Boundary Crossings Resulting in Active Learning in Preservice Teacher Education: A CHAT Analysis Revealing the Tensions and Springboards Between Partners

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We present a meta-analysis of a twenty-year long university-school partnership in which pre-service teachers collaborated with cooperative teachers and peers during practicums in innovative programs that featured active learning. The partnership evolved as a design experiment. Papers presented at conferences but never submitted to a research journal were revisited applying cultural-historical activity theory (CHAT) to understand the dynamics at play, and especially boundary crossing, within the university-school partnership's activity in terms of motive/object, instruments, community, roles, and rules/policies. We point to tensions that manifested contradictions of different levels between activity systems as the innovation unfolded. Suggestions for boundary crossing when field experiences are part of an undergraduate program are made.

Keywords: innovation, cultural-historical activity theory (CHAT), university-school partnership, online collaborative platforms, authentic problem, collaborative reflective practice, knowledge building, virtual community

INTRODUCTION

Teaching and learning in the digital era are taking many forms and shapes. Our own journey began over 20 years ago as we engaged in the exploration of the possibilities of the Internet to support university-school partnerships dedicated to active learning. A process of co-design began, first among a few teacher educators engaged in a national research network, each attempting to locally develop a university-school partnership centered on ICT integration. At one of the sites, researchers invited a school district superintendent to invest in a school that could become a lighthouse for other schools regarding the uses of information and communication technologies (ICTs). After conducting a need assessment with families, a large urban secondary school introduced a one-to-one laptop program that emphasized project-based learning. Researchers engaged in collaborative action research with school practitioners on ICT integration and effective use, selected and supervised student teachers interested in doing a 5-week or a 15-week practicum in the program.

Wanting student teachers to reflect on their teaching practice in a collaborative manner, teacher educators designed a virtual community of support and communication using two web-based platforms (Virtual-U's VGroups and, later, Knowledge Forum). Successive cohorts of students became virtually linked to one another as incoming cohorts accessed the contributions of previous ones and added their own contributions. Contributions were the results of onsite/online interaction for understanding a pedagogical problem that captured their interest.

This successful case of active learning is reported through an analysis of the university and school partners' activity systems (motive/object, instruments, community, roles, and policies). The first sections provide contextual and conceptual background and the methodology that led to successful use of ICTs in this higher-education case. The latter sections present a meta-analysis of previous research papers related to this case with the goal of identifying boundary crossings and resulting tensions and springboards between partners' activity systems. Suggestions are made for boundary crossing when fieldwork, as a form of active learning, is part of undergraduate programs.

BACKGROUND

In the mid-nineties, university-based teacher educators themselves had to uncover what could be the added value of information and communication technologies (ICTs) for teaching and learning. Even today, the challenge is still there: digital technologies develop rapidly; meta-analyses emphasize that pedagogy remains the critical factor (Tamim et al., 2011; Means et al., 2013); implementation factors such as training and support need to be considered when assessing the effectiveness of ICT interventions (Archer et al., 2014); and "learning is best supported when the student is engaged in active, meaningful exercises via technological tools that provide cognitive support" (Schmid et al., 2014, p. 285).

At the onset of our own use of ICTs, the assumption was that they could enable active learning, one of Chickering and Gamson (1987) widely accepted seven principles for improving practice in undergraduate education. Bracewell et al. (1998) revisited Schwab (1973) four commonplaces of the educational situation—someone teaching something to someone in a given context—in the following terms: A learner learning something, under the guidance of a teacher, in a given context. This reformulation acknowledged the control given to the learner in a context, especially one supportive of onsite/online human interaction. Dirckinck-Holmfeld and Sorensen (1999) stressed the importance of viewing collaborative learning as a holistic process that is taking place in a context—a community of practice. At the time, computer-supported collaborative learning (CSCL) was still in its infancy (Roschelle, 1992; Koschmann et al., 1994).

In teacher education, Schön (1983) book on the reflective practitioner, building on Dewey (1925/1989, 1934/1989, 1938) understanding of experience and reflection, was highly influential (Baird, 1992; Zeichner and Liston, 1996; Boud and Walker, 1998). Schön distinguished reflection-in-action from reflection-on-action. He defined the former as "a reflective conversation with the situation" (p.163), and referred to reflection-on-action as an activity occurring before or after practice. Kolb (1984) model of experiential learning also emphasized reflection on experience. Co-designing a virtual community of support and communication with pre-service teachers[1], we were encouraged by our early results, and found ourselves in agreement with

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[1] A R&D project of the TeleLearning Network of Centres of Excellence (TL-NCE, Canada, 1995-2002).

Blanton et al. (1998) who suggested the adoption of a socio-constructivist pedagogical framework to guide teacher educators in the use of telecommunications. A few years earlier, collaborative reflective practice on ill-defined problems for science teachers had been suggested as best practice by Desouza (1994).

At our university, the education of reflective practitioners was the primary aim of the four-year teacher education program. Collaborative reflective practice with school-based teachers engaged in innovative practice with ICTs was appearing most desirable. The working hypothesis put forward by our research team was that reflection on practice and knowledge building, supported by an online collaborative platform, could be highly relevant for the education of pre-service teachers doing practicums in the partner school, and as incoming practitioners of teaching and learning in the digital age.

The partner school was in the early stages of integrating ICTs in teaching and learning. Pedagogies such as cooperative learning and project-based learning were part of teacher professional development activities offered by the school district, and some teachers were doing their Master's Degree at our university. The school adopted an incremental approach, admitting the first year 60 students that were beginning secondary school. The administration hired two elementary school teachers, considering that their teaching practices were more attuned to the classroom processes they wanted to see being installed, namely ICT use, teamwork and project-based learning. On Year two, there were four classrooms instead. In 2002, the program was spreading over the 5 years of high school, and has since proven to be sustainable.

METHODOLOGY

We engaged in a design experiment, a methodology developed to create and evaluate educational innovations (Brown, 1992; Collins, 1992). Researchers adopting this methodology give to intervention special attention, and several research iterations are usual (design-based research, Collins et al., 2004; Zheng, 2015). We were also influenced by Engeström (1987, 2011) activity theory framework and formative interventions as they are, like design-based research, especially suitable when innovation is concerned. Engeström's framework is used to focus on tensions/contradictions between an activity system's main elements or between activity systems. It served to collect manifestations of tensions as data. It is through the identification of tensions/contradictions, and their resolution, that innovation occurs within the activity of a group or a community. We present here the basic constituents of the intervention conducted over the years by the author of this paper who was the pre-service teachers' supervisor during their practicums. She was also a researcher on ICT integration in teaching and learning.

Intervention

Participants (or primary activity systems' actors) involved preservice students, cooperative teachers, and teacher

educator(s)/supervisor(s). The school district administrators and personnel, the school principal and other school teachers, and parents also formed other activity systems in interaction with the primary activity systems considered in this paper.

Volunteer Participation

A pre-service teacher (PST) cohort doing a practicum in one-to-one laptop classrooms (OLC) was composed of five to eight participants (PST-OLC). This option attracted more volunteer students than available places. Selection interviews were conducted for matching pre-service teachers with cooperative teachers. What a practicum in one-to-one laptop classroom entails (teamwork, self- and peer-regulated learning, collaborative project-based learning or inquiry, and, sometimes, knowledge building) is hereafter presented.

Student Engagement With Authentic Problems

For authentic problems to lead to socio-cognitive knowledge, the learning environment must be designed to this end (Bransford et al., 1999; Savery and Duffy, 2001). Being a pre-service teacher in a one-to-one laptop classroom had, and still has, its load of challenges (e.g., understanding the curriculum in depth; teaming up with the cooperative teacher; knowing less than classroom students about software in use; moving from a teacher-centered to a student-centered approach and to a learning community model regarding participation in the classroom; managing students' use of laptops during lectures).

Collaborative Reflective Practice

Miettinen (2000) wrote: "It is the failure and uncertainty of the primary experience that gives rise to reflective thought and learning" (p.65). Shireen-Desouza and Czerniak (2003) defined collaborative reflective practice as follows: "A voluntary effort of the part of teachers in a school to share and critique idea about teaching, to reflect upon one's teaching and students' learning, formulate aims and goals about the curriculum through collaboration, and also take responsibility for their actions and consequences of their actions" (p. 77). Yoon and Kim (2010) showed the advantage of collaborative reflection to enhance individual reflection. For a PST-OLC, entries in an individual journal for reflective practice were replaced by contributions in an online forum. As genuine engagement was sought, there was no requirement for posting a specific number of contributions per week. Though participation in the forum was mandatory, a pre-service teacher had the option of opting out during the trimester. Over the years only one of them, who was encountering serious difficulties, chose to use a journal for reflective practice.

Focus on Ill-Defined Problems

The university-based teacher educator guided the PST-OLCs toward identifying one or a few practical problems for which there was no simple or clear definition or solution. They were invited to collaborate for reaching a better collective understanding of the problem and also for co-influencing their individual teaching practices. The university-based teacher educator, and also some school-based teacher educators, provided references, cases, and other forms of advice.

Seamless Onsite/Online Interaction

Given that the pre-service teachers of the PST-OLCs were all doing their practicums in the same school, they had their own room for individual work or exchange with others. Cooperative teachers were sometimes present in this room but pre-service teachers often met with them elsewhere. Seminars with the university-based teacher educator were conducted in that same room. At times, a teacher attended. There were, therefore, plenty of opportunities onsite to engage conversation on problems of practice. Online interaction was encouraged for leaving traces of one's thinking and building on one another's thinking on problems first discussed onsite. Cooperative teachers had access to the forum on the web-based platform.

Collaborative Knowledge Building

Scardamalia (2002) knowledge-building principles (e.g., real ideas and authentic problems; improvable ideas; collective cognitive responsibility for a community's advancement of knowledge) were highly relevant. Each PST-OLC was called to become a knowledge building community, and to leave the results of their collaborative inquiry on the platform. For the 2002-2012 period, such results were available in the form of a virtual tour, developed by one or two participant(s) who were then hired as research assistants, and required to seek validation of the tour from other pre-service teachers before posting it online.

Applying Wenger (1998) concepts of shared repertoire and regime of competence, pre-service teachers' learning and knowledge building artifacts were to contribute to the conceptualization of the teaching practice in a networked classroom. As an exercise of legitimate peripheral participation (Lave and Wenger's, 1991), incoming cohorts had to do an online practicum, that is, the reading/visioning of three virtual tours and/or, for the years 2013–2016, of the PST-OLCs' forum contributions themselves, and they had to write an individual reflective statement on the value of such an activity prior to their practicum in a one-to-one laptop classroom. During the trimester, they could search the platform, using keywords, for previous contributions made by participants of previous cohorts on a problem they were collaboratively reflecting upon in an attempt to advance their individual and collective knowledge and practice as well as the knowledge and practice of the virtual community as a whole.

The second design cycle (2013-2016) that replaced the first one (2002–2012) grew out of necessity given the fact that the new version of the online platform (Knowledge Forum) did not include the contents of the previous database. Therefore, the 2012 PST cohort and the 2013 PST cohort had to switch platforms to do the three required virtual tours. When the supervisor asked the 2013 PST cohort permission to make all their contributions accessible to future cohorts instead of only those part of a virtual tour, they accepted. No more virtual tours were developed.

Research

Socio-technical designs[2] for effective uses of ICTs in teaching and learning were at the heart of our research program, and especially those integrating collaborative platforms. Our own use was enhanced through a number of research iterations. In the first iteration, the Internet was used for bridging university and school practices in teacher education, and patterns of connection were identified (information exchange, coordination of teaching practices, and joint inquiry) (Laferrière et al., 1997). In the second iteration, the notion of a networked community helped integrate the connections that were taking place between the university and the school (Laferrière et al., 1998). In the third iteration, the research narrowed on the activity of the networked community of learners, meaning the online interaction between pre-service teachers (Collins et al., 2000). In iteration four, the research effort expanded to document the connections between networked communities—the university-school partnerships were inspired by the Holmes Group's (1990) professional development school model (PDS)[3] that emphasized (1) practice teaching, (2) professional development, and (3) collaborative research (Laferrière, 2001; Breuleux and Laferrière, 2004). Researchers also studied pre-service teachers' online discourse with regard to content and process: project-based learning (Laferrière et al., 2002); argumentation procedures (Campos et al., 2003); teaching and learning in a networked classroom (Laferrière et al., 2013, 2016).

For this research work, we applied Engeström's cultural-historical activity theory framework Engeström (1987, 2015) to the papers[4] mentioned in the preceding paragraph for conducting, in an illustrative manner, a meta-analysis[5] of the university and school partners' activity systems' components: motive/object, tools/instruments, community, roles, and rules/policies are examined. For innovation to occur, two activity systems must minimally compose the unit of analysis (Engeström, 2001). Most enduring tensions within and between activity systems' constituents and those created by emerging activity systems are pinpointed. Such tensions manifested more basic contradictions at different levels:

– Level 1: contradiction within the same component of an activity system (L1c)
– Level 2: contradiction between components of an activity system (L2c)
– Level 3: contradiction between an established and an emerging activity system (L3c)
– Level 4: contradiction between the new activity system and its neighboring activity systems (L4c)

For each tension identified, the level of contradiction it could reflect is indicated (L1c, L2c, L3c, and L4c).

For activity systems to evolve, boundary crossing reflected in moving beyond traditional roles and in the co-construction and adoption of new models is key (Akkerman and Bakker, 2011). This case study is attentive to such moves.

RESULTS

Partners' Shared Object: Innovation With ICTS

Since the start (1995), the motive of the founding and sustaining partners' (dean, school superintendent, school principal, one-to-one laptop program (OLP) teachers (including cooperative teachers), university-based teacher educators, pre-service teachers, one-to-one laptop program (OLP) learners, and parents) activity had been and remained innovation in teaching and learning with ICTs (**Figure 1**). For the school system, innovation was primarily pursued through the goal of initiating, developing, and sustaining the one-to-one laptop program. For the university, innovation focused on the preparation of pre-service teachers for work in the digital age through PST-OLCs' reflective practice and knowledge building with the support of a collaborative platform. In 2002, this university-school partnership had shrunk to one university-based teacher educator (Tension, L2c) but the one-to-one laptop program had grown, applying a school-within-a-school model, and was offered to all grade levels (Secondary 1 to Secondary 5). In the most recent years, a former member of two PST-OLCs, who is now a professor at the Faculty of Education, is introducing reflective practice and knowledge building on a collaborative platform for all pre-service students preparing to teach at the elementary level.

Partners' Tools and Instruments

Both university-based and school-based partners accessed the Internet at a high level for information and communication purposes, for teaching and for active learning (e.g., the design of practicums for pre-service teachers and the design of a one-to-one laptop program for school students). (**Figure 1**). Advanced collaborative platforms for active learning were the choice of the university-based teacher educators involved in the partnership, while teachers and school learners of the one-to-one laptop program were interested in software diversity and valuing open access ones (Tension, L4c).

Partners' Communities

Each Fall or Winter trimester, at the core of the university-based community was the PST-OLC (pre-service teacher cohort) and the university-based teacher educator involved in the OLP. On campus, they interacted with university peers and colleagues (**Figure 1**), explaining what the OLP was about and its *raison*

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[3]This was the Holmes Group's strategy for fostering innovation within pre-service teacher education programs as well as within local schools. PDSs caught the attention of the National Council for Accreditation of Teacher Education (NCATE, Washington).

[4]Studies connected to these papers were carried out in accordance with the recommendations of the Social Sciences and Humanities Research Council, SSHRC, Canada. Protocols were approved by Laval University's Ethics Committee.

[5]This meta-analysis focuses on the author herself who reflected on her own experience as she revisited those previous papers to which she had contributed. She is grateful to two university colleagues, Stephane Allaire and Christine Hamel, who previously worked in the partner school as students and research assistants. They validated the analysis.

FIGURE 1 | University and School Partners' Activity Systems represents two interconnected systems of activity and the complex dynamics within and between each of them.

d'être (Tension, L1c). OLP teachers had to do the same within their own school-based community, with the help of the school principal (Tension, L1c). Meanwhile, the repertoire of the virtual community of support and communication, composed of all the contributions of previous PST-OLCs, including those of the university-based teacher educator and of some OLP teachers, was underused during and after the practicums. Onsite and online communications with OLP parents, who had chosen to register their child (children) to the OLP and bought his/her laptop, were frequent.

Partners' Roles

The university-based teacher educator, the OLP teachers and the pre-service teachers all had to learn to be "guides on the side" (**Figure 1**). The university-based teacher educator's requirement that pre-service teachers' write personal learning projects, ahead of the practicum but after three or four visits in an OLP classroom, generated insecurity (Tension, L3c). They were instructed to refer to the template provided by the Faculty of Education's Placement Office only when getting short of ideas regarding the planning of their practicum. OLP teachers working with pre-service teachers were often present in the classroom compared to other cooperative teachers. They also favored teamwork more often (**Figure 1**). Moreover, they were learning, and letting pre-service teachers know it, when to instruct and when to give OLP learners control of their use of time when working individually or in teams (Tension, L1c). They liked the learning community model but often found themselves having to take central stage in the classroom (Tension, L1c). A few of them used Knowledge Forum, and considered the students of their classroom as knowledge builders. They worked in teams with

other teachers and engaged in collaborative reflective practice and knowledge building although they did not use a collaborative platform. They published individual webpages (Tension L1c). Pre-service teachers were welcomed at all teacher meetings. Having little conceptual and experiential knowledge of active learning and lacking deep understanding of the curriculum, pre-service teachers had a lot to learn. For instance, in the classroom, they leaned toward teacher-centered project-based learning, giving students the freedom to choose the "how" and, rarely, the "what" to be studied (**Figure 1**). They struggled with aligning the curriculum goals, pedagogical intents, and results (Tension, L2c). Nonetheless, some guided classroom students in the use of Knowledge Forum even when students tended to think that other software tools were "cooler" (Tension, L2c). On the whole, pre-service teachers found ways to contribute to the conceptualization of teaching in a networked classroom, that is, when all own a laptop connected to the Internet. Almost half of these pre-service teachers are now OLP teachers.

Partners' Rules and Policies

Pre-service teachers were advised by outsiders (university teachers and peers, and family members with teaching experience) to the one-to-one laptop community (OLC), to spell out, as they introduce themselves to a classroom, the rules they wanted to apply. That was contrary to the thinking of the OLP teachers and the university-based teacher educator who were favoring the learning community model (**Figure 1**): learning goals were to be established with the classroom, and rules were to derive from them (L4c). Pre-service teachers did not want to lose control of the classroom, an implicit rule they perceived was important (Tension, L1c). For instance, they did not want

classroom students to break the school policy with regard to the use of the computer (Tension, L2c). Being in touch with what was going on in the classroom, including on screens, while scaffolding a student or a small group of students, was expected of them (Tension, L2c). Working individually or in groups, classroom students were not always on-task and, sometimes, disturbed others. Pre-service teachers had to act. Another difficulty regarded learning assessment. At the beginning of the OLP, the school district had loosened up its evaluation policies but over time they tightened them up (Tension, L4c). At the government level, shortly after recommending the OLP as an exemplary case regarding learning assessment practices to the Organization for Economic Co-operation and Development (OECD, 2005), less emphasis was put on the acquisition of competencies, and OLP teachers and pre-service teachers felt the pressure of assessing rote knowledge in preparation of provincial exams (Tension, L4c).

Pre-service teachers also had to meet the expectations of the university-based teacher educator with regard to giving attention to pedagogy first and technology after (Tension, L2c), and engaging in collaborative reflective practice (onsite/online) and knowledge building (especially online) (**Figure 1**). To construct and maintain a joint problem space (Roschelle and Teasley, 1995; Fischer et al., 2013) was not easy for each PST-OLC, and for the university-based teacher educator as well (Tension, L3c). Pedagogical concepts such as socio-cognitive conflict and positive interdependence required deeper understanding. Ill-defined problems were for instance: How to interact with classroom students in ways that will allow for an authentic question to arise and engage them into a collaborative inquiry? Which technology would best support this or that learning activity? When to release students' agency, and for how long? How to organize and manage a networked classroom? A PST-OLC could search the collaborative platform and refer to the contributions of previous PST-OLCs having work on the same or a similar problem but such an action was not mandatory.

DISCUSSION

Under the lens of cultural-historical activity theory (CHAT), which serves as the theoretical underpinnings of this case study that grew out of a meta-analysis of previous unpublished papers, one gets a systemic view of what innovation in the classroom, supported by ICTs, entails, and especially when active learning is on the agenda. Active learning was enacted through reflective practice and knowledge building supported by a collaborative platform. The ill-defined problems that pre-service teachers struggled with when learning to teach in one-to-one laptop classrooms were brought forth during collaborative reflective practice and knowledge building. In her work with the PST-OLCs, the university-based teacher educator experienced the same problems being pinpointed (e.g., how to be a guide on the side; how to engage students in project-based learning; how to exercise control). While each PST-OLC had access to the repertoire of the virtual community, they nonetheless needed to engage in their own meaning negotiation over such problems as

a way to face the internal L1c and L2c contradictions they were experiencing.

These ill-defined problems do not appear to be that different also from the ones that post-secondary teachers face, inside and outside the classroom, when engaging students in active learning. For instance, student engagement into active learning require that they venture into a more active role, and some resist such role modification (Parent, 2017). When this happens, the teacher's emerging activity system enters in contradiction with the student's well-established activity system (L3c). At such a time, the partners (teacher and student) need to find a shared object in order to move forward.

In spite of the fact that with the school's partners activity system advanced collaborative platforms were not very popular, pre-service teachers were presented Virtual-U's VGroups and, later, Knowledge Forum for collaborative reflective practice and knowledge building. There was an obvious lack of coherence between the two activity systems but OLP teachers and the university-based teacher educator respected one another's boundaries, and accepted this L4c contradiction. In the end, only a few teachers and pre-service teachers had referred to the knowledge-building principles and made use of Knowledge Forum. It may be inferred that the use of similar instruments would have deepened pre-service teachers' experience with the same instruments, and, therefore, their use for active learning purposes.

The university-based and the school-based partners belonged to different communities, each with its beliefs and ways of thinking and doing. The experiential approach that led to sending pre-service teachers to emerging one-to-one laptop classrooms, and favored the use of advanced collaborative platforms went against the grain of the mainstream activity of the Faculty of Education, and, introduced, therefore, another L3c contradiction. While active learning was voiced, only a few professors enacted it with undergraduate students (L1c). An even smaller number showed interest in advanced collaborative platforms (L4c). Similarly, most pre-service teachers seemed to underestimate the value of active learning (L1c). But not the parents of the OLP learners (L4c). In a few words, the emerging activity system was installing a contradiction between the old and the new (L3c). The CHAT framework emphasizing that the resolution of tensions/contradictions leads to innovation, one gets a sense here of the boundary crossing that was required from the university system's actors. This activity system is more complex than the activity system of a school. Even when a school decides to implement a school within-a-school model, which adds to the complexity of its activity, the emerging activity system kept expanding (e.g., the number of teachers involved) while the emerging university-based activity system did not expand beyond one PST-OLC engaging in reflecting practice and knowledge building with the support of a collaborative platform during the Fall and Winter trimesters.

Being a guide on the side is more of a self-effacing role than being the sage on the stage, and requires a capacity to face the unknown as students take more active roles (e.g., generating questions and problems, searching for information, engaging in project-based learning, collaborative inquiries, and in knowledge

building). It may not be what prospective teachers have in mind when choosing this profession, and, if so, their expectations are in contradiction with the expectations for life and work in the digital age (Pellegrino and Hilton, 2012). Teaching beliefs and educational systems in place, including university professors'/lecturers' and students' expectations of their role, are key factors to work with for innovation and change in education, and these raise L1c, L2c, L3c, and L4c contradictions that will need to be overcome. The task will not be easy given that teachers' and students' roles become more complex than conventional ones when active learning is enacted. Technology seems to add to, rather than diminish, this complexity.

Learning to release students' agency without losing control, to negotiate behavioral rules with students that will allow for the learning objectives to be met, to scaffold student learning, and to proceed fairly in assessing individual and group learning are requirements of an active learning pedagogical approach. It requires boundary crossing within the university activity system and between university and school activity systems. Students of each of these activity systems also are facing a steep learning curve as they are required to exercise agency when they operate in less scripted learning environments, negotiate their different representations of an ill-defined problem and seek knowledge and action convergence with their peers. As pointed by Dede (2017), students must be prepared to reinvent themselves. Will these emerging practices transform into new rules and policies at the institutional level? Applying cultural-historical activity theory (CHAT), one may foresee that such an emerging activity system is bound to bring more tensions/contradictions between the old and the new ways of being a teacher and a student in post-secondary education. CHAT has a methodology for interested administrators and teachers to address such contradictions and bring about, in an informed and consensual manner, effective models, namely the Change Laboratory (Engeström, 1987, 2015; Virkkunen and Newnham, 2013).

CONCLUSION

We presented a case of active learning that stands out by its duration, and its systemic nature. It featured pre-service teachers learning to teach in networked classrooms with their cooperative teachers and university-based teacher educators who fostered their active learning by using, among others, collaborative platforms to support reflective practice and knowledge building. CHAT was used to provide a sense of the dynamics at play in such innovation. However, this study has limits with regards to the way CHAT was used for analytical purposes. For instance, many units of analysis, each involving two different activity systems with their respective subjects who participated in the university-school partnership, could have been analyzed. Contradictions, as manifested by identified tensions, could have been understood at a much deeper level with a fuller application of the theory and the Change Laboratory as its related methodology.

Nonetheless, the results illustrate what is at stake when post-secondary teachers venture into engaging students in active

learning. In this case, it was done through reflective practice and knowledge building using a collaborative platform. It is our way to prepare pre-service teachers for teaching and learning in the digital era, and to work with students that will have to demonstrate future skills that still remain to be completely uncovered.

Given the breadth and length of this innovation that fostered active learning, we formulate four suggestions, and the contradiction level (L1c, L2c, L3c, L4c) they address, for the boundary crossing of one's activity system when field experiences or practicums are part of an undergraduate program:

- A student who wants to evolve and thrive in the digital era will find him-herself advantaged by registering for elective courses or programs that promote active learning through the use of digital tools and resources, and, among others, collaborative platforms (L1c).
- A post-secondary teacher who wants to engage students in active learning will find him-herself advantaged by taking the role of a designer, or of a design researcher, proceeding through iterative cycles by collecting data that will inform his or her practice (L2c).
- A post-secondary teacher who wants to engage students in authentic problem setting and solving will find him-herself advantaged by being part of a partnership where both partners have agreed on a shared object toward which to direct their respective activity forward (3c).
- A post-secondary institution who wants to contribute at most advanced levels at cultural, societal and economic levels will find itself at advantage by spelling out to prospective students that active learning is expected of them (L4c).

CONSENT PROCEDURE

University students were informed that the innovation they were part of was part of a research program. Participation was on a voluntary basis. University students read and signed the consent form.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and approved it for publication.

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