TEACHERS PERCEPTION OF COMPUTER SUPPORTED PROBLEM SOLVING: AN ITALIAN RESEARCH

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Abstract. Requirements for educational software could be based on an analysis of existing learning situations. In order to obtain useful information about teaching practices, an explorative study has been conducted with a group of Italian teachers. Collected answers highlight that pedagogical support is needed in order to design effective educational software.

1 Introduction

During the design process of educational software it is very important to take into account teachers perceptions and needs [3, 16]. A software system to support face-to-face problem solving will be designed, within the LEAD project, taking into account suggestions coming from teachers in Participatory Design perspective. In order to obtain useful information about teaching practices, an explorative study has been conducted with a group of Italian teachers. A semi-structured interview was prepared in order to gather teachers' representation of computer use in classroom and, more specifically, as support for *Collaborative Problem Solving*. Collected answers highlight that pedagogical support is needed in order to design effective software supporting *Collaborative Problem Solving* into the classroom.

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2 Theoretical framework

This study, focused on *Collaborative Problem Solving* (CPS), belongs to the framework of cultural psychology, in particular to the collaborative and dialogical models of learning [5, 6]. Collaboration is universally recognised as a fundamental factor for cognitive development because it allows different points of view to emerge

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and to be compared [14]. In such framework, CPS has been defined a complex learning process during which learners and teachers represent, analyse and try to solve different types of problematic questions. During such process collaboration and argumentation are the basis upon which new knowledge can be created [1, 2, 11, 19].
ICT tools can provide an effective support to CPS and many pieces of software have been developed, especially in educational settings, for participants interacting at a distance. In this educational paradigm [8, 18], learning mainly occurs through virtual interaction between groups of learners supported by teachers, tutors, and experts. According to [9], such educational virtual environments can be included in two main categories:

- *Action oriented systems*: environments based on the *learning by doing* principle, where learners can do actions, manipulating objects and discuss the outcomes like virtual scientific experiment software.
- *Textual production systems*: such environments are based on the collaborative production of written texts. These systems refer to the educational model that considers knowledge as built through collaboration and with the *scaffolding* of a teacher or a tutor.

Nevertheless, some studies have found that in European educational systems the most part of didactic activities are still face-to-face [7, 17]. Looking at some specific contexts, such as the South of Italy, we see many constraints to the introduction of CPS software for the everyday educational practices. For example, lack of computers into the classroom, low level of ICT expertise, and low knowledge of CPS methodology among teachers.

The Participatory Design (PD) methodology [12, 15] seems suitable to overcome at least immaterial constraints, facilitating the implementation of computer use in didactics into Italian educational context.
PD allows final user to participate to the entire process of development of technologies. In this sense, it can give the possibility to develop an environment that takes into account idiomatic and idiosyncratic communication styles of work groups. Analysis of communication technologies used in the workplaces and the analysis of users' mental models can enable designers to understand what kind of tools should be included into the software and how to display them in order to obtain the maximum advantage. Using PD, software can be designed based on teachers' needs and representations of their practices. PD in this case is useful to mediate between teachers and students knowledge mental models to build distributed systems able to give user the perception of a good affordance. Through an interface based on everyday classroom experience, the process of appropriation of new didactic support should be facilitated [13].

3 corpus, research design and categories

LEAD Italian research group collected 20 teachers' interviews from kindergarten, primary and secondary schools inquiring, among other things, what teachers know

about Collaborative Problem Solving (CPS), how they use it in classroom, and how they imagine a software system that supports face-to-face CPS.

Interview was structured in the following 4 sections composed by one or more questions: professional identity, computer use, classroom activities, and school culture. For this study, only computer use and classroom activities sections have been analysed. Interviews have been audio-recorded, transcribed considering both verbal and non-verbal aspects, and later analysed using content analysis methodology [4]. First, corpus has been read and a system of categories has been created according to research objectives and textual occurrences [10]. Categories of analysis have been attributed to the text by 5 independent judges, discussing doubtful cases until reaching a 100% level of agreement. Finally, categories' frequencies have been calculated and an interpretative analysis of teachers' answer has been conducted, on the basis of content analysis results, to reach a deeper understanding of their representation of PS and software requirements.

Interviewed teachers come form different towns of South Italy (Salerno, Avellino, Bari and Barletta). They are mainly females (19 over 20); most of them teach humanities (15 over 20) and only a few teaches scientific subjects (5 over 20). This data actually mirrors the gender distribution among Italian educational context according to the Italian Ministry of Education.

Teachers' answers have been categorized with respect to the following principal themes:

- Level of ICT expertise[1]
  1. Non-users: using PC only at basic level or don't use at all;
  2. Medium-users: using PC for writing and browsing Internet;
  3. Expert-users: teachers using PC for writing and didactic.
- Definition of problem solving[2]
  1. Absent answer: teacher is unable to give a definition;
  2. Not pertinent answer: teacher gives a definition containing no reference to CPS model (e.g. "*I don't plan my school daily activities (...) I don't mind following the subject order (...) we decide together witch topic to discuss*");
  3. Generic answer: teacher gives a definition containing a single reference to CPS model (e.g. "*stimulating in the student the desire to solve a situation or a question in order to obtain an answer to the problem*");
  4. Pertinent answer: teacher gives a definition containing two or more references to CPS model (e.g. "*PS is the typical way of research questioning each situation (...) and find solution together*").
- Examples of problem solving[3]
  1. Absent answer: teacher is unable to give an example;

[1] For this category the following questions of the interview have been clusterised: "*What is the role of computer in planning and carrying out your classroom activities?*"; "*What is the role of Internet in planning and carrying out your classroom activities?*"; "*How do your students use computer in classroom activities?*"; "*What is the added value of computer in classroom activities?*".

[2] For this category the following question of the interview has been taken into account: "*Could you please give a definition of Problem Solving?*".

[3] For this category the following question of the interview has been taken into account: "*Could you please provide an example of using Problem Solving in your classroom?*".

2. Not pertinent answer: teacher gives an example containing no reference to CPS model (e.g. "*studying the child emotions, so we made a circle time*");
3. Generic answer: teacher gives an example containing a single reference to CPS model (e.g. "*we start form a problematic situation to find the answers on each topic*");
4. Pertinent answer: teacher gives an example containing two or more references to CPS model (e.g. "*thinking that the plant needs water for growing (…) from their answer (…) we verify it in practice*").

– Requirements of the CPS software[4]
1. Absent answer: teacher is unable to give a requirement;
2. Interface/functionalities: teachers focus on the requirements concerning the software interface (i.e. with respect to users' age) and the functionalities they think useful to support educational practices (e.g. "*perhaps with some music*", "*helping to build diagrams*", "*related to children's age*");
3. Type of problem: teachers focus on the type of CPS the software should support and the cognitive activities involved (e.g. "*not subject related, able to manage a problematic situation", "I imagine it like a real situation, I mean to ask the pupil a question he can understand*").

4 Results

4.1 Level of ICT expertise

Teachers interviewed have a medium level of ICT expertise (Fig. 1) and only 15% (3 over 20) uses PC systematically at school, 60 % (12 over 20) uses it once per week and 25% (5 over 20) never uses PC in didactics.

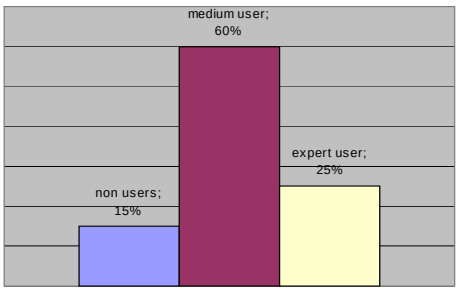

Fig 1. Teachers' expertise level

[4] For this category the following question of the interview has been taken into account: "*How do you imagine a software supporting CPS? What characteristics would you like it to have?*". In this case categories are not exclusive so the answer could focus on more than one aspect.

The most frequent motivation to use computer use is to be updated about their work and to prepare documents (Table. 1):

Table 1. Motivation for personal computer use.

	Italian	English
Interview #16	prendo il materiale perché io lavoro molto con la civiltà, con la cultura, e il testo che abbiamo attualmente non è molto ricco, quindi attraverso internet sperimento molta roba	*I get material because I work with humanities and culture, and the textbook we use is not very rich, so I experiment many stuffs through Internet*
Interview #10	lo uso per fare la programmazione, apportare le modifiche, stampare	*I use it to prepare the subject plan, to modify it, to print it*

Only 25% of teachers declare that they use computer also to sustain activities in classroom (Table 2):

Table 2. Motivation for computer use in didactic.

	Italian	English
Interview #17	Comunque io diciamo li porto lo stesso, sia per la matematica, per spiegare il computer come è fatto, e sia anche per esempio per musica	*I often bring the pupils to the lab, for mathematics, to explain the computer, also for example music*

4.2 Definition and examples of PS

On of the aspects emerging from the analysis of the interviews is the distance between the definition of the PS that can be found in literature[5] and the definition provided by the teachers (Fig. 2). Only 10% of them is able to give a pertinent definition of PS, while 50% can define it only in generic terms. 25% gives a not pertinent definition.

A more problematic situation emerges when teachers are asked to give examples of PS in their didactic practices. Teachers seem unable to give practical examples coherent with theoretical definition, or with the definition they gave (Fig. 2). This gap is probably due to a superficial knowledge of PS or to the incapacity to recognize practices they use in classrooms as *Collaborative Problem Solving*.

[5] For this study, we didn't refer to a particular definition of PS. The aim was to understand if the teachers could establish a relationship between theoretical knowledge and educational practices rather than verifying teachers qualification.

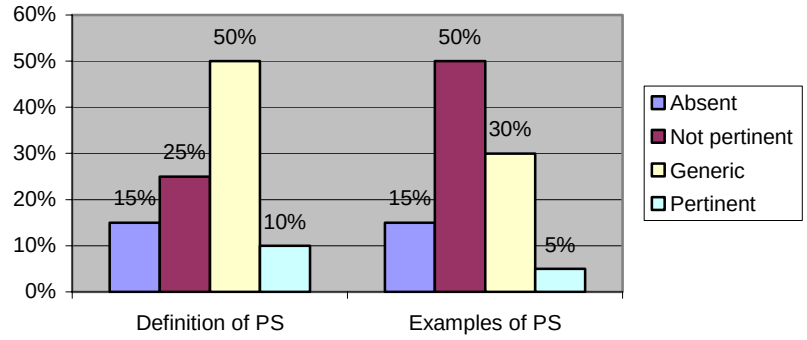

Fig. 2. Definitions of PS and examples of PS

4.3 Software requirements

The third aspect that has been investigated is requirements teachers consider relevant in a software system they would actually use in classroom. A large part of the interviewed (40%) is unable to describe any kind of features. When teachers provide an answer, it is about the interface and functionalities (Fig. 3).

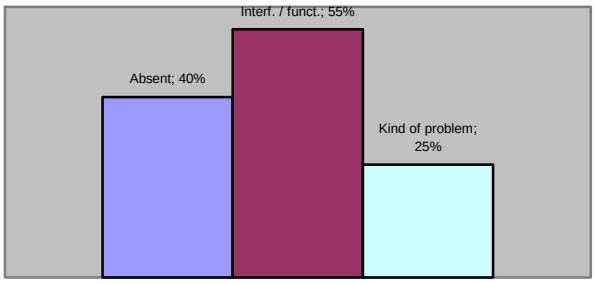

Fig. 3. Teachers' requirements for CPS software.

About interface, teachers ask for a software system that can be used autonomously by students and that is situated in children's real life (Table 3):

Table 3. Interface and functionalities requirements

	Italian	English
Interview #02	che preveda un momento in cui il bambino può utilizzarlo autonomamente ma che poi dia all'insegnante la possibilità poter concludere	*provide a moment in which the child can use it autonomously but then gives the teacher the possibility to finalise the activity*
Interview #10	i loro problemi reali, quindi mi immagino una cosa, una ripresa video e poi un'analisi successiva.	*about their real problems, so I imagine something with video clips and a successive analysis*

About type of PS, teachers imagine the software to support different problems also related to students' age (Table 4):

Table 4: Type of PS requirements

	Italian	English
Interview #12	in cui devi arrivare a una meta, risolvendo alcuni quiz.. dei giochi virtuali in cui c'è la ricostruzione di un percorso	*where you must reach a goal by solving some quiz. Some virtual games where you can reconstruct the path*
Interview #20	lo immaginerei con più soluzioni, magari lo stesso problema (…) .con gradi di difficoltà diversi	*with different solutions to the same problem (...) with different levels of difficulty*

5 Suggestions

Based on the results of these explorative interviews we can argue that:

1. teachers don't know much about CPS and they don't easily integrate it in classroom's curricular activities (e.g. "I gather the questions form children, if a pupil asks a question on his subject I find very difficult to connect it to an argument to a didactic unit that I have in my mind").
2. teachers have some requirements about a software to support Collaborative Problem Solving

Thus, design process of CPS software, at least for the Italian version, should include some kind of pedagogical support. Such support should be a short, synthetic, clear text containing theoretical, methodological, and bibliographical information.

To help teacher in designing and integrating CPS in everyday classroom activities, software should also provide a sort of template or wizard. Depending on some variables (e.g. number of students in classroom; age of students; subject of teaching), software should guide teacher through a set of phases and alternatives (e.g. problem definition; gathering information; hypotheses definition and assessment; solution of the problem). For each phase, software should present a set of possible

activities (e.g. brainstorming; meta-cognitive scaffolding; laboratory activity; role play; jigsaw; etc.)

About teacher suggestion of CPS software, we may look more coherently into the *interface/functionalities* dimension that gather the most part of teacher answers. Nevertheless, it seems clear that teachers' answers don't mention any requirement concerning interactivity and group work dimensions.

We also suggest that further investigations should be carried out in different cultural contexts to provide more information useful for the design process.

References

1. Baker, M.J., Quignard, M., Lund, K. & Séjourné, A. (2003). Computer-Supported Collaborative Learning in the Space of Debate. In: B. Wasson, S. Ludvigsen and Hoppe, U. *Designing for Change in Networked Learning Environments*. Kluwer Academic: Dordrecht.
2. Baker, M.J. (2002). Argumentative interactions, discursive operations and learning to model in science. In P. Brna, M. Baker, K. Stenning & A. Tiberghien (Eds.), *The Role of Communication in Learning to Model*, pp. 303-324. Mahwah N.J.: Lawrence Erlbaum Associates.
3. Banathy, B.H. (1992). Comprehensive systems design in education: building a design culture in education. Educational Technology, 22(3) 33-35.
4. Berelson (1954) "Content Analysis" in G. Lindsey, *Handobook of Social Psychology: Theory & Method*, Vol. 1, 488-522. Cambridge, Mass: Addison-Wesley.
5. Brown, A.L., & Campione, J. (1990). Communities of learning and thinking, or a context by any other name. *Contributions to Human Development*, 21, 108-126.
6. Cole, M. (1996). *Cultural Psychology*. Cambridge: Belknap.
7. Collis and Van der Wende (2002), Models of technology and change in higher education: an international comparative survey on the current and future use of ICT in higher education
8. Dillenbourg, P. (ed) (1999). *Collaborative learning: Cognitive and Computational Approaches*. Pergamon, Amsterdam.
9. Dimitracopoulou A. (2004). Designing collaborative learning systems: current trends & future research.
10. Glaser, B.G. & Strauss, A.L. (1967) *The Discovery of Grounded Theory*. Aldine: Chicago
11. Jonassen, D.H. (2000). Toward a design theory of problem solving. *Educational Technology: Research & Development*, 48 (4), 63-85.
12. Kensing, F. & Blomberg, J. (1998). Participatory design: Issues and concerns. Computer Supported Cooperative Work, 7, 3-4, 167-185.
13. Overdijk, M. van Diggelen, W. (2006) Technology Appropriation in Face-to-Face Collaborative Learning. Paper presented at 1th European Conference on Technology Enhanced Learning (EC-TEL 2006), 1-4 october 2006, Crete (Greece).
14. Perret Clermont, A. N. (1979). *La construction de l'intelligence dans l'interaction sociale*. Berne: Lang.
15. Perriault, J (1989). *La logique de l'usage. Essai sur lesmachines à communiquer*. Editions Flammarion, Paris
16. Reigeluth, C. M. (1993). Principles of educational systems design. *International Journal of Educational Research*, 19 (2), 117-131.
17. Ruthven, K. Hennessy, S. Brindley, S (2004). Teacher representations of the successful use of computer-based tools and resources in secondary-school English, mathematics and science. *Teaching and Teacher Education*, 20 (2004) 259–275

18.Slavin, R.E. (1989). Research on cooperative learning: An international perspective. *Scandinavian Journal of Educational Research*, 33 (4), 231-243
19.Resnick, L.B. Levine J.M. & Teasley S.D. (Eds.) (1991), *Perspectives on Socially Shared Cognition*. Washington DC: American Psychological Association.