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Activity Theory as a conceptual framework for understanding teacher approaches to Information and Communication Technologies

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ABSTRACT

While the issue of teachers' perspectives on the barriers to technology use has received considerable attention, teacher concerns have not been studied in a systematic and holistic way. The present paper examines teacher concerns regarding a proposed technology-based innovation using Activity Theory as a theoretical framework. Fifty-one teachers participated in an inservice blended learning course in which a real-life Computer Supported Collaborative Learning example was presented and subsequently discussed in the online forum. The teachers were asked under which conditions they thought Computer Supported Collaborative Learning could be incorporated into their daily practices. Teacher concerns were identified through their online posts. Time and curriculum constraints were reported by teachers as the main obstacles to the proposed technological innovation. The examination of these obstacles using Activity Theory helped to identify three major contradictions in teachers' activity system: (a) within the object of activity, (b) between the mediational means and the object of activity and (c) between the current and the proposed object. These contradictions are discussed from the perspective of Activity Theory and their implications for the design and implementation of technology are drawn.

1. Introduction

1.1. The issue of teacher concerns

The early 1980's marked the time of widespread introduction of Information and Communication Technologies (ICT) into the educational systems of the western world according to a number of rationales (Hawkridge, 1990). One of the rationales for the introduction was pedagogical and it was hoped that computers would transform traditional education by remedying its problematic features. About three decades later, the aim of transforming educational practices has not been obtained. Research suggests that (a) the rate of technology use is too low to make a difference and (b) technology is mostly used to support established practices rather than transform them.

Regarding the former, the rate of technology use was initially low as computers were either not available in sufficient numbers or unavailable altogether. It was expected nonetheless that once the student-to-computer ratio declined the rate of technology use would increase. As a result of lavish funding the technology infrastructure in schools increased spectacularly over the years as is manifested in indices such as students-to-computer ratio and internet connectivity (BECTA, 2006; Condie, Munro, Seagraves, & Kenesson, 2007; National Center for Education Statistics, 2006; OFSTED, 2004). Despite expectations that technology would bring about change in traditional practices, the rate of technology use in schools remained low as reported both by small scale studies and national surveys (Becker, Ravitz, & Wong, 1999; Cuban, 2001; Cuban, Kirkpatrick, & Peck, 2001; OFSTED, 2005; Sinko & Lehtinen, 1999; Williams, Coles, Wilson, Richardson, & Tuson, 2000).

Regarding the latter, even when technology was used, the type of use also failed to match the high expectations of transforming educational practice. It turned out that for the most part teachers used technology to enhance traditional practices rather than transforming them (Conlon, 2004; Cuban, 2001; Hennessy, Ruthven, & Brindley, 2005; Ilomaki, Lakkala, & Lehtinen, 2004; Smeets, 2005). Thus, the mere availability of technology did not result in any substantial change in terms of teaching practices (Cuban, 2001; Sandholtz, Ringstaff, & Dwyer, 1997; Windschilt & Sahl, 2002).

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Why technology is not used even though it is available or used to sustain existing practices has been a very puzzling problem. As Kerr (1991) eloquently put it several years ago "*why technology has found so small a place in classroom instruction ... is one of the great mysteries of contemporary ... educational practice*" (p. 115). It has been argued that the key to understanding technology use is the study of the most crucial mediating factor, the teacher. The issue of teacher perspectives has been thoroughly studied over the years, in terms of ICT knowledge and skills, attitudes towards and perceptions of ICT, and conceptions of ICT. Nevertheless, few studies have examined the teacher perspectives on ICT-based innovation in a holistic manner and the obstacles of such innovation from the teachers' point of view. The study of teacher perspectives regarding ICT-based innovation in terms of barriers to ICT use may reveal what the teacher priorities are. We argue that it is these obstacles as indicated in teacher concerns about ICT use that should be carefully examined as they provide both the key to understanding teacher approaches to ICT and possible ways of action.

When asked about what inhibits ICT use in their practices teachers mention several factors. Some are obvious and have attracted considerable attention over the years. These include lack of computers (Williams et al., 2000; US Department of Education, 2000), technology failures (Condie et al., 2007; Cuban et al., 2001; Jones, 2004) as well as lack of familiarity and skills (Jones, 2004; Williams et al., 2000; Smeets et al., 1999). However, other obstacles mentioned by teachers, such as time and compatibility, are more important but also more difficult for outsiders to comprehend.

As far as time is concerned, teachers often voice time-related concerns. Time has two interrelated dimensions. On the one hand, time refers to familiarity: teachers need time to learn the technology. Research suggests that one of the most significant inhibiting factors for ICT use is related to time: time to learn new skills, time to find out about technologies, time to find out about resources, plan, and try out new approaches to teaching and learning, time to reflect upon experiences and consolidate learning, time to share those experiences with others (Condie et al., 2007; Smeets et al., 1999; US Department of Education, 2000; Conlon, 2004; Jones, 2004). On the other hand, time refers to the feasibility of ICT introduction: teachers are concerned that given the circumstances they might be unable to incorporate ICT into their daily practices according to the much celebrated popular ICT rhetoric. The structure of current practices might act as a significant change barrier. For example, age-graded schooling has been identified as an obstacle since self-contained classrooms separate teachers from one another (Cuban, 1993). While such a structural feature of schooling might appear to be seemingly unrelated to whether or how ICT gets used, evidence suggests that common planning time with colleagues was the most important determinant of technology use (Windschilt & Sahl, 2002); moreover, discussions with colleagues and collaborative thinking processes also appear to be conducive to technology use (Levin & Wadmany, 2008). Scheduling and the 50-minute period which are typical of most schools many not facilitate change (Soloway et al., 2000; Becker, 2000; Cuban, 2001). Kerr (1991) noted that time pressure is an important inhibiting factor which leaves teachers room for nothing but the most basic classroom maintenance. One of the teachers in the Norton, McRobbie, and Cooper (2000) study reported that exploratory learning required time and time she did not have as she had to prepare her students to pass the upcoming test. In US Department of Education (2000) survey, 80% of the teachers surveyed mentioned lack of time in schedule for students to use computers in class as one of the main barriers for incorporating ICT into their practices. As Cuban et al., succinctly put it: "*Teachers told us that they did not have enough time to incorporate computers into their daily teaching. The would need hours to preview web sites; hours to locate the photos they required for the multimedia project they assigned to students; hours to scan those photos into the computers; and hours to take district and corporate courses to upgrade their skills...where, they asked, would the additional time come from?* " (p. 828).

Regarding compatibility, the greatest barrier teachers face when it comes to ICT integration into daily practices is the fit of ICT with these practices. It appears that the single most important issue regarding the integration of ICT into the curriculum is compatibility. Olson (2000) argued that when introduced into the classroom, the computer technology finds an existing technology: desks, boards, books, chalk, maps, etc. Teachers have mastered these technologies and employ them skillfully to achieve their goals. When a new technology is introduced, its compatibility with existing practices might to a large extent determine whether it gets used. The ultimate example in this respect is the overhead projector. As Cuban (1993) notes, as opposed to changing what the teachers do, the overhead actually extends it. For example, using the overhead, the teachers still lecture in front of the class so the overhead does not have any transformative impact. Additionally, as a technology the overhead is better than the chalkboard since teachers can add overlays and new transparencies without worrying about erasing the chalkboard or turning their back to the class. Cuban (1993) argues that the overhead was integrated into teaching practices because not only did it not challenge them but in fact enhanced them. Cuban's argument appears to be corroborated by recent surveys. BECTA (2006) report mentions that use of interactive whiteboards and other whole-class display technologies is steadily increasing. Condie et al. (2007) found that interactive whiteboards have a positive impact on teaching and learning and the same holds for visual technologies such as digital video and photography. As Beastall (2006) noted "*what was an overhead projector is now a digital projector*" (p. 102). The popularity of whole-class display technologies in general (such as the overhead projector) and interactive whiteboards in particular is indicative of the type of technology that is more likely to be used in classrooms compared, e.g. to educational software. It is technology which fits squarely into current practices and this is why it is easily assimilated into them. Display technologies are popular because they are compatible with current practices and are used to sustain those practices as opposed to changing them. Moreover, the lack of fit of ICT with established practices entails that the introduction of technology might disturb existing routines and practices. Norton et al. (2000) suggested that teachers might not use technology because the pedagogy implicit in the activities contained by technology might not be compatible with teachers' preferred teaching strategies. Similarly, Olson, James, and Lang (1999) noted that having to take student interests into consideration might unsettle teachers who are accustomed to whole-class discussions.

To conclude, teachers do not enthusiastically embrace technology because it is not compatible with their current practices and when they do they use it to sustain these practices rather than reform them. As a result, the vision of transforming education remains unfulfilled. We argue that the study of teacher concerns might enable us to uncover the explicit or implicit priorities teachers have regarding technology. Different proprieties might potentially signify conflicts between existing and new practices. These conflicts are worth considering because they have the potential to reveal lack of fit between current practices and innovation. Teachers solve these conflicts by either not using technology or by "domesticating" it, as Olson (2000) put it, i.e. putting it to the service of their needs. The understanding of these tensions is critical to understanding teacher reluctance to integrate ICT in their daily practices.

To study conflicts a theoretical framework is required which will allow us to conceptualize the tensions arising from an ICT-based innovation in a holistic way as teachers perceive it. Activity Theory is such a framework which has been extensively used to study innovations in many disciplines and settings but has not been, to our knowledge, systematically used to study how teachers approach ICT.

1.2. Activity Theory

Activity Theory (AT) was initially developed by Leont'ev in the course of the 20th century in the former Soviet Union (Leont'ev, 1978; Leont'ev, 1981a, 1981b). Leont'ev's conception of activity is depicted in Fig. 1.

According to Leont'ev, an activity is initiated by a motive such as a need or drive. An activity is made up of one or more actions the completion of which satisfies the initial motive. An activity and all the component actions are always realized in specific contexts which determine to a large extent the conditions under which the actions can be realized and the initial motive can be satisfied (e.g. availability of tools).

Over the past 20 years, Leont'ev's conception of activity has been further developed by Engeström (1987, 1999) and has also been integrated with Vygotsky's theory (Cole, 1996; Cole & Engeström, 1993). The resulting theoretical framework is referred to as Cultural–Historical Activity Theory (CHAT) which represents an attempt to combine Vygotsky's and Leont'ev's theoretical frameworks. Thus, Leont'evs initial conception of activity has been further developed into a theoretical tool which allows one to examine an activity system and determine inconsistencies, friction, conflict, and points of tension (Engeström, 1987, 1999; Engeström, Engeström, & Sunito, 2002). According to CHAT, an activity system can be represented as illustrated in Fig. 2.

As depicted in this figure, the classical subject-mediational means-object relationship triangle is expanded to include other components such as the distribution of labor, the community and the rules. To give an example in terms of education, the subject in an educational activity system is the teacher and the object is his/her student and the learning of this student. The mediational means include textbooks, audiovisual aids and materials, instructional strategies, etc. The rules include the educational laws, the national curriculum, school rules, classroom and instructional rules, timetables, schedules, etc. The community includes students, teachers, school administration, and the parent–teacher association. Finally, labor is distributed among teachers, school subjects, different units, mediating artifacts, and modes of work.

Nowadays, a common application of Activity Theory is for the study, analysis, and interpretation of the changes required for the transformation of collective practices in organizations, institutions, businesses, and other activity systems. Given that the integration of ICT in educational practice is expected to transform this practice, the application of AT for the study of ICT in teacher education appears to hold great promise. More specifically, the potential of Activity Theory lies in that it affords a holistic description of an activity system in terms of its basic components and interrelations. Thus, the interest can be in the conflicts within the components as much as among components of an activity system.

An educational innovation such as the introduction of ICT into the teaching and learning practices aims to transform a collective practice, i.e. education. Such an innovation has several dimensions which can be conceptualized in terms of the configuration of the main components of an activity system (see Fig. 2). However, an innovation might not always welcome by the practitioners, and in this case educators. Typically, innovations follow top–down models where administrators, policy makers, and academics devise an innovation which is to be implemented in practice. Quite often, innovations ignore the teacher perspectives and realities, even though the innovation is bound to be received in light of existing teacher beliefs, perspectives, attitudes, and practices. Given that teachers are not empty vessels, they are likely to incorporate technology into whatever it is they are doing. As was discussed in the former section, teachers are hesitant to use ICT for their priorities might not coincide with the priorities of the various authorities that design the innovation. Consequently, AT is a unique theoretical framework that allows the conceptualization of teacher concerns in a systematic way, enabling the study of contradictions and tensions in connection to ICT-based innovation.

1.3. Focus of the study

The study aimed to explore the ways in which the teachers perceive of their object of activity in response to a proposed ICT-based innovation. More specifically, drawing on AT as a conceptual framework, the study addressed the following questions:

(a) What are teachers' concerns about an ICT-based innovation?
(b) What would the ideal conditions be for implementing this ICT-based innovation in their daily practices?

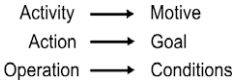

Fig. 1. The structure of human activity.

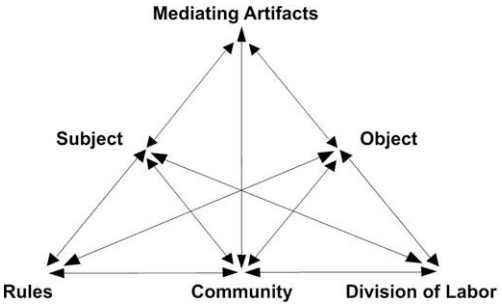

Fig. 2. The structure of a human activity system.

2. Method

2.1. Subjects

Fifty-one teachers from public elementary schools participated in the study (27 male, 24 female). The teachers had an average teaching experience of 11.2 years and at the time of the study were employed in the western part of the island of Crete. All teachers participated in an in-service training program which was offered by the Department of Education of the University of Crete and was partly funded by the European Union. The author taught a semester-long course on the educational applications of the Internet.

2.2. Contents

The course was a blended learning one including both lectures and asynchronous online discussions. More specifically, 13 weekly 3-h lectures were held over a period of one semester. In addition to the class meetings, an electronic forum was established for the purposes of the study and hosted the online discussions. The specific course revolved around the educational applications of the internet and included several units, one of which was related to Computer Supported Collaborative Learning (CSCL). The module included (a) theory and research papers on CSCL and (b) an extensive, real-world, worked out example of a CSCL innovation.

2.3. Procedure

After each lecture and discussion in class, the author started a new thread in the forum. Each thread dealt mostly with the weekly theme and the online discussions were scheduled to last for about one week (until the next lecture in class).

Participation in the online discussions was a standard course requirement for all participants. In an attempt to engage the teachers in the discussions as actively as possible, one post per week (i.e. per discussion theme) was set as the minimal accepted participation rate. The inservice teachers who participated in the study had no experience whatsoever with asynchronous online communication and it was expected that their participation would be both very slow and difficult. Thus, it was decided that the author be continuously involved in the discussions, by means of commenting teacher responses and/or posing further questions (Mazzolini & Maddison, 2003).

For the purposes of the present paper we focus on two related themes: (a) limitations of traditional classroom discourse and (b) teaching and learning applications of asynchronous electronic communication (forum). The first theme aimed to address the problematic features of teacher-led whole-class discussions (i.e. absolute control by the teacher, only one student can speak at a time, mostly closed questions, triadic nature, etc.). The second theme aimed to present asynchronous electronic communication as a solution to the problems identified in the first theme. The starting point was a "real" problem taken from teachers' everyday practices and we focused on how it could be remedied with asynchronous electronic communication.

2.4. Measures

Several sources of data were collected for the purposes of the study. Firstly, teachers' posts on the electronic discussion forum were used as a means of determining their views about ICT-based innovation. Secondly, small group interviews with all the participants were held at the end of the course. The interviews were meant to elaborate themes which had emerged in the course of the online discussions. The interviews were tape recorded and transcribed for subsequent analysis. Thirdly, following the end of each class meeting, the researcher took notes about issues which had surfaced during class discussions. Finally, a questionnaire measuring demographic data as well as teacher views about specific course contents was also administered at the end of the course.

2.5. Analysis

The main source of data that the present paper draws on is the teacher views as expressed in the online discussions. The data from the small group interviews and the field notes were only used for auxiliary purposes. Following the AT approach (Engeström et al., 2002), we used content analysis as a method for identifying teacher concerns. ATLAS.ti was used to code teacher views as reflected in their online posts. Firstly, the two relevant threads from the online discussions were imported into ATLAS.ti. Secondly, each separate teacher post was treated as a natural unit of analysis. Thirdly, following a bottom–up approach, a code was initially assigned to each segment containing a teacher concern. Finally, after all teacher concerns had been identified and coded, the initial codes were merged into new ones.

3. Results

In total, 757 messages were posted in the forum. Given the focus of the paper, we examine only the two topics in which CSCL issues were discussed: (a) limitations of traditional classroom discourse and (b) the integration of asynchronous electronic communication into the daily school practice. 96 out of the 757 messages (12.68%) were posted in the first topic and 84 (11.1%) were posted in the second topic.

3.1. Limitations of traditional discourse

Thirty-seven (72.55% of all course participants) teachers participated in the topic "Limitations of traditional classroom discourse". The teachers were asked the question: "*have you ever considered the limitations of traditional classroom discourse and its implications for student learning?*" Some of the teachers agreed that the traditional classroom discourse is very limiting in certain respects. Others were more open to the interpretations offered during the course. Yet others, tended to find drawbacks in the CSCL approach presented, and others rejected CSCL as being equally limiting. Despite variation, a very consistent pattern emerged: teachers responded that teacher-led dialogue is the

dominant pattern but not without a reason: there was a lot of curriculum material to be covered and this meant that there was very little time to engage in in-depth class dialogues.

It is interesting to note that 22 out of the 37 teachers (59.46%) who posted messages to this topic mentioned time as the major obstacle as far as the structure of traditional discourse is concerned. Some typical teacher responses:

"in the course of the lesson I don't think that there's time to think about anything except how to cover the designated curriculum" {teacher-1}
"classrooms are dominated by teacher monologues and little time is devoted to discussions with the students. This is due to the scarce time available to teachers" {teacher-11}
"one of the major challenges educators face is the limited instructional time. In particular, when it comes to large classes the time allotted for each student to express their views or pose questions is very limited" {teacher-14}
"one of the major issues educators face is the limited instructional time given the bulk of curriculum objectives and the large number of students. The time available per student is very limited. It is a fact that some students monopolize classroom discourse" {teacher-15}
"no matter how much we struggle to avoid monologue, it is eventually unavoidable. This is mainly due to time restrictions. How is it possible within a single 45 minute period to teach a class of 25 while simultaneously engaging all students in dialogue? There's less than 90 seconds available per student. Naturally, discussions are marginalized and teacher monologues prevail" {teacher-36}
"in the course of the lesson it is the teacher who does most of the talking, only a handful of gifted students usually dominate discussions, and there's hardly any opportunity to develop reflective thinking as the time allotted between a teacher question and a student answer is minimal" {teacher-46}
What is evident from those posts is that teachers are under significant, constant pressure to cover the curriculum prescribed by the state. Teachers explicitly mentioned their stress and anxiety with the bulk of the curriculum content which must be taught within the allotted time frame. According to the views expressed by the teachers, in-depth discussions are out of the question because of the curriculum: it is loaded with material which does not leave many alternatives when it comes to setting up whole class discussions and engaging as many students as possible in such discussions. As the teachers emphasized, the only viable course of action is to ask a few closed (i.e. yes–no or short answer type) questions which are usually answered by gifted students.

3.2. Integrating CSCL into daily practices

Several questions were posed in this topic but for the purposes of the paper we focus mainly on one: "*under which conditions would you welcome the integration of asynchronous electronic communication into your daily practice?*" The question regarding conditions meant to address the issue of teacher priorities, of what teachers would consider as the major obstacle to the widespread adoption of asynchronous electronic communication. This question would help probe teachers' ideas about which aspects of the current practice are incompatible with asynchronous communication.

Forty-one teachers (80.39% of all course participants) posted messages in this topic. The major themes which resulted from the content analysis of teacher responses are presented in Table 1.

As can be seen in Table 1, about one in five teachers mentioned both time and curriculum constraints while four out of ten reported time and/or curriculum barriers. Thus, the majority of teachers who posted to the forum viewed time and curriculum constraints as impeding the daily adoption of CSCSL. Table 1 also shows that about one in five teachers regard teacher knowledge and existing infrastructure as significant obstacles to innovation. Some characteristic views teachers expressed regarding time:

"the curriculum should be more flexible so as to allow the teacher and the students to work on a given topic in a very detailed manner and for as long as it takes, without the stress to cover the designated curriculum" {teacher-8}
"I would gladly use the asynchronous electronic communication in my daily practice if I was not under pressure to cover the prescribed curriculum . . .I would experiment on a daily basis if I was assured by the authorities (superintendent, school principal) and the parents that I would not be held accountable for not teaching all designated curriculum materials" {teacher-18}
"the main problem I see (with the asynchronous electronic communication) is time: which subject is it going to replace in the current curriculum?" {teacher-14}
"I don't think that it is possible to integrate the forum on a daily basis as the ministry of education supplies us with textbooks which have to be taught. I do not think that we can ignore the textbooks and teach whatever we want . . .the content of instruction is determined by the ministry of education and not by us which means that time is a luxury" {teacher-44}
"the main problem I see with the integration of asynchronous electronic communication in everyday practice is where to find the time to do so" {teacher-41}

Some characteristic teacher views regarding curriculum constraints:

Table 1
Teacher views on the barriers to daily CSCL integration.

Constraints	*N*	%
Time only	6	14.63
Curriculum only	3	7.32
Teacher knowledge only	5	12.2
Infrastructure only	2	4.88
Time & curriculum	8	19.51
Time and/or curriculum	17	41.46
Curriculum & teacher knowledge	5	12.2
Teacher knowledge & infrastructure	8	19.51
Time & curriculum & teacher knowledge	3	7.32
Curriculum & teacher knowledge & infrastructure	4	9.76

"I do not think that the integration of a forum into the everyday practice is possible with the present curriculum" {teacher-3}
"I think that the curriculum must become more flexible" {teacher-11}
"the daily integration of asynchronous electronic communication in classroom practice is only contingent upon the curriculum – at least for today" {teacher-4}
"it is basically an issue of curriculum and time schedule" {teacher-47}

4. Discussion

As far as the integration of asynchronous electronic communication into daily practices is concerned, teachers rank time as the first obstacle and curriculum as the second. While teachers identify two distinct obstacles, in fact the two are intertwined. This is because when teachers speak of time they mean that there is hardly any time available considering that the curriculum is full of material to be covered. Because of this, the time to cover certain topics or concepts in depth is de facto limited. Thus, what teachers perceive of as a time limitation is essentially a curriculum limitation. In this sense, time is only a symptom and not the cause of inconvenience for teachers. Even though teachers experience time as the major restrictive factor and report it as such, they are implicitly alluding to curriculum issues. As Olson et al. (1999) noted, when teachers mention time-related issues time acts simply as a "code word" hinting at other important concerns. The teachers who participated in our study experienced time pressures which were caused by the mile-wide inch-deep Greek National Curriculum for elementary schools (i.e. grades 1–6).

Interestingly enough, while teachers do mention infrastructure and training as barriers these are not on the top of the list. The majority of teachers think that what essentially limits innovation is not so much the deficiencies in terms of infrastructure or training but the curriculum per se. Given these teacher concerns about the proposed ICT-based innovation, how can AT help to conceptualize them? The potential of AT lies in that it helps to uncover three main tensions both within and between components of the teachers' activity system: a contradiction within the object of activity, a contradiction between one of the proposed mediational means and the object of activity and, finally, a contradiction between the current object and the object implied by the adoption of the new mediational means. These contradictions are presented in Fig. 3.

4.1. Contradiction within the object of activity

Ideally, teachers' object of activity should be the students and their learning of whatever is specified in the curriculum. Nevertheless, as teachers' responses reveal (e.g. time, curriculum) the teachers are more concerned with covering the prescribed curriculum than with their students' learning of it. While this may sound ironic, given the curricular pressures teachers end up "teaching the curriculum instead of teaching their students". This represents a fundamental conflict within the very object of their activity and is depicted as a lightning-shaped arrow in the object of activity component in Fig. 3 (Engeström et al., 2002).

More specifically, the conditions prevailing in their local contexts such as excess curriculum material, limited instructional time, and large number of students per class, shape a different object of activity for teachers compared to the one envisaged by the Ministry of Education and other authorities advocating technological innovation. This is manifested as a pressure exerted on teachers to cover the curriculum rather than to focus on students' mastering of the curriculum. Since elementary school students do not have to take any national or district-level exams, student exam performance cannot be used as an indirect indicator of teacher performance or effectiveness. The only explicit and formal requirement that teachers must comply to is to cover the prescribed curriculum. In fact, teachers can be officially held accountable for failing to teach the designated curriculum. These curricular pressures result more in a struggle to cover the curriculum within the allotted time frame rather than ensuring that the students are actually mastering the curricular objectives set. As one teacher succinctly put it: "*we are racing against time to cover the curriculum material*". This imperative to cover the prescribed curriculum practically entails that the first and foremost teacher concern cannot be student learning as ensuring it would take a considerable amount of time, a commodity not quite abundant. In other words, given the intended curriculum, the teachers' responses indicated that the implemented curriculum was their top priority at the expense of the attained curriculum.

The examination of teacher concerns reveals that the obligation to cover the designated curriculum denatures the very object of their activity: instead of focusing on what their students learn and the quality of such knowledge, the teachers are primarily preoccupied with curriculum coverage. Understanding this contradiction within the teachers' object of activity is critical for it gives an indication of the degrees of freedom that teachers have in their contexts and, subsequently, what is attainable in terms of innovation and change in such contexts, be it ICT-related or other. On the face of it, the contradiction within the teachers' object of activity is unrelated to ICT. Nevertheless,

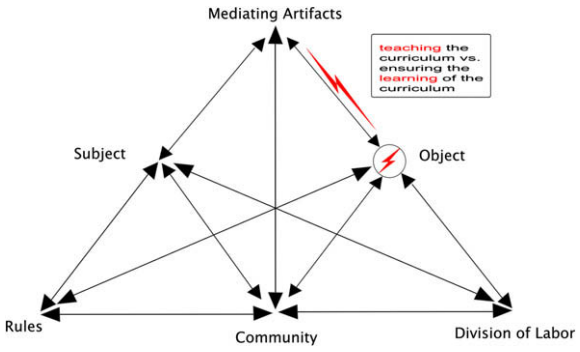

Fig. 3. Contradictions within and between components of the activity system.

the teachers expressed the view that the potential incorporation of asynchronous electronic communication into their daily practices would only exacerbate their problems, i.e. intensify the tensions within their object of activity. As teachers put it, other things being equal, if they incorporate asynchronous electronic communication into their daily practices their main task will only be more difficult to obtain. What teacher responses suggest is that if they embrace technology then it is more likely that they will put themselves in a more difficult situation as on the top of everything else they would also have to address technology related issues. Hence, from the teachers' point of view, using ICT will not only fail to solve any problem but will definitely create more problems which would in turn require further measures.

4.2. Contradiction between the mediational means and the object of activity

Teachers' responses point to the inevitability of a yet another contradiction. This contradiction is between the object of their activity as they see it (i.e. curriculum coverage) and the mediating artifact of the proposed innovation, namely asynchronous electronic communication. The contradiction is represented as a lightning-shaped arrow between the object of activity and the mediational means in Fig. 3. More specifically, to achieve the current object of their activity teachers make use of certain technologies, such as chalkboard and textbooks, which they have domesticated. It should be noted that these technologies are fully compatible with their current object of activity and their practices as a whole. On the other hand, the proposed technology, asynchronous electronic communication, is not compatible with their current object of activity. This is because it is not a technology which can be easily and effectively used to assist teachers in their main task, i.e. deliver a large body of factual knowledge within a limited time frame.

What became obvious to the teachers after studying the real-world CSCL implementation presented during the course was that setting up the virtual learning environment, devising an appropriate task, training students in the use of the technology, preparing the students for the requirements of the task, and implementing the online discussions required at least ten times as much time compared to typical expository instruction. As is reflected in their concerns, the teachers realized that such an implementation is practically out of the question in their local contexts. The teachers understood perfectly well both the CSCL theory and empirical research which were presented during the course. What the teachers nonetheless stressed was that they did not understand where would the time to implement such a practice come from. Thus, on a purely pragmatic level, it appears that the use of ICT would disturb extant practices and unsettle teachers, creating more problems without addressing the core of their existing troubles, i.e. the bulk of curriculum material to be covered. Considering that CSCL is far from being a mass presentation or display technology, integrating it into their practices would not help pursue their current object of activity.

4.3. Contradiction between the current and proposed object

The teachers were familiarized with the advantages of asynchronous electronic communication over the traditional triadic dialogue: making learning more active, more collaborative, more reflective, and more meaningful. In terms of AT, the teachers realized that part and parcel of the proposed ICT-based innovation was a new object of activity. The teachers understood that, to be successful, the proposed technological innovation would introduce meaningful learning as a new object of activity adopting an ICT-mediated student-centered pedagogy. However, as teachers explicitly put it, given the circumstances in their contexts, meaningful learning was practically out of the question as the urge to cover the curriculum did not leave much choice. This concern is clearly reflected in the fact that some teachers explicitly wondered about which academic subject asynchronous electronic communication would replace in the curriculum. Even the few teachers who were more open to innovation compared to others stated that at the very best they could see CSCL being implemented for one period per week, admitting that daily use was close to impossible. Consequently, teachers' responses point to the inevitability of yet another contradiction, namely between the current object of activity, i.e. covering the curriculum as teachers see it, and the object of activity to be introduced through CSCL, i.e. facilitating meaningful learning using student generated questions.

4.4. Implications

Firstly, the three contradictions identified above reveal a stark contrast between educational plans, as enlightened politicians, administrators, and academics conceive them, and educational realities, as teachers struggle to cope with those plans. On the one hand, policy makers, academics, and administrators consider ICT to be a panacea for the deficiencies of traditional education. On the other hand, as is painfully evident in teacher responses, technology was perceived of more as an additional problem than as a solution. From an AT perspective, the incorporation of ICT into current practice would simply not help teachers pursue their current object of activity. As a consequence, it is only natural that teachers were reluctant to embrace CSCL technology. From this perspective, the lack of enthusiasm about CSCL was to a certain extent justified. After all, it would be difficult to imagine any professional group that would eagerly and unquestionably adopt a new artifact which not only fails to address any core problem but in fact is destined to cause new ones. In retrospect, we argue that the skepticism teachers expressed is more of an indication of appropriate professional conduct than a "deficiency", as the blame for not using ICT has been traditionally put on the easy victims, the teachers.

Secondly, the teachers emphasized that the proposed technological innovation did not provide the single most important condition which, although it could not in principle guarantee its success, would at least safeguard it from the predictable failure of innovations, i.e. instructional time. As teachers mentioned, time defines most of their choices, essentially dictating what is viable and what is not regarding technology integration into their practices. This is in line with reviews which suggest that time is ranked as the third factor in inhibiting ICT use, second only to lack of confidence and lack of access to resources (Jones, 2004). Teachers' responses to the proposed innovation also point to what it would take to ameliorate the problem for the local Greek context. The teachers simply voiced that time is the most essential component for innovation. In addition to infrastructure and teacher training which are a sine qua non, this calls for a major curriculum reform which would furnish teachers with more time. The teachers implied that a curriculum with less emphasis on subject matter coverage is a necessary condition for innovation. Unlike the current mile-wide inch-deep curriculum, such a new curriculum would create a new object of activity for the teachers and provide the requisite degrees of freedom. While time is a necessary condition, the literature shows that it is not a sufficient one.

Thirdly, ICT-based innovation should take into consideration the teachers' worlds as well as the contexts within which they function. For example, the fact that the issue of teacher realities is notoriously absent from landscape reviews (Scrimshaw, 2004) is truly amazing. On the one hand, teacher practices are developed in response to the material conditions they experience in their working environments. The external objective conditions define the context in which teacher practices are formed. If we wish to transform educational practices through a technological innovation, we should focus on the forces which helped shape teaching practices in the first place. Without a consideration of the contextual factors shaping teacher practices, the fate of ICT-based innovation is rather predictable. On the other hand, an innovation is unavoidably bound to be received in terms of teachers' existing beliefs, views, attitudes and, most importantly, practices. As teachers are not empty vessels, they are bound to integrate technology into whatever it is they are thinking and doing. An educational innovation is not realized in void and, consequently, the local context of implementation should be considered in order to gain an understanding of the forces at play which shape existing practices. Innovations which do not address the core of teachers' concerns stand little chance of succeeding. The fact that CSCL was presented as a solution to a specific problem of contemporary practices, i.e. the teacher-controlled triadic dialogue, while the teachers interpreted it as a problem on the top of existing ones, vividly illustrates the importance of taking into consideration the teacher perspectives.

5. Conclusion

Contrary to expectations, research suggests that teachers are either using technology very infrequently or using it to support their practices rather than revolutionize them. In this study teachers were presented with a worked out CSCL innovation and were asked about what it would take to integrate it into their daily practices. Teachers mentioned time and curriculum as the main obstacles to the proposed technological innovation. This is in line with findings of previous studies which suggested that the issue of time is a very important consideration for teachers (Kerr, 1991; Norton et al., 2000; US Department of Education, 2000; Cuban, 2001; Cuban et al., 2001). The analysis suggested that in the local Greek context, time constraints were caused by the bulk of the curriculum material which had to be covered. The examination of teachers' concerns from an AT perspective revealed three main sources of tension between existing practices and the proposed one. This analysis corroborated the argument that the structure of current practices is not conducive to change (Cuban, 1993, 2001; Cuban et al., 2001; Olson, 2000). As the contradictions suggest, there are certain structural features of existing practices which are largely incompatible both with the mediational means and the new implied object of activity. Thus, for an ICT innovation to be viable, teacher concerns should be carefully examined as they highlight barriers to innovation.

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