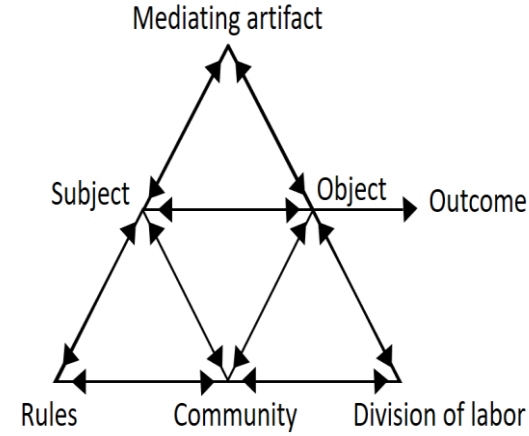


Figure 1 - One activity system, the unit of analysis of action in activity theory.

The Department of Mathematics of the University of Turin has developed a teacher training model for designing activities aimed at the development of mathematical competences [11], deeply rooted in the participation in PCL. The model has been adapted and experimented to train teachers to design problem based CLIL activities.

3. The model of teacher training

The model is intended to provide secondary school teachers with competences on CLIL, problem posing and problem solving and digital methodologies for learning. In particular, teachers learn how to collaborate online and to work in a community in a vehicular language, to build innovative, even interdisciplinary, problem based activities.

The teacher training model includes the following features:

1. face-to-face training modules, organised in:
    a. collaborative problem solving,
    b. multidisciplinary problem posing,
    c. use of a Virtual Learning Environment (VLE);
2. synchronous and asynchronous online training in a Virtual Learning Environment, through:
    a. forums of discussion for the asynchronous tutoring, monitored by tutors, which foster teachers' collaboration and exchange of materials and experiences,
    b. online synchronous tutoring held via a web conference tool integrated in the platform, which allows for interaction between tutor and participants through the voice, a chat and the screen-sharing,
    c. multimedial didactic materials,
    d. databases for sharing didactic materials created and used by teachers;
3. implementation of an online professional learning community, which learns and works collaboratively, focused on the enhancement of teaching and learning;
4. preparation of materials autonomously and collaboratively and testing on students;
5. evaluation of appreciation and usefulness of the training.

4. Methodology and implementation of the model

The model shown in the previous paragraph was designed and detailed after a preliminary experience, where the main activity of Problem Solving was tested. Data was collected from observation during the training meeting and from a questionnaire filled after the lesson. The analysis was conducted both qualitatively through the CHAT analysis, with the aim of identifying key strengths and issues of the training activity, and quantitatively to assess the validity of the training process and of the methodologies proposed. Results were used to design a full experience of teacher training based on the findings of the preliminary analysis.

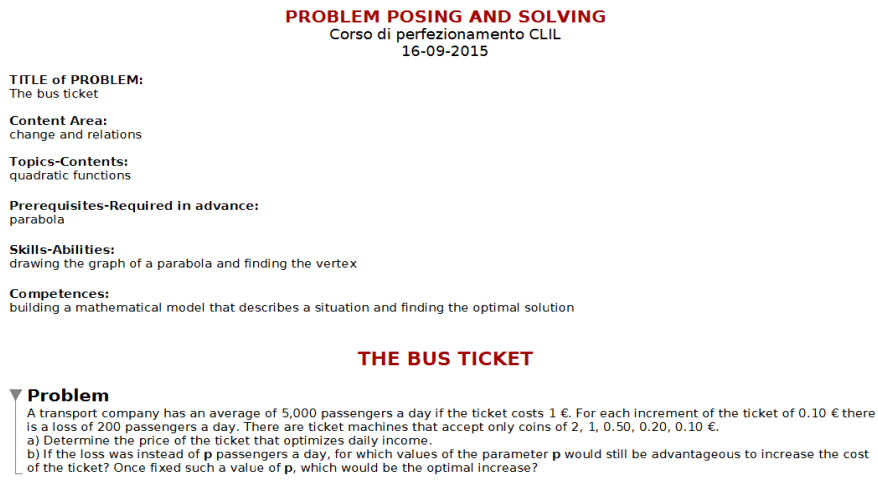
4.1 Preliminary experience

The preliminary experience was conducted within a CLIL training course for teachers of scientific disciplines, organised by the *Centro Linguistico di Ateneo* of the University of Turin in Autumn 2015. The experience took place in a laboratory lesson of 4 hours, held by the authors, with 54 participants. After a presentation of the Problem Posing and Solving methodology [12] with some examples, participants were split into small groups of 3-4, each of them with a re-

al-world problem involving scientific subjects (Mathematics, Physics, Chemistry, Computer Science) to solve. Two main tasks were assigned to teachers:

1. to solve the problem as if they were students, discussing in a target language (English in that case) and to discuss the solution in written form, in English again.
2. to analyse the problem-solving process from the teacher's point of view and identify the content involved, skills and competences acquired by students while solving this problem.

Figure 2 shows an example of problem assigned to one group of teachers.



PROBLEM POSING AND SOLVING
Corso di perfezionamento CLIL
16-09-2015

TITLE of PROBLEM:
The bus ticket

Content Area:
change and relations

Topics-Contents:
quadratic functions

Prerequisites-Required in advance:
parabola

Skills-Abilities:
drawing the graph of a parabola and finding the vertex

Competences:
building a mathematical model that describes a situation and finding the optimal solution

THE BUS TICKET

Problem
A transport company has an average of 5,000 passengers a day if the ticket costs 1 €. For each increment of the ticket of 0.10 € there is a loss of 200 passengers a day. There are ticket machines that accept only coins of 2, 1, 0.50, 0.20, 0.10 €.
a) Determine the price of the ticket that optimizes daily income.
b) If the loss was instead of **p** passengers a day, for which values of the parameter **p** would still be advantageous to increase the cost of the ticket? Once fixed such a value of **p**, which would be the optimal increase?

Figure 2 - Example of problem assigned to the teachers.

All the works handed in by the teachers were assessed by the trainers. At the end of the lesson, the authors also showed a rubric table for the assessment of the problem solving competence, specifically elaborated for CLIL activities. Unfortunately, there was no time left to practise with the rubric table in a peer assessment activity.

The researchers observed the teachers' activity and studied it though CHAT analysis. The subject of the activity can be identified with the teachers and the object is the resolution of the problem as for their first task, and the analysis of the resolution as for the second one. Further aim of the activity is the professional development and innovation of their teaching practices. The tool through which the tasks was fulfilled can be identified as their disciplinary and linguistic knowledge and their teaching reflection capabilities. For logistical problems the use of technologies could not be introduced in the activity, teach-

ers could use the instruments that they preferred. Rules of the activity system are the use of English language and that work be autonomously divided among groups components, who formed the community. Figure 3 shows the activity systems of teachers during the training.

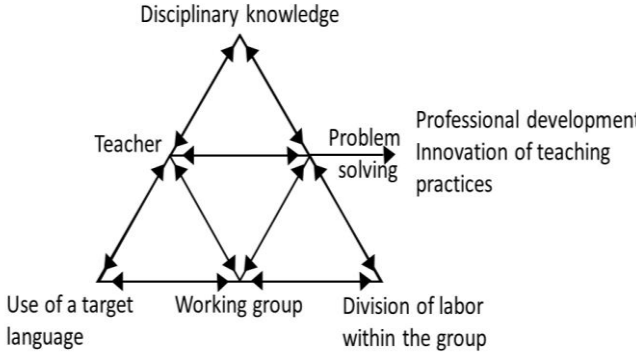


Figure 3 - Activity System of teachers during problem solving.

While intended for fulfilling the activity, the systems faced three kinds of tensions:

- the role of the teachers was changed to that of students,
- teachers experienced group working, which is quite unusual in a profession that is mainly individual,
- teachers were forced to speak in English.

These tensions created difficulties in the teachers' work, but at the same time they were a useful occasion for learning. This was testified by the data analysis of the questionnaire that teachers were asked to fill in after the lesson.

Besides the aspects related to the management of the training lesson, the questionnaire inquired about the teachers' impressions of the methodology, through a Likert scale ranging from 1 to 5. Results were particularly encouraging, as teachers responded that this methodology would be useful for their students to develop disciplinary, linguistic, problem solving and team working competences. Details are shown in Table 1.

Moreover, in an open question, teachers were asked to identify the key strengths of the activities and the difficulties they faced. The features that hindered the teachers were also acknowledged as the most formative ones, and as valid reasons to try the new methodology with students. Confirming the qualitative observations, these features were:

- experiencing team work and collaborating with colleagues,
- being forced to speak in English,
- changing their role in the solving task.

They also appreciated gaining some useful tips for their classes.

Do you think that the problem posing and solving activity in English could be useful to students to:	1	2	3	4	5	MEAN
improve language skills	2%	0%	27%	42%	29%	3,96
improve the ability of working in a group	0%	2%	10%	42%	46%	4,31
strengthen the specific disciplinary competences	0%	6%	15%	48%	31%	4,04
enhance self-confidence	0%	4%	29%	44%	23%	3,85

Table 1 - Results of the questionnaire at the end of the preliminary experience.

4.2 Second experience

On the basis of this feedback, a wider training course was designed and implemented some months later, in Spring 2016, within another CLIL course in the province of Biella. The course saw the participation of 35 secondary school teachers expert in several subjects, both humanistic and scientific. The design of the activities was based on the key strengths identified in the previous experience: using the same methodologies that teachers were supposed to learn, swapping the roles (teacher-student) to support the shift to a student-centred approach, building a professional learning community for sharing experiences and materials. The training model presented in paragraph 3 was fully implemented. It started with two face-to-face meetings one on problem solving (which included the same activity of the preliminary experience) and one on problem posing (where teachers were asked to create new problems working in groups). The two meetings were held in a computer laboratory, teachers could use learning technologies to solve the problems and a Virtual Learning Environment, VLE, (an integrated Moodle platform) to share their work. In the same occasion the potentialities of the VLE were presented to the teachers-in-training.

An online community came to life in the VLE; teachers could get professional development through asynchronous tutoring, forums, databases of materials, and synchronous meetings in web-conferencing about the didactic use

of the platform, so that they were able to adopt it with their students. They were asked to produce original material, to test it with students, and to share it with colleagues along with an analysis of how the activity works.

At the end of the training teachers were asked to fill a questionnaire where they could discuss key strengths and weaknesses of these methodologies.

5. Results and discussion

The results of the second experience confirmed the teachers' appreciation of the methodologies proposed and the effectiveness of the training course Figure 4 shows the appreciation for the training organisation and methodologies. There are no negative answers (labelled with 1 and 2 in a scale to 5), except for a teacher of Physical Education who complained that there were no problems for her subject (her participation was not expected by the trainers). The best appreciation went to the group work, to the group activity and to the use of English.

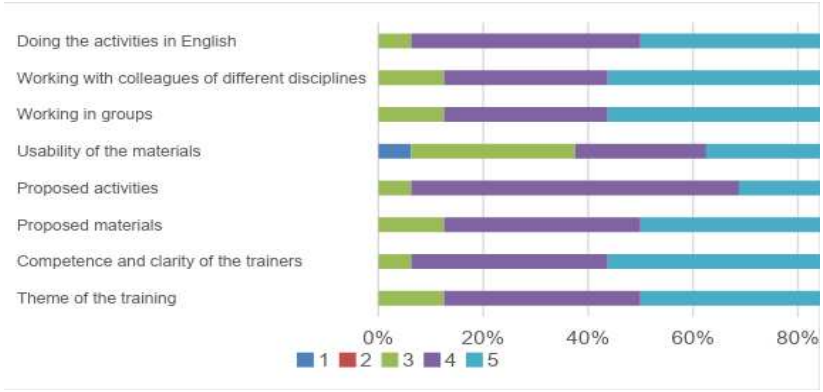


Figure 4 - Appreciation of the training course.

The problem based methodology for CLIL activity was appreciated even more than in the first experience, maybe because it stretched over a longer time span. Details of the teachers' answers are shown in Table 2.

	1	2	3	4	5	AVERAGE
Stimulate students' interest toward the subject	8%	0%	12%	36%	44%	4,08
Help students to better understand the disciplinary contents	8%	8%	20%	32%	32%	3,72

Develop their capability of reasoning and abstraction	0%	8%	16%	40%	36%	4,04
Develop their critical thinking	0%	8%	20%	44%	28%	3,92
Develop competences of cooperation and team working	0%	4%	8%	32%	56%	4,4
Strengthen language competences	4%	8%	12%	40%	36%	3,96
Provide competences useful for the working future of students.	0%	8%	12%	40%	40%	4,12

Table 2 -Teachers' opinion of effectiveness of problem based CLIL activities.

The questionnaire also inquired about the difficulties in the implementation of this kind of activities, both from students' and teachers' point of view. Students' expected difficulties are the use of English in real world situations, problem solving and group working. They are exactly the features that distinguish the new methodology from the traditional teaching approach and they are clearly acknowledged by teachers as useful to develop competences, as shown above: these results are evidence of the resistance of the Italian school system to go beyond the transmissive teaching model and to embrace innovation.

As expected, teachers' main difficulties are the use of a foreign language, the need of changing one's method and the lack of time to design meaningful activities. As teachers acknowledged, the training worked just to contrast these problems, increasing self-confidence in their language skills, making them experience the usefulness of the new methodologies and facilitating the sharing of materials.

6. Conclusions

The Department of Mathematics of the University of Turin proposed a model of teachers training that could be utilised to fill a gap in the professional development that Italian school teachers strongly need. As the problematics of European teachers do not differ from Italian ones, the model could be enlarged at international level. The evidence gained by the experiences presented in this paper, deducted by qualitative and quantitative analysis, support the usefulness of this model, training teachers to design meaningful problem based CLIL activities. The final goal is to develop students' disciplinary, linguistic and transversal competences that will allow them to become competitive in their future working experiences.

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