Contradictions between the virtual and physical high school classroom: A third-generation Activity Theory perspective

Elizabeth Murphy and María A. Rodríguez Manzanares

Elizabeth Murphy holds a PhD in Educational Technology from Université Laval, Canada. Her program of research focuses on teacher practices in technology-mediated contexts. She is currently principal investigator on a Social Sciences and Humanities Research Council of Canada (SSHRC) Standard Research Grant, principal investigator on a SSHRC Strategic Joint Initiative, and co-investigator on a SSHRC Community University Research Alliance. María A. Rodríguez Manzanares is a doctoral candidate in the Faculty of Education, and a lecturer in Spanish at Memorial University of Newfoundland, Canada. She received a Bachelor of Arts Degree and a Graduate Diploma in Postcolonial Literature from the University of Barcelona, Spain, as well as a Master of Arts and Master of Education from Memorial University. Address for correspondence: Dr Elizabeth Murphy, Faculty of Education, Memorial University of Newfoundland, St. John's, NL, A1B 3X8, Canada. Email: emurphy@mun.ca

Abstract

This paper uses a third-generation Activity Theory perspective to gain insight into the contradictions between the activity systems of the physical and virtual high school classroom from the perspective of teachers who had transitioned from one system to the other. Data collection relied on semi-structured interviews conducted with e-teachers as well as management/support personnel of an organisation charged with delivering web-based high school courses in the Canadian province of Newfoundland and Labrador. Contradictions related to time and workload, physical presence, interaction and rapport building, and use of direct messaging and email. The contradictions can be explained by a difference between the mediating tools in each activity system. The absence in the virtual classroom of body language and visual presence as mediators requires e-teachers to find new ways of interacting and building rapport and necessitates a shift from a practice of controlling to engaging students' attention.

Introduction

In the study reported on in this paper, we use third-generation Activity Theory (AT) as a tool to gain insight into the contradictions between the intersecting activity systems of the physical and virtual high school classroom from the perspective of teachers who had transitioned from one system to the other. Our objective was to identify and

characterise the contradictions and to evaluate how they may lead to potential innovation in the practice of the e-teacher.

Some studies have been conducted at the post-secondary level using AT and contradictions as a framework for analysis (eg, Dippe, 2006; Nelson & Kim, 2001; Voigt & Swatman, 2006). As well, a very limited number of studies have been conducted at the secondary level. For example, Fåhræus (2004) conducted a study of high school distance education in Australia and adopted the students' perspective as the subject of activity. He identified contradictions between students' desire to collaborate, on one hand, and the lack of support for collaboration on the other, including teachers' approaches and lack of technological support. We found no studies that used a third-generation AT perspective to study the contradictions between the activity systems of the physical and virtual high school classroom. Our paper fills this significant gap in the literature.

Theoretical framework

AT serves as a framework or lens to gain insight into tool-mediated, goal-directed human activity in context (Cole & Engeström, 1991) and to understand 'how new technologies can affect educational change' (Bellamy, 1996, p. 126). An activity system consists of interacting components of subject, object, rules, community, division of labour and mediating tools (Engeström, 1987). Human interactions are mediated with each other and with objects through tools, rules and division of labour (Mwanza & Engeström, 2005). According to Vygotsky (1978), these mediating tools include culturally, socially and historically determined physical as well as psychological tools such as language, models and concepts.

The study of interacting activity systems is a characteristic of the third generation of AT, where at least two interacting systems are the focus of analysis (see Engeström, 1987). Engeström (2001) proposes the following model of third-generation AT shown in Figure 1.

An activity system is a 'virtual disturbance- and innovation- producing machine' (Center for Activity Theory and Developmental Work Research, 2003–04, p. 1). Contradictions are always occurring within and between activity systems. Contradictions
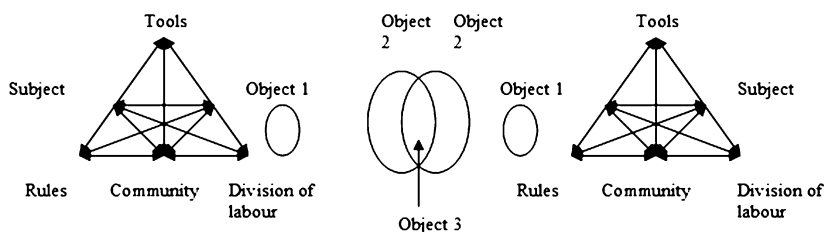

Figure 1: Third-generation AT model

can be defined as 'historically accumulating structural tensions within and between activity systems' (Engeström, 2001, p. 137). They manifest themselves as 'problems, ruptures, breakdowns, clashes' (Kuutti, 1996, p. 34). Contradictions 'generate disturbances and conflicts, but also innovative attempts to change the activity' (p. 34). Applied to the setting of virtual high school classrooms, an AT analysis could help us understand how contradictions in e-teachers' practice in this context of technology-mediated activity may result in transformation of teaching practice and in educational innovation.

The case

The case study (Yin, 2002) focused on web-based distance education in virtual high school classrooms in the Canadian province of Newfoundland and Labrador. More than one third of the schools in the province are rural schools, and a quarter of schools have populations of fewer than 100 students (Government of Newfoundland & Labrador, 2006). The Centre for Distance Learning and Innovation (CDLI) promotes equal and quality educational opportunities through the provision of distance education courses for students in these communities and schools (see Barbour, 2005; Government of Newfoundland & Labrador, 2000). CDLI requires that students be registered in an actual physical school in order to avail of its web-based courses. Enrolments as of 2005 were over 1 500 with 27.5 e-teachers and more than 30 courses in approximately 100 schools across the province (see Government of Newfoundland & Labrador, 2006, 2007).

On average, six out of ten classes are delivered synchronously and four asynchronously. Asynchronous instruction relies on use of the WebCT™ learning management system. Synchronous communication and instruction is conducted using Elluminate Live™ (E-Live). E-Live includes various collaborative tools such as Class List Display, text-based Direct Messaging (DM), two-way audio, a White Board, Graphing Calculator and application sharing. The DM window supports synchronous text-based conversation that can occur simultaneous to other forms of interaction such as with voice using the two-way audio. The schools also have equipment such as computers, headphones, scanners, faxes and printers. A teacher or group of teachers mentors (M-teams) in each school also provides support on-site, such as invigilation for examinations. At the time when the study was conducted, instruction was typically not supported by use of video because of the high bandwidth requirements of this form of interaction.

Method

Participation and recruitment

Volunteer participants included 13 of the 27.5 e-teachers employed by the Centre in 2005 as well as seven management/support personnel. The e-teachers represented a range of geographic locations within the province as well as range of disciplines including mathematics, French as a second language, social studies, fine arts, science, English language arts, and technology education. All had between 11 and 33 years of prior teaching experience in physical (face-to-face) classrooms.

Data collection
Data collection relied on semi-structured interviews (Patton, 1990) conducted with all volunteer participants. Two of the participants were interviewed in person whereas all others (including all e-teachers) were interviewed using E-Live. The interviewer could, while the interviewee was speaking, type a message using the DM tool to invite further clarification or to direct the interviewee's comments. The whiteboard could be used by the interviewees to illustrate learning resources or approaches. Interview questions were guided by the study's objectives, which were framed by AT.

The questions for the e-teachers were grouped into categories as follows: (1) background; (2) beliefs and personal theories; (3) teaching methods, approaches and goals; (4) classroom activities; (5) challenges, constraints and possibilities within the system; (6) changes and development over time in the organisation; and (7) use of tools. Questions for the managers/support personnel aimed to elicit insights into the system in general, in terms of organisational goals, characteristics, possibilities and constraints. Interviews lasted 90–120 minutes, were recorded and subsequently transcribed by one person and verified by a second person for accuracy. Interviewees were subsequently provided with a copy of their transcript for validation and were invited to change or edit any parts of the transcripts. None of the participants availed of this option.

Data analysis
Interview transcripts were first broken into units of meaning. Data analysis MAXqda2 software facilitated this process. Subsequent coding of the units was completed by the main researcher and three doctoral students. The three students were guided by and trained to use coding rules to identify contradictions. Training sessions involved the principal researcher working collaboratively with one or two coders at a time. The goal of these sessions was to promote intra- and inter- rater reliability (Neuendorf, 2002). When the coders were familiar with the coding system, each of them worked on different transcripts individually. Final codes were verified by the principal researcher.

For each unit of meaning, coding involved reading the unit, identifying if a contradiction was or was not present and, if present, articulating it according to the coding rules established for the study. These rules were as follows

1. Only one contradiction can be assigned to a unit of meaning.
2. A contradiction is defined as a tension, contrast, denial, or opposition between two propositions.
3. Reporting of the contradiction by the coder must be done in two sentences with the subject of both sentences the same.
4. The two sentences are reported using the actual words of the interviewee as much as possible.

This process yielded a total of 168 contradictions. From among these, there emerged a category of contradictions, which we labelled the virtual classroom (VC) versus the

physical classroom (PC). This category is made up of 95 units or contradictions. We subsequently conducted a keyword analysis (Miles & Huberman, 1994) of these 95 contradictions which led to the creation of sub-categories. These sub-categories were then labelled.

In addition to identifying contradictions, we used our data to profile the systems of the PC and the VC. We begin our presentation of our findings with a synthesis of the elements related to the two systems.

The PC and VC from a third-generation AT perspective
The intersecting activity systems of the PC and VC of our particular case share commonalities. For example, the object of activity for teachers in the VC as in the PC is to teach students. In terms of rules, norms and procedures, the curriculum prescribed by the Department of Education is the same. Voice-based communication remains a mediating tool in the VC as in the PC. Whole-group conversations during instructional time are another procedure or established means of interacting shared by both systems. The communities of both the VC and PC include teachers, students and parents. The division of labour features the Department of Education at the top of the hierarchy in both systems.

The differences between the two systems of our case are most evident at the level of mediating tools. In the VC, lack of physical co-presence combined with lack of tools that support visual interactions render impossible a reliance on symbolic tools such as body language and facial expression. While the mediating tools support only one unidirectional channel of voice-based communication at a time, they also allow for text-based interactions that support multiple, multi-channelled and directional, simultaneous public and private conversations. Rules about talking take on a different relevance in the VC because of the possibility of these text-based interactions.

The mediating tools also affect procedures related to the length of the school day and instructional time, which correspond in the VC to periods of virtual synchronous or asynchronous co-presence. Instead of a centralised presence, the VC is characterised by decentralised or distributed presence. The division of labour broadens horizontally in the VC of our case to include multiple as opposed to single entities in the hierarchy. These elements are further described and presented in Table 1.

Contradictions between the PC and the VC
Keyword analysis of the contradictions between the PC and the VC led to the identification of four sub-categories. We labelled these sub-categories using the main keywords and with a goal of promoting astringency in the label. The sub-category labels and their number of units were as follows: time and workload (32); visual cues (30); interaction and rapport building (18); and use of direct messaging and email (15). For each of these sub-categories, we provide a synthesis of the contradictions. We aim in our reporting to use, as much as possible, the actual language of interviewees.

Table 1: Synthesis of the elements of activity systems of the PC and VC

AT elements	Physical classroom	Virtual classroom
Subject	Teacher	Teacher
Object	Teach students	Teach students
Mediating tools	Eye contact	Voice
	Body language	Email
	Visual cues	Text messaging
	Facial expressions	Textbooks
	Physical hand raising (Physical tools)	Electronic whiteboard slides
		Scanner
	Blackboard	Software
	Chalk	Virtual hand raising
	Textbooks	
Rules	Department of Education prescribed curriculum	Department of Education prescribed curriculum
	Rules such as 'no talking'	No rules about talking
	Students seated in rows visually facing teacher	Students face a computer screen
	Informal planning	Formal planning
	Public conversation	Private and public conversations
	Physical presence	Anonymity
	Length of school day corresponds to periods of synchronous physical co-presence	Length of school day corresponds to periods of virtual synchronous or asynchronous co-presence
Community	Teachers	Teachers
	Students	Students
	Parents	Parents
	Centralised physical classroom	Distributed classroom
	Centralised school community	Distributed school community
	Centralised organisation	Distributed organisation (CDLI)
	Centralised geographic community	Distributed virtual community
Division of labour	Department of Education	Department of Education
	One school district	CDLI
	One community	Five school districts
	One school	100 schools
	One principal	100 communities
	Teachers within school	100 school principals
		CDLI principal
		M-Teams
		27.5 e-teachers

Time and workload

In the PC, planning, preparation, evaluation and assessment can be carried out with relative ease. Teachers can assess homework informally in the 2 minutes it takes for students to find their seats. If they need to give back an assignment or test, they simply come in the next day and hand it back to the students. However, e-teachers in the VC must take time to do formal assessments. For example, to hold a quiz, the e-teacher has to get schools' schedules and arrange supervision. If e-teachers give a test, it has to be

scanned, attached, sent to the students, who must complete it and send it back to be corrected, then it has to be reattached and sent back to the student electronically, all of which places workload demands on the e-teacher.

In the PC, instructional design is informal because teachers can simply have some notes prepared and examples ready and they can present a problem just with a piece of chalk. In the VC, instructional design is formal and preparation is more onerous, time-consuming and a more painstaking pre-planned process. E-teachers need the lead-time to get PowerPoint notes developed. They cannot start from scratch on a blank online white board.

Whereas in the PC, interaction with students is traditionally from 8 or 9 a.m. to 3 or 4 p.m., interaction with students in the VC is more constant because it does not depend on physical presence, but occurs through email or synchronous text messaging. Whereas a teacher can take assignments or quizzes home to mark, the e-teachers in our study typically relied on technology for marking (eg, PDF writer) which means that they often stay at work during nighttime. In the VC, e-teachers cannot get access to students simply by paging them at the office but require more time and technology to do so. Likewise, meeting with parents consumes more time and effort because it has to be done online using E-Live.

Visual cues
In the PC, the fact that teachers and students are physically co-present in the same classroom space means teachers can walk down the row, see if a student is making a mistake, stop and point it out right away. Teachers can immediately scan across faces, smiles and frowns to see if what they are trying to communicate was understood or if the student was totally lost, not paying attention or off-task. They can read the signals, look around at the body language and faces, and instantly gauge the lack of compre-hension or boredom, determine who is unfocused and quickly get them back on track.

The absence of physical co-presence in the VC means that e-teachers cannot see facial expressions, body language or visual cues to know if students understand. They do not know if students are listening in one ear and going on the Internet and checking out something else on the other or falling asleep. They cannot sit down with students and talk to them, which makes motivating and interacting more challenging. They are limited by the lack of control and have less capacity to discipline students who are not paying attention, or get them on track if they are totally off.

Physical co-presence in the PC allows the teacher to communicate information to students about who they are within the first 20 minutes of class simply by how they stand or gesture. Teachers do not have to force the interaction with students but can simply nod, smile, sit down with students and motivate and encourage them. In the VC, e-teachers cannot rely on visual cues or body language to communicate who they are; instead, they must rely on open expression, constant prompting, engaging and ques-tioning students. They have to push the interaction and develop techniques to keep

students focused, get feedback and make sure students are responsive and attentive. They have to ensure that written communication is composed carefully so it cannot be misconstrued, misunderstood or misinterpreted.

In the PC, students may feel anxious about raising their hand and talking in front of 15 or 20 people and be more reluctant to share, speak and voice opinions. In the VC, students cannot see each other or the e-teacher, and e-teachers cannot see the students. Students may not have the same anxiety about raising their hand, voicing opinions and talking in front of 15 or 20 people.

Interaction and building rapport

In the PC, interaction is spontaneous, ongoing, unplanned, immediate and informal, and often occurs outside of the instructional interaction. Teachers can interact with students as they are walking down the hallway at recess time or during extra-curricular events. Informal, off-chance, casual social interactions outside of class and in corridors with students are important for reassuring students and letting them know the teacher is there for them especially in cases of student tragedy (eg, a community death, a pregnancy). In the VC, e-teachers cannot typically interact physically or face-to-face with students. Informal, off-chance, casual social interactions outside of class and in corridors are not possible. Personal interactions and rapport building must be premeditated, consciously promoted and can only be achieved with more work.

Daily interactions in the PC allow teachers to be aware of what is going on in students' lives and in their communities and to gain respect for them as a person and vice versa. Likewise, students often already know who their teachers are, where they come from, what kind of a person they are to work with on a day-to-day basis, and what they are involved in around the school. In general, teachers can easily develop rapport, trust, mutual respect and a caring relationship so that students are willing to go to them with questions or concerns.

In the VC, e-teachers do not have day-to-day contact with students and are therefore often unaware of personal aspects of students' lives. They have students who they have never met before and do not know much about and vice versa. Other than typing emails and making phone calls, there is little they can do to be involved in students' lives in cases of tragedy. They may not know from the principal about a problem or issue involving students, therefore the problem may continue until they find out through another channel.

Use of direct messaging and email

In the PC, interaction is typically public, which means that students cannot pass on personal or private information in the middle of class that they may not want other students to be aware of. In the VC of our study, students will use text messaging or email to ask questions and make comments. Students can be open in a private interaction and can pass on information and nobody else knows what has been discussed. Students who

are shy and do not want to ask questions or look dumb in front of everyone can text the e-teacher questions privately in the middle of class.

In the PC, because students can see and be seen themselves, they probably would not say the same things as when they are texting in a VC. Students will not be as honest about how they feel if they have to go up to the teacher face-to-face and actually say it. With texting, they can be braver and more honest because they are used to this text pattern.

Students have been brought up to not talk in class unless they have a question to ask or they have to put up their hand because the teacher would find the talking disruptive. In the VC, the e-teacher can put up with a bit of chatter and the students can be noisier because it adds to the climate but it is not disruptive because text chat is quiet talk. In the PC, teachers cannot use text messaging to check for individual understanding. Instead, one or two students put up their hands so the teacher assumes all students know the answer when in fact this is often not the case. E-teachers can have 20 students' responses coming at one time and see immediately if students understand or not.

Discussion

Our analysis of the intersecting activity systems of the PC and the VC provides one case or example to illustrate and reinforce Engeström's (1987) argument that activity is a culturally, socially and historically contextualised phenomenon. In our case study, body language, visual cues and facial expressions served traditionally as symbolic mediating tools that allowed to check for understanding, control for attention, and achieve rapport building and interaction. However, as was witnessed from the contradictions in the VC, the e-teachers could no longer rely on these tools.

Likewise, practices that rely on the centralised system of the PC were disrupted and disturbed in the VC, where the distributed nature of the system called for new ways of communicating and interactions. Thus, the spontaneous and informal interactions and rapport building inside and outside of class in corridors and extracurricular activities became more formal, planned, conscious, pre-meditated interactions in the VC.

The decentralised and distributed nature of the system of the VC and lack of physical co-presence meant that e-teachers could not have as a goal or secondary object of their activity the control of students' attention. Instead, e-teachers could at best aim to engage the attention of students to produce a virtual centrality that might be characterised by mutually shared interests and goals.

In the VC, the reliance on electronic tools such as text messaging resulted in a change in classroom management rules that control the flow of conversation. In the practice of the e-teachers in our case, new rules were emerging whereby multiple conversations could be carried on publicly and privately among students and with their e-teacher during class time. The VC of our case was one that provided support for decentralised forms of communication controlled more by student than teacher initiative.

The lack of physical co-presence, the distributed nature of communication and inter-actions as well as the existence of new tools such as DM created contradictions, which result in disturbances and challenges for e-teachers. At the same time, they also allowed for new forms of practice to emerge. In our case, the new form was just beginning to take shape. The new form is evident in the shift from an object of activity that focuses on centralised control to one preoccupied with distributed engagement.

We can conceptualise this shift in terms of Engeström's (1987, 2001) constructs of expansive action and expansive learning. Historically, socially and culturally, the object of the activity in our case study was to teach students, ie, instruction (Object 1). In the VC, a second and related object of activity (Object 2) was to engage students while this same object in the PC was to control students. According to the perspective of expansive learning, the object of activity is redefined to expand the scope of possibilities. The expansion in this case would be towards a new object that can be shared by both activity systems (Object 3). We define this object as helping students learn.

Conclusion

Our findings illustrate Engeström's (2001) claim that contradictions are a source of change and innovation in practice. They also illustrate how the innovation or transfor-mation emerges not necessarily because it is planned or intentional but because it is actually a response to the tensions between two systems. As Engeström argues, 'In important transformations of our personal lives and organisational practices, we must learn new forms of activity which are not yet there. They are literally learned as they are being created'(p. 138).

Our focus on contradictions in this context of two activity systems provides support for Bellamy's (1996) claim that AT helps understand 'how new technologies can affect educational change' (p. 126). As Kuutti (1996) argued, contradictions generate 'inno-vative attempts to change the activity' (p. 34). The innovation in this case was reflected in a move away from controlling students and towards engaging them. More specifi-cally, it was evident in the shift in object from teaching students to helping them learn.

In terms of research, this study was limited to consideration of two activity systems at the secondary level. Third-generation AT could also be applied to the study of instruc-tors at the post-secondary level who are transitioning from classroom-based to web-based classroom contexts. This study's design adopted the e-teacher as subject of the activity system. However, the perspective of students as subjects moving from one activity system to another might yield different findings from those presented in this paper.

In terms of implications for practice, the e-teachers in this case may need opportunities to consciously develop techniques and strategies to work through the contradictions that arise as they move from one activity system to another. They may benefit from opportunities to develop new skills, techniques and strategies that can help them make best use of text messaging to support student learning. Likewise, they may benefit from

changes in policies or procedures that take into consideration increasing workload demands resulting from the use of mediating tools.

Acknowledgements

References

Barbour, M. (2005). From telematics to web-based: the progression of distance education in Newfoundland and Labrador. *British Journal of Educational Technology*, *36*, 6, 1055–1058.

Bellamy, R. (1996). Designing educational technology: computer-mediated change. In B. Nardi (Ed.), *Context and consciousness: activity theory and human-computer interaction* (pp. 123–145). Cambridge: The MIT Press.

Center for Activity Theory and Developmental Work Research (2003–04). *The activity system*. Retrieved September 5, 2006, from http://www.edu.helsinki.fi/activity/pages/chatanddwr/activitysystem/

Cole, M. & Engeström, Y. (1991). A cultural-historical approach to distributed cognition. In G. Salomon (Ed.), *Distributed cognition* (pp. 1–47). Cambridge: Cambridge University Press.

Dippe, G. (2006). The missing teacher: contradictions and conflicts in the experience of online learners. In S. Banks, V. Hodgson, C. Jones, B. Kemp, D. McConnell & C. Smith (Eds.), *Proceedings of the Fifth International Conference on Networked Learning 2006*. Lancaster: Lancaster University. Retrieved March 10, 2006, from http://www.networkedlearningconference.org.uk/abstracts/pdfs/P38%20Dippe.PDF

Engeström, Y. (1987). *Learning by expanding: an activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsultit.

Engeström, Y. (2001). Expansive learning at work: toward an activity theoretical reconceptualization. *Journal of Education and Work*, *14*, 1, 133–156.

Fåhræus, E. R. (2004). Distance education students moving towards collaborative learning: a field study of Australian distance education students and systems. *Educational Technology and Society*, *7*, 2, 129–140.

Government of Newfoundland and Labrador (2000). *Supporting learning: report of the Ministerial Panel on Educational Delivery in the Classroom*. Retrieved November 22, 2006, from http://www.edu.gov.nf.ca/panel/panel.pdf

Government of Newfoundland and Labrador (2006). *Education statistics: Elementary – secondary, 2005–2006*. Retrieved November 22, 2006, from http://www.ed.gov.nl.ca/edu/pub/stats05_06/stats05_06.htm

Government of Newfoundland and Labrador (2007). *Department of Education annual report 2005–2006*. Retrieved May 22, 2007, from http://www.ed.gov.nl.ca/edu/pub/ann_rep/doe_ar05-06.pdf

Kuutti, K. (1996). Activity theory as a potential framework for human-computer interaction research. In B. Nardi (Ed.), *Context and consciousness: activity theory and human-computer interaction* (pp. 17–44). Cambridge: The MIT Press. Retrieved November 7, 2006, from http://www.dwr.bth.se/Kari_Kuutti%20Nardi_book.PDF

Miles, M. A. & Huberman, A. M. (1994). *Qualitative data analysis* (5th ed.). Thousand Oaks, CA: Sage Publications.

Mwanza, D. & Engeström, Y. (2005). Managing content in e-learning environments. *British Journal of Educational Technology*, *36*, 3, 453–463.

Nelson, C., & Kim, M. K. (2001). Contradictions, appropriation and transformation: an activity theory approach to L2 writing and classroom practice. *Texas Papers for Foreign Language Education*, *6*, 1, 37–62.

Neuendorf, K. A. (2002). *The content analysis guidebook*. Thousand Oaks, CA: Sage Publications.

Patton, M. (1990). *Qualitative evaluation and research methods* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Voigt, C. & Swatman, P. (2006). Online case discussions: tensions in activity systems. In X. Kinshuk, R. Koper, P. Kommers, P. Kirschner, D. Sampson & W. Didderen, *Sixth IEEE International Conference on Advanced Learning Technologies* (pp. 748–750). Kerkrade: IEEE Computer Society.

Vygotsky, L. (1978). *Mind in society: the development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Yin, R. (2002). *Case study research* (3rd ed.). Thousand Oaks, CA: Sage Publications.