

Teachers' Views of the School Community Support in the Context of a Science Curricular Reform

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Abstract

This study examines teachers' perceptions and comprehension of their school community support for change in implementing a new teaching approach in science and technology in the context of a reform initiative at the secondary level. It is part of a two-year research-intervention conducted with science teachers from a private school. Data was first collected through ethnographic notes and audio-recorded focus groups with 256 students. Although appreciated by students, the implementation provoked conflicts at the school community level. Building on the Cultural-Historical Activity Theory (CHAT) and on the expansive learning cycle aiming at transforming an activity system, the actual study aims at deepening our understanding of the origins of contradictions at and between some of the poles of multileveled activity system that is object-oriented, mediated by artefacts (instruments), and comprises the community, rules and division of labor poles. Findings highlight the clash in the participant teachers' values versus the community's in implementing innovative teaching practice. Teachers report favoring nontraditional ways of teaching and giving more room to adolescents' autonomy while the stakeholders (school principal, parents) are often looking for traditional teaching practices and students' school achievement. The results put into evidence the need to identify common grounds and to make sense of the new science teaching approach aiming at promoting students' autonomy, critical judgment, and school success levels.

Keywords: change laboratory, contradictions, Innovative teaching approach, school principal's and parents' resistance, school principal and school reform

1. Introduction

Back in 2001, the Ministry of Education of Quebec initiated the implementation of a competency-based curriculum in primary and lower secondary education. At the center of the reform is found socioconstructivism as well as the concept of the development of competency in context. The student is considered the main instigator of his learning and the teacher, a guide acting as a mediator in student learning (Deslandes & Lafortune, 2000; Dodd, 1998; Shumow, 1997). In continuation of these programs, the Ministry of Education has pursued the reform in 2006 at the upper secondary level in science and technology. The student is thus being requested to ask questions, solve problems and find solutions (MELS, 2007). For their part, teachers are encouraged to use open-ended questions related to environmental issues in order to promote science learning in context (Barma, 2011). This requires that teachers move away from the lectures they are used to and adopt new teaching strategies (Barma, Power, & Daniel, 2010; Barma, Lacasse, & Massé-Morneau, 2014).

At the same time, studies have shown the school principal's support as being critical to the successful implementation of reforms or institutional changes (Barma, 2011; Deslandes, 2006; Fullan, 2010). Moreover, a great deal of research indicates that principals act as catalysts in promoting collaboration between the teachers around issues of reforms and school improvement (Leithwood, 2009; Leithwood, Patten, & Jantzi, 2010; Supovitz, Sirinides, & May, 2010). Over the past three decades, a wealth of studies at the national and international levels have shown the benefits of parent involvement and school-family partnerships in student

learning and development (Deslandes, 2009; Epstein, 2011; Higgins & Katsipataki, 2015). In times of curricular reform, parents of students are particularly concerned and sometimes preoccupied. These ways of doing and learning are different from those that many parents have known (Dodd, 1998). Often parents react negatively to these non-traditional practices if they do not understand the issues related to their youngsters' learning (Deslandes & Lafortune, 2000; Dodd & Konzal, 1999; Lehrer & Shumow, 1997). In order to better face the new challenges related to education reform implementation, research indicates that the school should act as a learning organization and encourage discussions and collegiality between its various actors (complementary services, counselors, teachers, parents and students) (Barma, 2008; Deslandes, 2006; Deslandes & Bertrand, 2001). Even though most reported family-school relationships are positive, some are rather fertile grounds for tensions and misunderstandings (Ravn, 2005). This is especially true in times of curriculum reform (Deslandes & Lafortune, 2000; Dodd & Konzal, 2000). The new curricular prescriptions are changing the established dynamics between the actors and are likely to introduce tensions that must be resolved at the collective level. The current work aims at gaining a deeper understanding of the tensions that arose in a school community following the introduction of novel instructional strategies in four science classes over two years (Barma et al., 2014). Identifying tensions make it possible to get a deeper understanding of the reality in a specific work environment. They are understood as manifestations of contradictions when they become recurrent and accumulate over time (Engeström & Sannino, 2013).

1.1 Research Goals

The central question investigated in this paper is about high school teachers' perceptions and comprehension of their school community support for change in implementing a new teaching approach in science and technology. To our knowledge, no other studies in Quebec have looked at teachers' perceived degree of collaboration with the school principal, other colleagues, and the parents in the context of a reform initiative at the secondary level. Hence, we designed this work to study in depth the areas of tensions as manifestations of contradictions that emerged in the connections between the school community members through the initiation of novel teaching practices. In essence, contradictions are dialectical and "refer to a unity of opposites, opposite forces or tendencies" (Engeström & Sannino, 2011, p. 370) in such a moving system like the activity system of the teacher's practice.

This current study is in continuity with Barma's researches (Barma, 2008; Barma et al., 2014) initiated around issues of implementing curricular reform in science and technology at the secondary level. Barma's analysis brings to our attention the fact that although teachers resolve some tensions they encounter by introducing a new practice in their classroom, it can lead to unexpected reactions on the part of some parents and that "perhaps it is inevitable that bold actions of transformative agency require the involvement of communities beyond individual practitioners" (2014, p. 9).

1.2 Theoretical Background

Three concepts or notions are at the heart of this study: school community, role construction at the individual and group levels and culture/ideology at the institutional and societal levels. The concept of *school community* refers to "people intimately associated with a school-students, their families, teachers, administrators, school staff and volunteers—bound together by their common interest in the students served by the school" (Redding, 2011, p. 16). In the present work, we are particularly interested in understanding the school community members' perceived viewpoints with respect to changing the teaching approach in science and the classroom environment. This is of paramount importance because it is by now well known that school leaders must develop strong and healthy relationships with families and community members to ensure the success of any school reform (Sanders & Sheldon, 2009).

The concept of *role construction* refers to individuals or groups' values, beliefs or expectations that guide their choice of behaviors and interpretation of others' actions within specific contexts (Auerbach, 2007; Hoover-Dempsey et al., 2005). In the context of education reform implementation, some authors (Patrikakou, 2016; Sheridan, Holmes, Smith, & Moen, 2016) suggest that *role-construction* (in this case, school principal's, parents' and colleagues') depends on the individual meaning construction not on what teachers do (or fail to do) but on how they interpret ideas. In other words, the school community members' responses to educational policy (e.g., different teaching approaches in science) are influenced by individual beliefs, attitudes or emotions. The latter ones have thus an impact on how they react to new ideas. Parents' beliefs are crucial in developing family-school partnerships (Patrikakou, Weissberg, Redding, & Walberg, 2005). Some parents' beliefs in favor of traditional ways of doing things in education remain unchanged despite information offered by the school personnel (Dodd, 1998; Dodd & Konzal, 2000). For example, in Shumow's study (1997) conducted with 31

parents of elementary students experimenting education reforms based on constructivist perspectives indicate that a majority of them still identified the basic skills transmission as the most important goals of schooling. Among the justifications provided for their choice, some parents valued school learning in terms of its applicability in students' future adult life. Fewer than half of them believed that teachers are expected to present new ideas and problems to children and to facilitate exploration of new information. The majority of parents in that study viewed their primary parental role as giving encouragement, positive reinforcement and support to children. Parents' perspectives and reactions tend to influence the success of any policy or reform. According to Patrikakou (2016), parents involved in family-school partnerships often project their personal understandings, creating a challenge in implementing education reform activities. It is therefore relevant to examine parents' role construction and beliefs in the context of education reform.

The concept of *school/societal culture* is grounded in the macrosystem as postulated by Bronfenbrenner (1986) in his ecological model. It retains our attention because it represents the traditions, norms, values, and ideologies in a given institution and society. The theory postulates that individuals affect and are affected by systems, including those at a more macro level. At the school level, principals are key to shaping the school culture (Fullan, 2010; Leithwood, Patten, & Jantzi, 2010). They are expected to encourage teachers to take risks and to try new teaching approaches (Bryk, Sebring, Allensworth, Luppescu, & Easton, 2010). They must also sustain reform efforts by allowing time for teachers to share ideas, to work together around issues of reform implementation or school improvement, as well as providing the resources that are needed (Constantino, 2003; Hoover-Dempsey et al., 2010; Supovitz, Sirinides, & May, 2010). As committed principals, they must provide continuous support to foster collaboration with parents and to maintain effective communication channels between the school community members for successful and lasting curricular reform initiative (Berebitsky, Goddard, & Carlisle, 2014; Goddard, Goddard, & Tschannen-Moran, 2007; Hoover-Dempsey, Whitaker, & Ice, 2010).

Societal culture and ideology also influence the implementation process of reform in education. In fact, parents' beliefs and goals are shaped by the culture and context in which the families exist (Hill, 2010). In North America just as in many European countries, there is an emphasis on individual achievement, on promoting self-esteem, and self-express, on competition as well as a devaluation of cooperation and interdependence (Hill, 2010). Until recently, schools have been asked to mainly focus their teaching on academic skills and knowledge. They tended to teach skills in a traditional linear, step-by-step methodology, and especially when it comes to science teaching (Barma, 2008).

At a broader level, Krieger and Ravn (2009) suggest the existence of a competition and marketing rationale in a dominant ideology of consumerism in the education realm. In their view, students are perceived as individual learning elements expected to rank at a higher level in international comparative surveys like the Program for International Student Assessment (PISA). Parents as clients and customers are expected to choose in the educational market what is best for their child. As it has been found in prior researches (Addi-Racah & Elyashiv-Arviv, 2008; Baeck, 2010; Ravn, 2005, cited in Deslandes, Barma, & Morin, 2015), Deslandes et al.'s (2015) work highlighted this culture of clientelism in some Quebec schools that seems to give more power to parents and to open the door to greater expectations and greater demands on the part of the whole society.

In sum, numerous factors come into play in the process of successfully implementing new teaching approaches. It is imperious to have a clear understanding of these challenges before going forward in identifying some elements of solutions.

1.3 Conceptual Framework

Our study and the data analysis are anchored in a developmental approach and the third generation Cultural-Historical Activity Theory (CHAT) (Engeström, 1987, 2001, 2015). Drawing on Vygotsky's (Vygotsky, 1978) and Leontyev's (1978) works, Engeström has depicted a model for considering the implementation of a new teaching approach as an activity system in which actors or school community members (e.g., teachers, directions, and parents) are confronted with primary contradictions necessary to foster an expansive form of learning. Areas of tensions and contradictions are at the core of CHAT and are understood as part of any human activity. They have an important role in the transformation of human actions. They are never directly accessible to a researcher but if they remain uncovered and unresolved, they will paralyze the on-going transformative processes in one's professional activity (Virkkunen & Newnham, 2013). They are in fact driving forces or obstacles to change development. Engeström and Sannino (2013) pinpoint the identification of contradictions as the first element in the expansive learning cycle aiming at transforming an activity system.

Instead of focusing on the individual at the center of activity, CHAT considers the activity system, which is the key unit of analysis, as the result of goal-oriented individual and social interactions (Engeström, 1987; Engeström & Sannino, 2011). In his systemic triangular model, Engeström (2001, 2015) illustrates human collective activity with six interacting poles or components of practice (see Figure 1). The *subject* or the viewpoint from which the activity is analyzed (in this case, two science teachers), the *object* or the *goal* is the implementation of a new teaching approach in line with the Quebec curricular reform in order to promote learning science in context (*outcome*). Another pole of the model corresponds to the *tools* or artifacts used by the teachers, in this case (e.g., instrumental resources, teaching strategies, communication modes) to achieve their goal. The lower part of the triangle puts into evidence the mediating role played by the socio-institutional dimension of human activity. The *rules* pole refers to expectations, school policies, norms, values, beliefs and ideologies that regulate actions and interactions within the system. The *community* component consists in this case of the teachers, principals and parents of the students attending the targeted school. At last, the *division of labor* dimension has to do with the changes in role, tasks and responsibilities among members of the community.

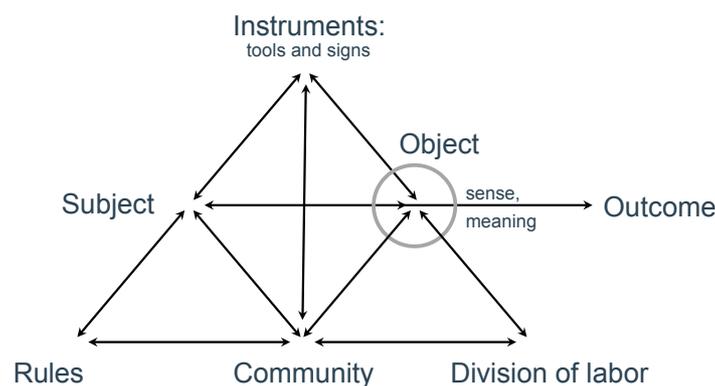


Figure 1. Model of a collective activity system (Engeström, 1987, p. 78)

In this study, Cultural-Historical Activity Theory (CHAT) appears relevant to better understand how they can be overcome and to foster agentic actions (Barma, 2011) in the context of the implementation of a new teaching approach and its impact on the extended school community. Vygotsky (1997) pointed out that: "...duality is at the very foundation of the volitional act, and this duality becomes especially prominent and vivid whenever several motives, several opposing strivings, clash in our consciousness" (Vygotsky, 1997, pp. 167-168). They are thus necessary and a first step to the expression of agentic actions (Sannino, 2015). Leont'ev's (2005) reflections on conflicts of motives that individual face, bring to our attention that engaging into volitional actions is more than just about "choice and decision making" (p. 15). These premises constitute a solid ground to investigate how teachers address challenging issues at work and demonstrate will to gain control over them. Amidst contradictory motives and choices to make, how does will form? How do individuals gain self-control over a difficult situation? What is their perception? The notion of conflicts, as defined by Tjosvold (1997, cited in Engeström & Sannino, 2011, p. 374) refers to situations "in which the actions of one person are interfering, obstructing or in some other way making another's behavior less effective". Recent studies have brought our attention to the necessary step of, not only overcoming conflicts of motives situations, but also as a crucial step to have people demonstrate the will to give a new meaning to the situation in order to solve them (Barma et al., 2014).

This study is part of a two-year research-intervention conducted with two science teachers from a private school and who had asked for support. Barma and her research team (2014) helped the teachers in conducting a teaching sequence that dealt with controversial environment issues. Based on Vygotsky's (1997) principle of double stimulation and on a Developmental Work Research approach (DWR), the team developed a collaborative relationship with the participants. Data was collected through ethnographic notes and audio-recorded focus groups with 256 students. Although appreciated by students, the implementation provoked conflicts at another level, that is, at the school community level (i.e., parents and school principal and other colleagues). The authors

suggested the emergence of conflicts of motives: the two teachers' values on one hand and on the other hand, the parents' expectations and the rather mixed support from their institution (Barma et al., 2014). Before going any further in the resolution process of the conflicts, it is imperial to study in depth the discursive manifestations of the hypothesized contradictions, that is, the discursive expressions of conflicts (which are a form of tensions) faced by teachers with relation to parents and the school principal.

Building on CHAT theory and in line with Barma et al.'s (2014) prior work, the main research objective is as follows: to deepen our understanding of the origins of contradictions including hypothesized as conflicts situated at and between some of the poles of multileveled activity systems (students, teachers, parents, school principal). The collected information is likely to provide elements as starting points in further reflections to broaden our reading of school activity understood as way more than the sole classroom context.

2. Method

2.1 Participants

Given the importance of the school community in a successful reform implementation, Barma and one trained master's student interviewed the two involved science teachers with respect to the perceived dynamics between the actors in introducing a new teaching sequence around issues of climate change. The research team adopted a Developmental Work Research approach (DWR) premised on establishing a close collaboration with both teachers but also by providing them the results of the ongoing analysis over the two years in order to enable them to analyze and interpret their practice (Virkkunen & Newham, 2013). At the beginning of the school year 2010, the participants didn't seem to know how to give meaning to the curriculum prescriptions. They had to address controversial issues, change their teaching approach in order to engage the students in an open-ended questions and face up to the director's and parents' requests but don't know how. The first interactions led us to focus on a problematic situation emerging in the form of conflicts of motives they were facing at work and find out how they would break away from it.

2.2 Data and Analysis

Data was collected during formative interventions by Barma and her research team and used four in-depth interviews with the two science teachers conducted in the year 2011 and then in 2012. Table 1 illustrates the timeline of the data collection. Each one of the interviews lasted for about one hour or so. The first year, the interview consisted of open-ended questions focused on their perceived role as science teachers, their usual teaching strategies, their on-going projects in science and technology and the targeted competencies as well as some feedback from the school principal or the parents. The second year, the interviews were about their on-going projects and the changes they had made in presenting the environment issues to their students, the targeted curricular competencies, and the school levels they were teaching to. Questions were also included regarding the obstacles and facilitating conditions they had met in implementing the new teaching approach. The interviews followed a conversational mode and were thus, not based on a pre-determined pattern. They were tape-recorded and afterwards transcribed. They yielded 126 pages of excerpts. Analyses were first based on Engeström Activity Theory Framework (2001) that depicts an activity system as being object-oriented, mediated by artefacts (instruments), and comprising the community, rules and division of labor poles. The second level of analysis focused on pinpointing where areas of tensions were situated at each poles of the activity system as well as a systemic reading of their unfolding.

Table 1. Data analyzed between 2010-2012

Type of data	School years	
	2010-2011	2011-2012
Researcher and student-researcher's ethnographic notes	Research meetings: Researcher, teachers and school principal (1 hour) Student-researcher teacher B (1 hour) Researcher and school science department (2 hours)	Research meetings: Research meeting with school principal (30 minutes) 17 e-mail Intervention in the classrooms (20 hours)

	16 e-mail	
	Intervention in the classrooms (5 hours)	
Teaching documents	Planning of the teaching sequence	Planning of the teaching sequence
	Evaluation matrix for communication skills	Video of an expert
		Evaluation matrix: content and communication skills
		Matrix for peer review
Students productions	12 definitions of environment	26 initials definitions of climate change
	27 Prezis (Note 1)	21 written documents describing actors involved in climate change
		21 Prezis
		65 peer reviewed Prezis
Speaking turns	203 for students	614 for students
	400 for teachers	603 for teachers

3. Results

The most important results are presented under the labeling of school and societal culture and of communication and availability of relevant resources in the context of changing teaching approaches innovations. Statements from the participants illustrate the main points.

3.1 School and Societal Culture in the Context of Changing Teaching Approaches

This section comprises data regarding the school principal, colleagues, parents and the society of which they are part.

According to the two participants' opinion, the school principal expects them to make sure students succeed well in the ministerial exam and that they don't get any complaint from the parents.

- Teacher B: ...*that we make our students successful in the ministerial exams* (2a-928).

- Teacher A: *They do not want any complaints. [...] in fact they hope that we reduce their work load in making sure that they have no complaints from parents or students* (2a-934-936).

In the participant teachers' vision, it is also a question of clientelism culture:

- Teacher B: [...] *there is a question of clientelism. (1:932). We have a large customer base (student cohorts) that continues in science. I think that the school principal likes to mention the statistics indicating that around 70 or 80% of our students pursue in science studies* (2a-1005-1007).

- Teacher A adds: *We are in a private school, [...] in order to survive, it must retain its customers and therefore we must adopt a more clientelist approach. To keep customers, there must be good student results in academic courses that are considered important by customers [...]* (2a-957-961).

Looking back at one activity conducted at a Demonstration Center outside the school but nearby in the city, the participants believe that neither the school nor the parents are ready yet for that innovative teaching practice:

- Teacher A: *That's logistics. [...] The school is not prepared to have us engaged in such activities, neither are the parents. It was an activity: we went to the Demonstration Center, I find it is a "key" in science* (1-648-650).

- Teacher B: *Yeah, when they understood, [...] they said that we do not do that usually; normally transportation is provided by the school.... it's expensive, it is not something that is necessary [...]* (1-674-675).

Regarding other colleagues' expectations and support, both participants claim in the first year of the study there is a willingness to collaborate in general. At the same time, they appreciate the fact that their novel teaching initiative is not imposed as a wall to wall practice as the following excerpt reveals: [...] *I would not be comfortable if our ways of doing things were standardized* (2: 405).

The situation is however perceived as being somewhat different in the second year of the study as shown in both

teachers' comments:

- Teacher A: *I am not convinced that everyone sees the need to make projects like this. It does not look like what we often do; it did not connected with teachers* (2a-1205-1206).
- Teacher B: *There is a new business culture that is very individualistic. Yes, with teachers. Then there is the fear to be judged. There are many teachers who do not accept criticism... As teachers, we should be allowed to make mistakes [...]* (2a-1239-1243).

One of the participant teachers said:

- Teacher B: *I have not done one single project with the other departments* (2a-1100-1102).

Nevertheless, that same teacher (Teacher B) declares enjoying very much working with the other participant teacher and mentions that, in general, there is little judgment coming from other colleagues.

As for the parents, the participants think that they expect them to make sure their adolescent succeeds well:

- Teacher A: *Yes, parents, they want student to succeed [...]. To them, success is due to the quality of teaching. We often hear [...] that his teacher did not motivate him. Teachers are seen as being sole responsible of students' achievement [...]* (2a-1058-1063).

Some parents spontaneously offer their help to the teacher as shown in this excerpt:

- Teacher B: *But there are parents who offered spontaneously offer their help, they are happy with what we do. They are happy that we get out of the classroom [...]* (2b-439-449).

At the same time, some of the parents' values, beliefs and past experiences appear in opposition with the participants' values that underpin their new teaching practices. For instance, the participants recall that when they did an activity at the Documentation Center, some parents could not understand the well-founded objectives of the activity and some even advised their adolescent not to attend classes on that day. Other parents feared for their adolescent's security because the students were requested to use the city bus as means of transportation to the Documentation Center. On one hand, the participant teachers endeavored to develop the adolescents' autonomy, self-initiative and critical judgment; on the other hand, some parents seemed to be over-protective. This is well illustrated in the following statement:

- Teacher B: *[...] In our mind, Secondary 4 level students are old enough to travel alone by bus or on their own, but we were told that it was not a good idea and that we were expected to provide student transportation* (1-658-660).

Moreover, some parents exert pressure on the school and manifest their power influence by making complaints to the school principal when they don't agree with the teaching practices put into place. The understanding of their role as parents seems to be more related to their client status, claiming for status quo and traditional teaching practices.

With respect to the societal culture that includes the parents' at the collective level, the participants' comments reveal perceived expectations of school success and of students' training in the use of technologies whose responsibilities rely mainly on the teachers' shoulders:

- Teacher A: *I think society wants us to make sure students succeed well [...]* (2a-1256-1258).
- Teacher B: *I think that parents and society in general expect us to train future employees that are able to use new technologies because this is the basis of just about everything that is, economically promising. Society expects science teachers to be engaged in scientific and technological literacy* (2a-1067-1072).

In the participants' viewpoint, current ideologies and predominant values at the societal level influence the parents' goals and aspirations regarding their youngsters. They reported:

- Teacher A: *Parents who send students to our private school have money and generally there is still a huge bias linked to sciences, that is, to the possibility of making a lot of money in sciences [...]* (1-932-936).
- Teacher A goes on: *I think their choice of career is linked to their culture and much to what goes on around them. We have students with a lot of money, it is a private school. That explains all of the prevalent stereotypes [...]* (2a-1029-1034).

3.2 Communication and Availability of Relevant Resources

The participants expressed criticism regarding the absence of pedagogical leadership on the part of their school administration. They said that the school principal never visits their classroom and that he/she is unavailable to

the teachers. The following extract provides an example of the difficulty in communicating with the school administration:

- Teacher B: *The school principal does not come into our classrooms [...] From time to time, the pedagogical counselor comes around but it is only to check the noise level in the classrooms, there is no pedagogical monitoring (2a-1145-1148).*
- Teacher B: [...] *It is easier for a parent to have a meeting with the school principal than it is for a teacher. The principal is not in close relationships with teachers (2b-489-491).*

Hence, it is not surprising to find out that the school administration is not well knowledgeable about the project going-on, that is, the implementation of novel teaching practices in science and technology.

- Teacher B: *Informally and indirectly: we had talked about it. They know about it because it is mentioned in our course syllabus [...] but it's as if they were standing far away from this because they not want to have additional work to do [...] They did not ask us "what do you do", what is the purpose for doing it? We asked them to sign authorization forms for the project, but they did not read, they do not know what the project is about (2b-506-512).*

However, one of the participants tried to partly overcome the situation by becoming involved in the local teachers' union. The teacher intervened when the administration who knew almost nothing about the project took the parents' side when they made some complaints.

- Teacher B: *I am a local teachers' union representative. I try to inform my school principal [...] This is my way of doing things: to involve the labor movement and to say that we must counter the school administration's resistance [...] (2b-472-480).*

They regret not having any time allocated to them as part of their teaching task to exchange ideas, to work together, thus to develop a collaboration with other teachers.

- Teacher B: *Sometimes I meet Teacher A in the corridor. [...] we can't exchange ideas because our schedule doesn't allow us any time to do so (2a-1085-1086).*
- Teacher B: [...] *We do not have a lot of working opportunities with the other departments (2a-1100-1102).*

The participants also reported inadequate material resources essential for the success of teaching initiatives implementation as illustrated in the following excerpts:

- Teacher A: [...] *Not just with Skype, it is with all technologies, I really get frustrated ...because when you invest a lot of time in planning an activity and then [...] you arrive into the classroom, you do not really know why, but [...] even though we have a super powerful computer network, the connection is very bad, just like having a Cadillac, but no gasoline (2-178-186).*
- Teacher B: *The most difficult point is that we really try to implement new things, but we are blocked by the institutional structure in the sense that we are unable to have adequate computer support, we have no freedom in terms of planning relevant out of the school setting activities, it is difficult, it is complicated (2b-416-419).*

As indicated above, the participant teachers deplored the inadequacy of the school computer system. It sounds like a paradoxical situation in the context of applying the reform in teaching science and technology courses.

4. Discussion and Conclusion

The major results will be discussed in light of the Cultural-Historical Activity Theory (CHAT) theory. Let us recall that in applying a new teaching approach in environmental and science education (*object*) in order to favor learning science in context (*outcome*), two teachers (*subjects*) met some conflicting motives with relation to the *community* pole (school administrators, teachers and parents) and tensions at the *tools* pole (communication, resources). The purpose of the study was to deepen our understanding the origins of the contradictions and to identify some elements of explanations before going on to the next sept in the change process. The collected information is likely to provide elements as starting points in further reflections and in moving forward in an expansive learning cycle process aiming at an activity system transformation to resolve some contradictions present at different poles of the system.

According to Engeström and Sannino (2011), tensions, which are the discursive manifestations of contradictions, are usually manifested in the form of resistance, disagreement, argument and criticism. Through the participants' discourse, it was possible to highlight some of their manifestations in the form of conflicts of motives, emerged between the *subject* pole and the *rules* pole. Other contradictions in terms of double bindings were identified at

the *instruments* pole. Our findings suggest there may be areas of conflicts related to the two science and technology teachers' pedagogical interests and values in applying new teaching approaches (*subjects*) versus the *community's* traditional vision and expectations regarding teaching methods and student results. There are also areas of double bindings between the two teachers' willingness (*subjects*) to implement the curricular reform versus inadequate allocation of resources (*instruments*) to do it successfully at an optimal level.

4.1 Participant Teachers' Values Versus the Community's in Implementing Innovative Teaching Practices

Obviously, findings confirm Barma et al.'s (2014) hypothesized clash between the teachers' values and the community's. First, in line with the curricular reform in science and technology, teachers report favoring nontraditional ways of teaching and giving more room to adolescents' curiosity, critical judgment while the stakeholders (school administrators, parents) are looking above all for traditional teaching practices and students' school achievement. These observations are in accordance with previous works that have shown resistance to new practices from the members of the school community (Deslandes, 2006; Deslandes & Lafortune, 2000; Dodd & Konzal, 1999; Lehrer & Shumow, 1997). On one hand, the two participant teachers say to prioritize students' autonomy and the development of the 21st century competencies; on the other hand, parents are expecting traditional ways of teaching as sound values on which to build a curriculum. Parents are hoping their adolescents will be able to well manage in a competitive world in which the field of sciences offers full of financial possibilities. In the context of a private school, parents seem to view themselves as clients, thereby legitimizing their role when trying to impose their own terms, their own way of doing things.

At the same time, the school principal who is possibly eager to preserve the reputation of the school tends to have a rather alienated relationship with what goes on in the school in terms of novel teaching practices. Working from a marketing mindset, the school administration appears to view parents as clients and consequently, responses positively to their claims. For instance, the school principal doesn't hesitate to refer to the norms in place within the school regarding the necessity to provide for transportation when doing activities out of the school setting. In the same line of thought, participant teachers report very few exchanges with other colleagues and other departments. These types of behaviors are in opposition to research findings that highlight the key role of the principal's support and the importance of teachers working together in times of changes in school curriculum (Barma, 2011; Fullan, 2010; Goddard et al., 2007; Supovitz et al., 2010). Whether it is a question of norms, values, ideologies or beliefs, the school community members in this study do not seem to exhibit attitudes and actions in coherence with the essential conditions in applying changes in teaching approaches.

4.2 Teachers' Willingness to Implement Innovations and Little Availability of Resources

Based on the participants' perspective, findings demonstrate some deficiencies in the quality of the *tools* or *instruments* made available to support changes in teaching practices. These are mainly related to inadequate computer software at times, lack of any time allocated to share ideas with other colleagues and very little knowledge on the part of the school principal regarding the participants' innovative teaching project. Obviously, the communication channels between the school principal and the participants do not function well. As mentioned in prior works, it appears unrealistic to expect teachers to effectively work together without giving them the time necessary and resources (Bryk et al., 2010; Supovitz et al., 2010). How can a principal be expected to assume leadership in changing teaching practices when he/she almost doesn't know anything about the targeted projects going on? As for the material resources, it might be a case "runaway object", in Engeström and Sannino's (2010) term that refers to continuously changing and accelerated technological development. Let's recall that we are living in a period of austerity and financial cuts as well of growing financial instability for several private and public schools. Would it be relevant as Impedovo, Andreucci and Ginestié (2015) suggest, to think about the creation of new artifacts that could act as "boundary objects" to help in distributing knowledge. One could think of the distribution of knowledge using other artifacts such as capsules on the school web site. It seems that we are all saturated with written documents, guides, etc. All in all, the above contradictions could be use as mirror date in a sequence of an expanding learning cycle (Virkkunen & Newnham, 2013). Figure 2 summarizes our interpretation of teachers' representations and parents' activity systems.

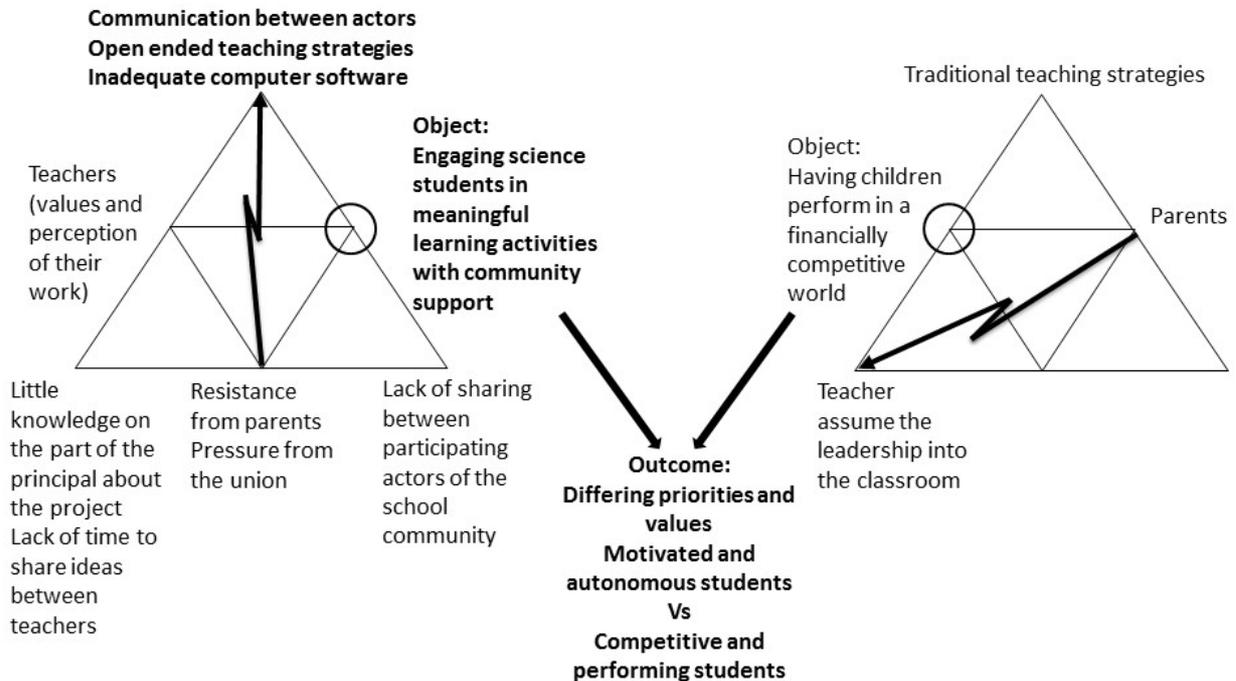


Figure 2. Representation of teachers' and parents' activity systems illustrating contradictions with lightning shape arrows

4.3 A Call to Move forward

Even though the current research results point to limitations mainly with respect to the inability to generalize, they nevertheless highlight the need to move across boundaries and to adopt Engeström's (2000) collective activity systems that will allow all actors, including parents, to identify common grounds and to make sense of the new science teaching approach aiming at promoting students' autonomy, critical judgment, and school success levels.

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Note

Note 1. *Prezi* is a cloud-based presentation software that allows people to share ideas in a collaborative and dynamic way.

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