Boundary spanning among educational partners in the service of equality of opportunity

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Abstract: This study focuses on boundary spanning within and across a university-school-community partnership meant to foster equality of opportunity for at-risk secondary school students. Cooperative education for 9^{th}-11^{th} graders enrolled in a general education program was the context of the study. Formative interventions and design research methodologies were applied, and ethnographic methods used. Results are presented in three forms: 1) tensions/contradictions that arose between educational partners' activity systems; 2) partners' manifestations of boundary spanning, and 3) students' learning outcomes. Implications for educational policy with attention to context are drawn.

Keywords: At-risk students, relationship to/with knowledge (RK), digital technologies, student engagement, student attainment, community engagement, activity theory, science education, sense-making, collaboration.

Introduction

Educational research in Canada, or elsewhere, finds its social relevance in the innovation it suggests for the benefit, in particular, of student and school success. Educational researchers suggest different approaches for enhancing student engagement and learning outcomes. For instance, math and science educators put forward strategies to go beyond the teacher-centered model, and make classroom innovation sustain and scale.

Brown (1992) and Collins (1992) questioned the capacity of orthodox methodologies to bring innovation in the classroom, and they put forward the notion of the design experiment. The methodology evolved to become *design-based research* (DBR, Barab & Squire, 2004; Collins, 1999; Design-based Research Collective, 2003; Wang & Hannafin, 2005), *design research* (Collins, Joseph, & Bielaczyc, 2004; Edelson, 2001; McKenney, & Reeves, 2012; Reeves, 2006), and *design-based implementation research* (DBIR, Penuel, Fishman, Haugan Cheng, & Sabelli, 2011). Nonetheless, Engeström (2011) challenged educational researchers that had engaged on this path when writing that the methodology was too top—down for it to lead to innovation that endures.

In our own work, we translated design experiment by *experimentation de devis* (Breuleux et al., 2002) when first engaging in collaborative research regarding the effective uses of information and communication technologies, especially classroom-based knowledge building

(Bereiter, 2002; Laferrière & Allaire, 2010; Scardamalia & Bereiter, 2006). DBR was our methodology in other partnership research (PROTIC, École éloignée en réseau, Chantier 7, and FAST). However, even when we thought of being working with partners on the same problem, DBR was not easy to install. We agreed with Dede (2004) that it was the problem that had to be first, and DBR second. We also favored *developmental work research* (DWR) and *formative interventions* (Engeström, 1987, 2015) by using the principle of double stimulation stemming from conflicts of motives by science teachers to foster their agency and increase the motivation of adolescent students (Barma, Lacasse, & Massé-Morneau, 2014). And we conducted studies from the theoretical perspective of *rapport aux savoirs* to analyze epistemological and practical aspects of teaching and learning (Bernard, Savard, & Beaucher, 2014). However, stepping back, we have become more and more keenly aware that we kept raising both "problems" and "solutions" – which we had been inducted to do as we learned the practice of research. Engeström's confronting remark[1] began to haunt us because we want that innovation that proves useful for at-risk student be reflected in school culture.

In this paper on boundary spanning, we focus on the tensions/contradictions arising and diminishing as partners' activity systems interact. We zero in on the FAST partnership, analyzing tension creation/reduction between educational partners' activity systems. We refer to the notion of *rapport aux savoirs*, translated as "relationship to/with knowledge" (RK), to give a sense to the reader of how the actions of the partnerships affected the students (micro-level analysis of learning outcomes), and to Engeström's conceptual framework (1987, 2015) to analyze the partnerships at the meso and macro levels. Next, we present the methodology, and results follow. The discussion highlights mediating actions that helped overcome or reduce tensions/ contradictions between educational partners, and brings forth potential links between the RK, including researchers' RK, and Cultural-historical activity research (CHAT).

Background

The FAST project stands for *Formation en Alternance Science et Technologies*/School-Work Alternance for the learning of science and technology. This research-intervention work began with the (shared) problem that young people with academic or disadvantaged backgrounds were not succeeding enough, especially at a time when skilled labor needs, including the science and

[1] See the methodological distinctions between formative-intervention methodology and design-based methodology (Engeström, 2011; Sannino, Engeström, & Lemos, 2016).

technology sector, are increasing, and where the mastery of minimum technical and scientific culture is necessary for better social integration. Students' low motivation and lack of commitment affect their performance at a time when they need to be presented with equal opportunities to learn, successfully perform meaningful work and get recognition in a world where knowledge is increasingly important. Therefore, the question of giving meaning to ST courses and scientific knowledge, to paraphrase Mathy (1997), is central to the question of student and school success in the field of scientific disciplinary knowledge and is associated with action. Our working hypothesis became that they would find more meaning studying science and technology (ST) if they were exposed to "knowledge in action". In the pursuit of enhancing at-risk students' RK, a cooperative education program supported by digital tools and resources was envisioned. To this end, we sought to build university-school partnerships. The innovation process extended more fully with two partner schools. They each introduced their own models in their schools and our research and intervention team (RIT) provided mirror data. In one school, a school-based business was created and in the second, students alternatively engaged in school and workplace activities using new tools and resources.

Rooted in design research methodology (Collins & Bielaczyc, 2004), and also in interventionist methodology (Engeström, 2011; Virkkunen & Newnham, 2013), this research-intervention was characterized by a close collaboration between partners. Successive rounds of data collection, co-modelling and analysis to inform decision-making helped enable the consolidation and interpretation of data to achieve the expected result: improved academic achievement of students. The methodological choices met the requirements of innovation since it provided data periodically to stakeholders for them to improve their results (co-design), and allowed researchers opportunities to revise, refine or consolidate their interpretations, taking into account its specific characteristics and its contextual elements (e.g., Barma, Laferrière, Lemieux, Massé-Morneau & Vincent, 2017).

For this *ex-post facto* reflective study on boundary spanning among educational partners, we retained the students' activity system (micro-level analysis of their RK), students' and school practitioners' activity systems (meso-level analysis), school practitioners' and workplace practitioners' activity systems (meso-level analysis), Ministry of Education and school practitioners' activity systems (macro-level analysis), and school practitioners' and RIT's activity systems (macro-level analysis).

Two conceptual frameworks

The socio-anthropological perspective of the RK

In the wake of the work of Bourdieu and Passeron (1964), Charlot, Bautier and Rochex (1992) introduced and studied the *rapport au savoir* question. Based initially on statistical analyzes, the sociological work of Bourdieu and Passeron showed regularities in school inequalities in relation to social origin and, adopting a comprehensive view, the authors tried to explain them bringing forth the Reproductive strategies of modern societies. They concluded, among other things, that inequalities in academic achievement are not explained solely by economic reasons. The notion of "cultural capital" allowed them to explain that children not only inherit the material means of their parents, but also inherit the instruments of knowledge, expression, knowledge - make, techniques, and ways of working. The mastery of the language and what accompanies it, the stories told to children, the books available at home, the value of going to the library, knowing how to stand and wait for one's turn, among many other elements (which appear to be minor), are knowledge transmitted by families and contribute (very importantly) to children's academic success. What they can already do (achievements) is very close to what the school asks (implicitly) them to do, thus pointing to the benefits of those who arrive in school with such a "cultural capital". Given that the resources generating cultural capital are unequally distributed, it was understood to be a key factor of social differentiation.

Studying the question of student academic failure, Charlot and his colleagues (1992) focused on "atypical" cases. Their socio-anthropological approach considers the learner as an individual who constructs and gives meaning to knowledge through a set of interactions. Charlot emphasized the point of view of the subject and its history. From this perspective, school failure is seen as a situation which is constructed in the academic history of the individual (a history inseparable from that of his or her singular history) in light of events, practices, ruptures, etc., rather than as a characteristic "inherited" from the social group or as the effect, in its educational history, of the social and cultural characteristics of this group. Charlot (1997) explains that students "for whom going to school and engaging in school work makes sense, develop a RK that allows them to experience the desire and pleasure of learning" (Bernard, 2014, p. 107). By referring to the RK notion, one recognizes that students do not all give to school the same meaning, nor to the learning of knowledge in different subject matters. Yamazumi (2006)

stressed that projects at schools ought to teach content with reference to their social and out of school contexts.

For Charlot (1997), the individual's RK has three dimensions: 1) an epistemic dimension (Learning is what type of activity? Learning as an activity of what kind?); 2) an identity dimension (Who am I as a learner? In which ways will learning lead me to the job I want to do? Change and transform my relationships with others?); and 3) a social dimension (What value do my parents attribute to school knowledge? What is their interest in my academic results?). Therefore, individual's RK is a notion that is not incompatible with the notion of the "social self", based on the individual's relationships with others. We here see the possibility to bridge the sociological perspective of Bourdieu and Passeron (1964) and CHAT since, with respect to the Marxist tradition, "the starting point in understanding a human being [is not] the activity of consciousness – empirical or transcendental, individual or absolute – but real empirical activity, practice, transforming real natural and social surroundings. The emphasis is not on individual, but on collective social activity. From such a perspective, the activity of an individual and individual consciousness both derive from collective activity" (Lektorsky, 2009, p. 76).

The RK framework was the basis on which we developed the analytical grid to analyze students' RK (micro-level analysis). For the analysis of the meso and macro levels, we turned to CHAT, and most specifically to Engeström's expansive learning theory (1987, 2015).

The expansive learning theory

Learning activities are human activities socially situated. The concept of activity is central here (Vygotsky, 1978). The generalized object of an activity system is rooted in its historicity and the situational, the constructed object is what gives direction to the actions and interactions that are to take place during the building of the activity (Jahreie & Ottesen, 2010). As voiced at the onset, the object-oriented activity of the developing partnership was student and school success applying the principle of equality of opportunity by providing them with more equality of opportunity for success.

Actions (Leontiev's second level of activity, 1978) are goal oriented and often redefine the interrelations between the actors who share a new activity (Sannino, 2008). This means that CHAT focuses on new forms of learning and social practices that develop beyond individuals' own activity. University-school partnerships (Holmes Group, 1990) constitute a move from

within that can be instrumental in exploring new ways of teaching and learning (Engeström, 2001). Such partnerships may take a variety of forms and shapes and involve boundary spanning as tensions/contradictions arise and are overcome (*Ibid.)*

Edwards and Kinti (2010) suggested to place special focus on the way the process will co-develop [or be co-designed]. Nelson and Stolterman (2000) defined design as "the creation of something that has not yet existed, not of finding something already in existence" (p. 29). The FAST project involved a complex process of establishing partnerships between schools (school administrators, students, teachers, students, counsellors, social workers) and businesses and community organizations (managers and employees), and researchers. From a CHAT perspective, RIT recognizes that participants' beliefs and knowledge are cultural tools having an effect on the quality of the interaction among educational partners.

Engeström's framework is especially suitable for tension/contradiction identification and resolution within and between activity systems overtly pursuing the same object and outcome (improved student learning as manifested, among others, by students' RK enhancement). But in the absence of a pre-established organizational framework like the one generally prevailing in schools, innovative actions can be demanding, especially whenever an individual seeks to create a continuity between what is new and that which has already been stabilized in the culture of a given setting – the dominant form of a certain activity (Sannino, 2008). The perpetuation of dominant activities is a barrier to change. In the FAST project, it was assumed that the sequences of actions carried out by teachers or other youth workers would serve to establish a form of empirical abstraction (Engeström & Sannino, 2011), pigeonholing interventions within pre-established categories (Davydov, 2008). This normative, top-down vision minimizes the divergences and conflicts that are necessary for a new form of activity to emerge (Engeström, 2008). Concept formation occurs via a process in which theory and practice are constantly interrelating with and remodelling one another. In dialectical terms, this manner of categorizing corresponds to a continual back-and-forth movement and fosters a co-configuration of representations in keeping with the aim of constructing an innovative model of intervention.

Following Il'enkov (1977, 1982), the theory of expansive learning sees contradictions as historically evolving tensions that can be detected and dealt with in real activity systems. Engeström characterizes contradictions as drivers of change that are inherent to all human activity. In capitalism, the pervasive primary contradiction between use value and exchange value

is inherent to every commodity, and all spheres of life are subject to commoditization. This pervasive primary contradiction takes its specific shape and acquires its particular contents differently in every historical phase and every activity system (Engeström, 1987, 2015). Most importantly, he sees contradictions as the driving force of transformation. Using dialectical, linguistic and emotional criteria, discursive manifestations of contradictions in the form of tensions are identified in the discourse and revealed by the presence of opposing forces (Engeström & Sannino, 2012). The object of an activity is always internally contradictory. It is these internal contradictions that make the object a moving, motivating and future-generating target. RIT focused on the concept of boundary between four activity systems. Kerosuo (2006) defines boundaries as 'established distinctions and differences between and within activity systems that are created and agreed on by groups and individual actors during a long period of time while they are involved in those activities' (p. 4). Phelan, Davidson and Cao (1991) also propose a definition for boundaries: 'real or perceived lines or barriers between worlds' (p. 225). The metaphor of expansion, which highlights "communities as learners" when they learn "something that is not yet there" (Engeström, 2001), served the FAST project: Its framework was used to make sense of what was happening when educational partners interacted.

Methodology

RIT knew the rudiments of collaborative action-research and some of its members were familiar with DBR, which has since become the methodology of the learning sciences (Bransford, Brown, & Cocking, 1999), and/or knew about CHAT. From their respective methodological frameworks, RIT members understood the complexity of productive interaction between educational partners. They anticipated that several sociocultural factors would manifest in the design under study, meaning the co-design of the social arrangements that were to allow high-school students to use new technologies and have work experiences as part of their schooling (meso level). Moreover, the design had to take global contextual factors into consideration (macro level). In DBR, the "discovery" takes place when establishing contexts (designs), which have practical value and which delve directly into the participants' knowledge in order to assure that the objectives are met at the end of a certain number of cycles or repetitions (Breuleux, Erickson, Laferrière & Lamon, 2002). Expansive learning theory provided an understanding of the tensions/ contradictions that arose and ways forward for overcoming them.

Participants

Agreements were reached between university researchers, school-based practitioners (principals, teachers, including special education teachers, counsellors and social workers) and workplaces (businesses and community organizations) so young people could alternate between classroom time and some time spent in a school-based business or in the workplace. Workplace administrators and employees, and university-based researchers wanted to find ways to make schoolwork more meaningful to students. CEFRIO, a knowledge transfer organization, was highly instrumental in this process that primarily involved school district and school administrators. At the beginning of the summer of 2011, each partnership had its own understanding of the problem to be addressed.

For this paper, the two most active and enduring partnerships were selected. Partnership A involved 16 educators, including external business/community experts. Partnership B involved over 64 school-based and workplace educators. In each partnership, over 70 students were identified as potential candidates, given their low school engagement and poor academic results, and given the option to participate in the project. In partnership A (2011-2012), 14 students were provided the opportunity to model a school-based enterprise activity. That included missing their subject classes on Wednesday afternoons while remaining responsible to catch up with lectures and homework. They were 11 to complete the programme. In partnership B (2011-2012), 56 students chose and went to a field placement, made use of an iPad, including to view videos of classes they had missed, and participated in preparatory and follow-up activities.

Data gathering and methods of analysis

Micro-level data and analysis

A questionnaire was administered (Laferrière et al., 2014) and interviews conducted with students regarding their thinking and experience of the FAST project (Trépanier, 2013). To study students' RK, we borrowed from the socio-anthropological approach (Charlot et al., 1992). In preparing the analytical grid, we considered three elements, namely epistemological, axiological and praxeological (inspired partly by the quiz ROSE[2] related to the relevance of science education). The epistemological axis refers to sense-making regarding the nature of knowledge; the axiological axis is linked to the pleasure of learning and the value assigned to ST; and the praxeological axis focuses on issues concerning the utility of ST knowledge.

[2] See http://roseproject.no/?page_id=4

Meso and macro level data and analyses

In Engeström's expansive learning theory, a minimum of two activity systems as a whole is the unit of analysis, thus acknowledging that human activity is goal-oriented and tool-mediated, not only by individuals but also by collectives (Engeström, 1987, 2015). Figure 1 presents the four units of analysis selected for this paper.

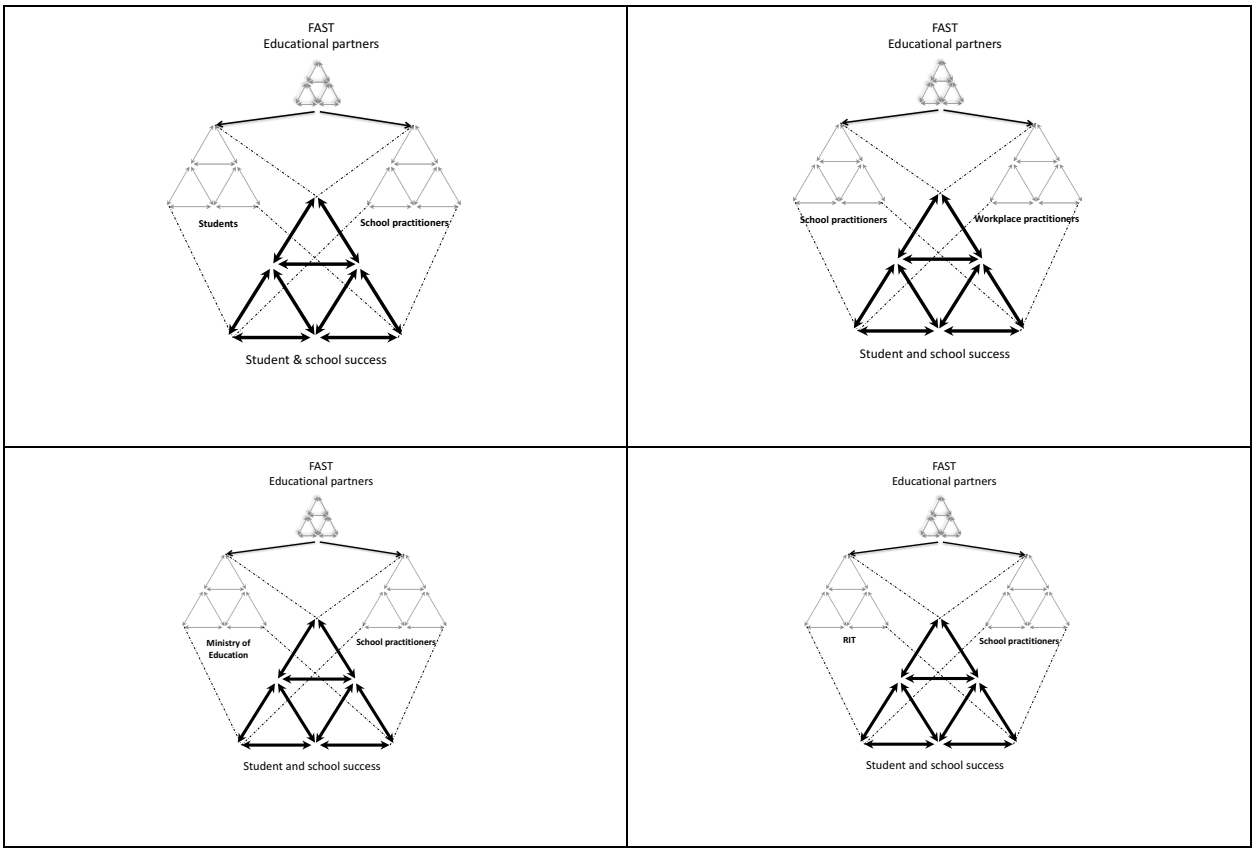

Figure 1. The four main activity systems in interaction (adapted from Barma et al., 2017)

Ethnographic data was primarily participant observers' notes (onsite and online contexts), videos, and partners' interviews. In partnership A, formative intervention had been conducted, and in partnership B, data was also collected through DBR iterative cycles of reflection (informed by data) and action. Adopting a dialectical analysis approach (Engeström, 1987, 2015), tensions/contradictions were identified and followed up.

Results

Micro-level analysis: Students' RK in partnership A

Related to the activity produced by partnership A (school-work alternance activity supported by digital tools and resources), male students' response to the questionnaire showed high scores regarding the two following questions: 1) It is important to me to know how to use ICTs for understanding ST (epistemological axis); 2) I would like to pursue a career in ST (axiological axis). A striking female students' response was they did not find ICTs useful to better understand ST (praxeological axis). Whereas interviews revealed that the RK's axiological axis seemed to benefit more, followed by the praxeological one.

Value assigned to ST (axiological axis)

Some students found learning ST pleasant as they began feeling confident in the use of technology: *As it could not have been worst, the technology help me learn* (student A); *Many people work better with this technology* (student B); *I did things I never did before* (student C); *I would like to do that this summer* (student D). Others emphasized *liking working as a team.* Others mentioned *learning in a different way.* One student stressed *investing myself more in my projects* (student E). Regarding their learning experience in the workplace, students made reflections such as the following ones: *Knowing what I have to do* (student F); *I find it very good, because it will help us find a passion* (student G); *It helps us know what we love* (student H); *I do not know what to do later, I hope it will help me for that* (student I); *To find out what I am most attracted to* (student J); *It's a great opportunity to get to know each other and touch something else* (student K).

Usefulness of ST (praxeological axis)

Students stressed the following uses they made of technology: *Searching information, communicating by e-mail, recording video, audio, making audio, video, photos, images*, *realizing text documents (Word), producing presentation documents (PowerPoint, Prezi)*, *creating tables, doing calculations (Excel)*, *conducting a survey, and holding a video conference. Less frequent uses were the following ones: Data entry, Excel charting, creating user guides, game testing*, *preparation of computer hardware (computers and laptops)*, *service at computer loan counter and breakdown service*, *graphic design and logos, digital cartography*, and *sample analysis.*

Sense-making regarding the nature of knowledge **(epistemological axis)**

Students gave some new meanings to learning, and they perk through in the above comments. Regarding the nature of knowledge itself, the following comment stands out: *A new way of knowing* (student L).

Micro-level analysis: Students' RK in partnership B

In the activity produced by partnership B, built knowledge had not only a value linked to its production but also a value of exchange within their community. But here again the RK's axiological axis seemed to benefit more, followed by the praxeological one:

Value assigned to ST **(axiological axis)**

One eleventh-grader said: *Well, you know, for sure we were selected, on the one hand. I had to put together a letter. But the reason why I wanted to sign up was, you know, it would allow me to really do something at school, because I have no feeling of belonging to my school. I really could give a good goddam.* Another student stressed: *I think it's to help us not drop out of school and to motivate us. In addition, it could give us other career choices.*

Usefulness of ST **(praxeological axis)**

One student offered the following understanding: *It's not skills that are necessarily school-related [that we need] but skills that can be used in everyday life – the essential thing is more along those lines. Because, school skills, they [the teachers] show us everything in order to find out what we like. But we know that already! We're already working on that in school, in general. Getting skills for everyday life and that aren't related to school – that aren't just skills that you have to learn… At any rate, it's better than learning stuff related to school, I think.*

Sense-making regarding the nature of knowledge **(epistemological axis)**

The one student comment that stood out the most regarding new meanings to learning is the following one: *When you get down to it, (…) if, say, it was a teacher, he shouldn't play the teacher too much. He should be acting more like the youth worker.*

Moreover, students involved in the activities of both partnerships saw their academic grades improved. And teachers' perceived student behavior as more favorable to academic learning.

Meso and macro level analyses

Rise of tensions revealing contradictions within and among activity systems

Within students' activity system (Figure 2), the basis inner contradiction identified was related to what going to school meant i.e. learning to the test or learning to give meaning to a learning task. For boundaries to be crossed, students' RK had to manifest a different need state. At both sites, students demonstrated agency in negotiating a "new" code of living as they engaged in workplace-like activities, be it in the school-based business or in the school-work alternance activity, and took on new roles as a new division of labor revealed to be key.

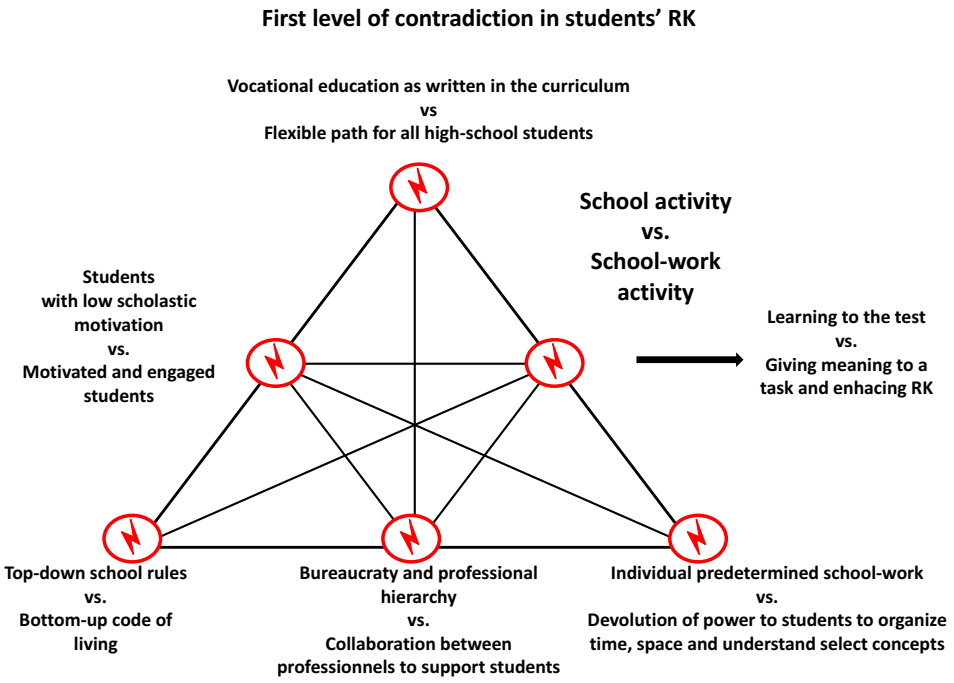

Figure 2. Dialectic analysis of sites A and B: Primary contradiction in students' RK

Expansive learning began to manifest for individual teachers as they opened up to new forms of teaching and learning. Teachers and students (Figure 2) moved away from an established form of dominant pedagogy to more experiential learning that took place within and outside the classroom. For boundaries to be crossed and innovation to happen, disagreements and tensions/contradictions raised during the early weeks of the partnerships had to be resolved.

Figure 3 pinpoints the secondary contradictions identified as the first level of contradictions was addressed. School practitioners (principals, teachers) had to demonstrate

flexibility in accepting that the 'regular' schedule of the students would need to change: A new instrument had been introduced in the school activity, the cooperation education program (FAST), and some educational partners had been involved since day one. In terms of rules, it meant that a deconstruction had begun, and that student's daily activities had to be adapted. The first schedule that was applied to "coop education students" had to accommodate to the fact that most teachers did not want to modify their classroom schedule. At both sites, it created resentment on the part of the students as they had to make up for loss of classroom lessons while they were in their field placement. At one site, some teachers created digital videos for "absentees" so they could catch up by listening to the videos on their iPads at home but there was also resentment on their part. The mediating role of the guidance counsellor was important as it helped address students' needs and their career interests as well as explain to some school practitioners the purpose of the FAST project. The following years, schedules created less frustration, either because students spent less time in the workplace or because some teachers integrated FAST elements (e.g., preparatory and follow-up activities) during classroom time. Another manifestation of boundary crossing was the more frequent presence of one counsellor in the teachers' classrooms.

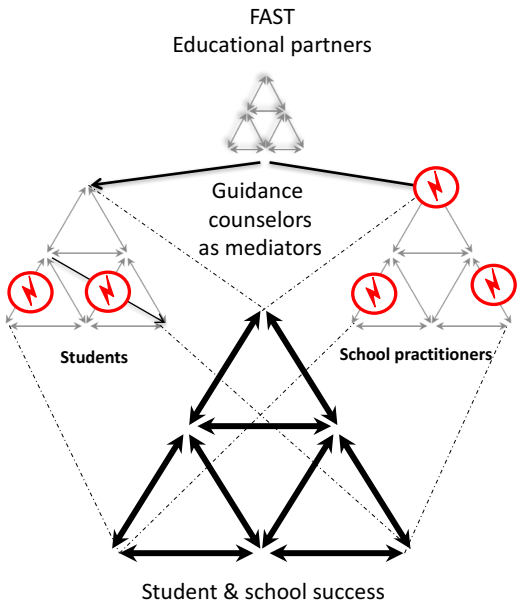

Figure 3. Students' and school practitioners' activity system interacting for student and school success

The crucial role of community workers, youth workers and knowledge transfer agency workers, as mediators between school practitioners and workplace practitioners, is stressed in Figure 4. As documented in Barma et al. (2017), during the first year of the FAST project, there was a loss in the object of the activity as community workers and youth workers did not manage to define precisely their mediating roles between the two "worlds". Students being at the centre, they had to decide by themselves what kind of work activity had meaning to them. At one site, community workers came across a lot of tensions before they were able to act as boundary crossing agents between the school and the workplace. At the other site, knowledge transfer workers acted as placement officers, coached workplace administrators, and facilitated the transition between school and work in other ways. It helped reduced the tensions felt by participating teachers as these new roles had to be assumed. Workplace practitioners also engaged in boundary crossing as they defined and organized the space and a schedule for the upcoming students. A contradiction arose in the object of the workplace practitioners' activity: performing at the business level or educating the students. Reduced interaction time with students made the contradiction less apparent.

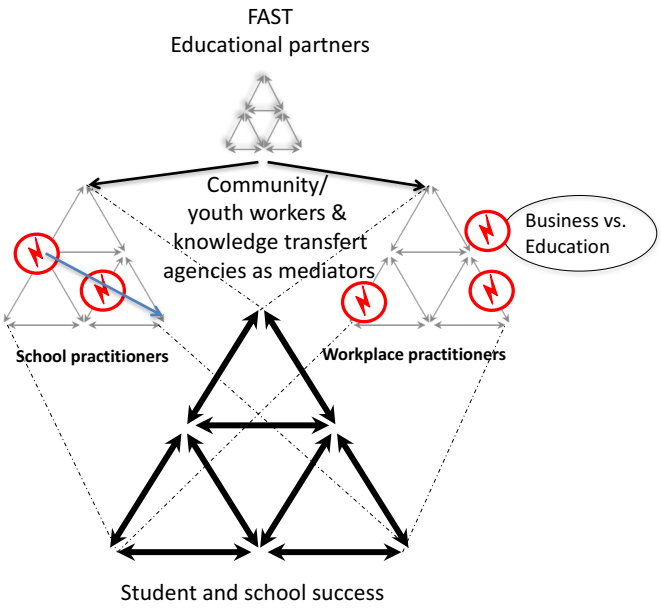

Figure 4. School practitioners' and workplace practitioners' activity systems interacting for student and school success

School practitioners (Figure 5) had to reinterpret the national curriculum (ministère de l'Éducation, 2006). That created tensions until they figured out how to respect it while creating space for the FAST project to proceed. Moving beyond the boundaries that their familiar interpretations of what was mandatory to teach students had created, principals and/or teachers develop new schedules, and modify their roles to accommodate students. In so doing, some teachers found new energy while others kept focusing on the loss of their teaching time. Funding from third parties also had a mediating effect. The Ministry of Education manifested openness and interest but did not have to modify any ruling during the project nor did it took action following RIT's positive final report (Laferrière et al., 2014). Research results left RIT with the impression that the province of Quebec was lagging behind most Canadian provinces and many States when it comes to structuring out of school experiences for secondary school students.

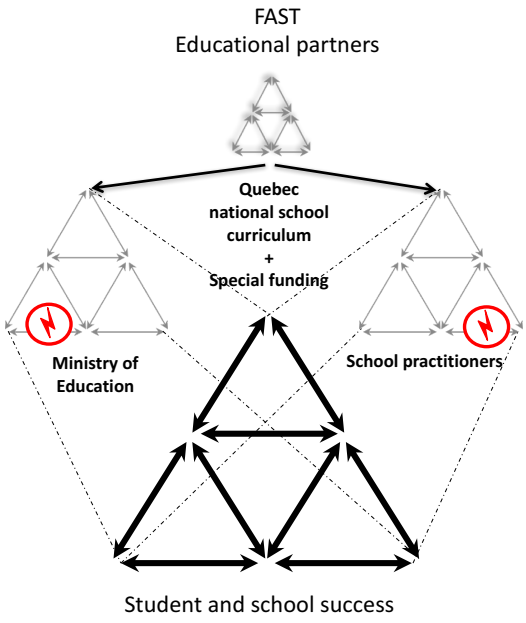

Figure 5. Ministry of Education and school practitioners' activity systems interacting for student and school success.

Before we focus on the interaction between RIT and school practitioners, we highlight the second level of contradictions identified over the unfolding of the FAST project (Figure 6). RIT was especially recognizing two types of instruments: school-work alternance programs and the Quebec national school curriculum. At the onset of the FAST project, however, they remained

part of a grey zone during RIT discussions regarding which methodological approach to appropriate. Some knew DBR, others RK or formative intervention. There was a definite negotiation of meaning going on regarding the research and intervention process unfolding as well as ways to conceptualize the relationships between educational partners (school principals, parents, teachers, etc.).

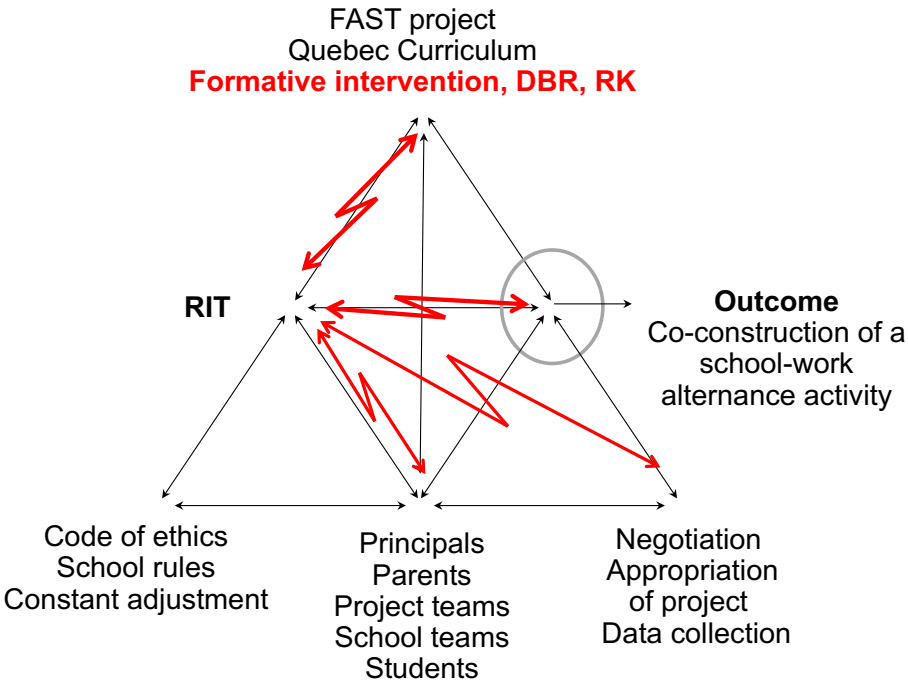

Figure 6. RIT's activity systems and second level of contradictions

Our last unit of analysis reflects the ongoing adjustments that RIT made as school expectations (and their own) were disclosed (Figure 7). The original model had been that of a small team of partners, including one RIT member. School-based teams also were inclusive of a RIT member. RIT members were aware that the scientifically-based rationale behind the original model – as spelled out in the grant proposal to the research agency (FRQSC) that funded the project – was barely taken into account. They worked at scaffolding boundary crossing (e.g., preparing documentation, encouraging direct involvement of the two knowledge transfer agencies in the implementation of the two models (school-based business and school-work alternance activity), funding research assistants to interact with students, develop digital resources, organize taking notes during meeting and feeding them back, and providing mirror data).

Tensions/contradictions were latent but worries regarding learning outcomes got real when, for instance, the process was slowing down as new school administrators took charge or deception or when time for student to experience "alternance" was reduced to almost a minimum.

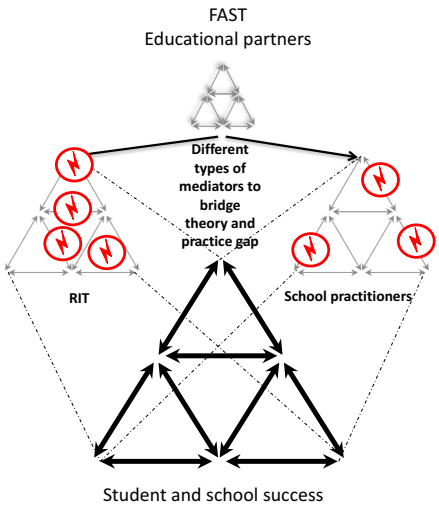

Figure 7. RIT's and school practitioners' activity systems interacting for student and school success

Discussion

Boundary spanning manifested as participants crossed some boundaries within and between their activity systems. Students were offered a variety of situations conducive to active participation inside/outside the school to help them give meaning to the knowledge they were acquiring (Figure 2). Keeping with their own interests while offering them the possibility of learning in a workplace was the strategy put in place, one enforced more fully at times than at other times by educational partners. Participants positioned themselves to move into the third space they contributed to create. We identified mediators who played a key role in crossing boundaries and resolving identified tensions (Figure 8): Guidance counsellors played a crucial role in bridging students' needs/interests and school practitioners' practices (Figure 3), RIT's theories and the school teams' practices (Figure 7); Social workers and knowledge transfer agency workers supported the new roles being taken by students, school practitioners and workplace practitioners, and were instrumental in tension resolution between the school and the workplace (Figure 4). We were remembered of Gutiérrez, Baquedano-López and Tejeda (1999) illustrating how apparent

conflicts and differences in learning organizations can be transformed into collaborative and productive 'Third Spaces'. At the frontiers and across the boundaries of their respective activity system, students, school practitioners and workplace practitioners brought their own resources and expertise (Morselli, Costa & Margiotta, 2014).

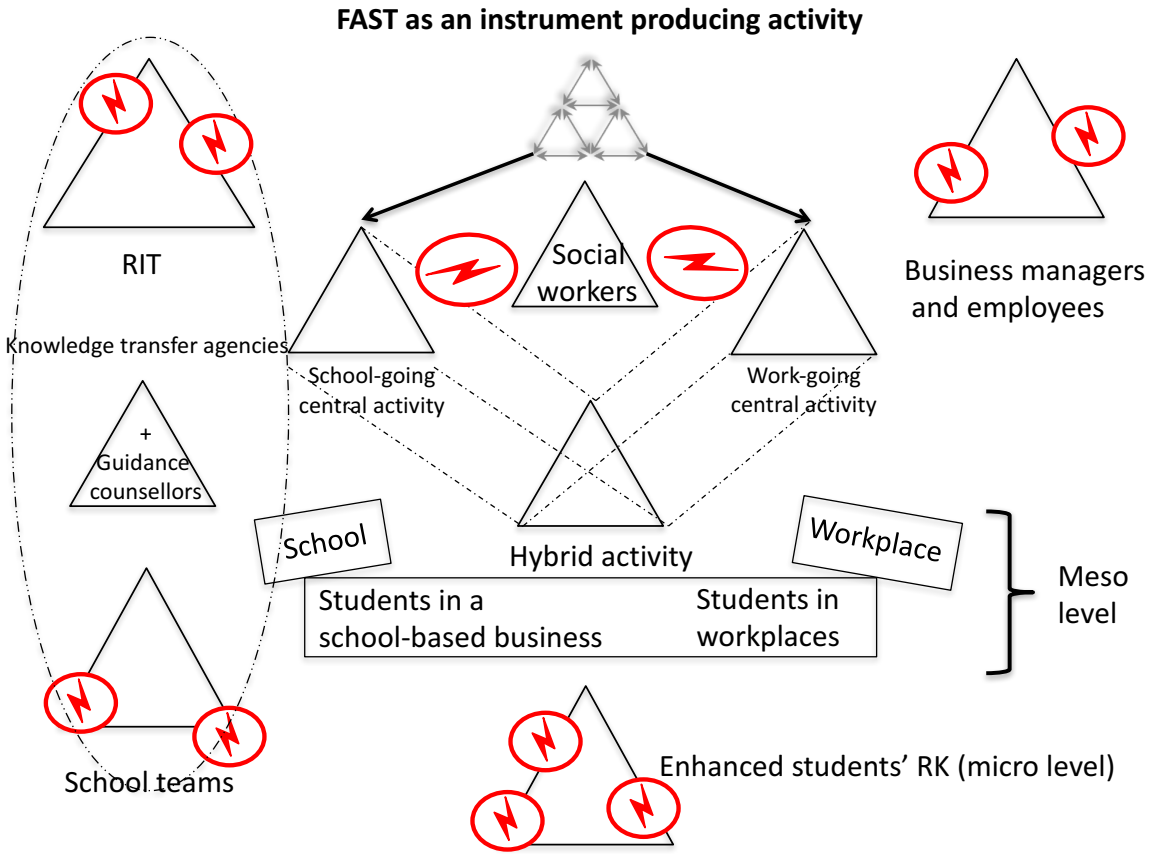

Figure 8. FAST educational partners' activity: A macro analysis

The national curriculum being a macro-level component that was in the mind of all educational partners, Figure 8 does not mention the Ministry of Education. (Figure 5). Changing educational policy at the national level was beyond the reach of the educational partners involved. Did RIT missed an opportunity for enduring innovation by not seeking the Ministry's engagement at a deeper level than indirectly providing funding for the conduct of the FAST project (Figure 6)? And another by not being more successful at scaffolding boundary crossing for school practitioners (Figure 7)?

FAST educational partners' activity (Figure 8), directed at a running object (e.g., enhancing students' RK), developed in ways that generated tensions/contradictions that had to be overcome through boundary crossing. A boundary spanning process unfolded, especially through the mediating actions of guidance counsellors, social workers, and knowledge transfer agencies.

Students gave few new meanings to learning (epistemological axis) but experienced more satisfaction (axiological axis) and found some usefulness to ST (praxeological axis). Could this positively affect their self-image? Their place in the world? They likely got glimpses of the collective knowledge required in specific workplaces, and some sense of the value of exchange within those workplace-based communities. It was a small step in the direction suggested by Fourez (1989, 1995) and by Larochelle and Désautels (1992) who denounced the fact that science courses presented in a dogmatic manner teach scientific results while neglecting to help students develop a representation of science as a social construct. In *La construction des sciences,* Fourez (2002) refers to the modelling method as the building of a representation in context. Being scientific and technically literate supposes that one can construct representations and scientific models: following this up with the reinvestment of such acquired knowledge into solving problems that may be encountered in everyday life. For Fourez (2014), being scientifically literate means knowing, "how to use knowledge for choice and decision, and not focusing on its value in an "ivory tower"" (p. 62). The RK notion, whose emergence and development lie in the field of Francophone educational research, can be related to English-speaking studies that have focused on science education and, in particular, on the understanding of students in the classroom and especially in science (Caillot, 2002; Penuel, 2014; Stone-Wiske, 1998).

When a student learns, it is through the mediation of others [and artefacts, tools and instruments, according to CHAT] that s/he engages in activity (Charlot, 2003). Learning is not a disembodied activity but may be conceived, to paraphrase Leontiev (1984), as a collective activity with motives, goal-oriented actions, and operations conducted in real conditions. It is the learner as subject that gives meaning to his or her learning through a set of interactions and paths (Bernard et al., 2014). Rochex (1995) told the story of three painters that speaks of the commitment and meaning that one gives to actions. The example presents the case of three painters who perform the same "material operations", but not the same "cognitive actions" or the same activities at the project level. The first is a tenant of an apartment who moves and repaints the apartment in order to recover his deposit. The second is a professional building painter who

paints the apartment because it is part of his work specification. The third, finally, is a loving painter who prepares the place he will come to live with his new companion. Analyzed from a CHAT perspective, the material operations that Rochex is referring to are not only operations but actions. When he refers to “cognitive actions” we see it more in terms of goal-oriented activity. It explains why the level of satisfaction in their respective activity is different. It is because the initial goal was different in each case. In other words, learners "engage" in a different way and do not get mobilized in the same way (Rochex’s example taken up by Astolfi, 2002).

Further research work (Barma, Bernard & Laferrière, in progress) regards the tentative development of a grid that combines Leontiev’s three activity levels with the RK socio-anthropological approach, one that could also include the *théorie de l’action conjointe* (Sensevy, 2011) as proposed by Caillot (2014, p. 17). Could this lead, as hinted by Barma et al. (2015), to teaching as an activity that recognizes to a deeper level the agency of the student as well as the agency of other educational partners? Could this become another way of creating new boundary zones to be crossed between CHAT and the socio-anthropological approach for a more complete understanding of the activity of learning at the micro, meso and macro levels?

Taking for granted that all educational partners are learners and that innovation does not occur without expansion of their respective activity systems, two implications for educational policy makers are put forward: 1) Problems that matter require time for all educational stakeholders to interact, and share the same problem space; and 2) models as solutions are context-based, and differentiation is to be promoted.

Conclusion

Taking a step back from our own epistemological RK as researchers, we are aware that we had to cross some of the boundaries of our research activity. We wanted to address at-risk students in a promising new way. Boundary crossing meant moving from DBR to more horizontal and interventionist approaches (praxeology). It led to this *ex post facto* reflective study on how FAST educational partners have crossed some of the boundaries of their respective activity systems. All members had to engage in constant adjustment as they were challenged to follow a runaway object (student and school success).

We suggest that RK is a fruitful perspective for reflecting on the epistemological, axiological and praxeological dimensions of educational research practice at both individual and

collective levels. This path may better suit educational partners who work in the field with organizations and value transformative agency as a collective process. Applied to the school-work alternance activity, the expansive resolution of boundary crossing zones would first include the reconfiguration of temporal and spatial relationships when their space is defined in research proposals.

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