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Towards a systematic understanding of community in online learning

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TOWARDS A SYSTEMATIC UNDERSTANDING OF COMMUNITY IN ONLINE LEARNING

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Dedicated to ZHAO Feng

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Abstract

Distance education has become an integrated part of higher education, and online learning communities (OLCs) show promises to promote learning in distance education. However, many issues regarding OLCs remain unclear in literature: OLC is not well defined, its key elements are not identified, and its relationship with learning has not been fully explored. In order to build a systematic understanding of OLCs for supporting distance learning, this dissertation reviewed the existing literature to develop a conceptual model of OLCs that identified OLC's key elements and the interactions among these elements. After identification of such elements, the study tested this model by developing and validating an instrument to measure community, an OLC element. The validation process of the instrument revealed community to have four factors: student-student interaction, student-instructor interaction, perceived benevolence of others, and relationships. With the instrument, the dissertation then explored the relationships between community and learning in online courses of different interaction patterns, which serves as an early step to understand how communities and OLCs affect learning in different online learning contexts.

Chapter 1 Statement of the Problem

As a form of education, distance education is characterized by the physical separation of student and teacher (Holmberg, 1977). Having its origins in correspondence education from the 19th century (Moore & Kearsley, 2005), distance education has adopted different delivery systems as technology has advanced, with most of today's distance learning now taking place over the Internet. Distance learning has become increasingly prominent in higher education: during the 2006-07 academic year, two-thirds of U.S. higher education institutions offered some form of distance education courses, most of which were online (Parsad & Lewis, 2008). The number of higher education students taking online courses tripled from the 2000-2001 to the 2006-07 academic year (Radford & MPR Associates, 2011). Distance education promises to provide learning opportunities to students who might not attend classes otherwise while also enabling higher education institutions to reduce costs, respond to students' needs, and expand the scope of curricula (Palloff & Pratt, 1999; Power & Gould-Morven, 2011).

However, distance education also faces certain challenges. College faculty have reservations about teaching online courses (Blin & Munro, 2008; Maguire, 2005), partially due to concerns that the quality of online courses might be lower as compared to traditional face-to-face courses (Inman & Kerwin, 1999; Moreland & Saleh, 2007; Noble, 2001). With regard to student experiences, the attrition rate of distance education is consistently higher than traditional education (Carr, 2000; Diaz, 2002). Students' feelings of isolation remain a major problem in online learning (Berge & Huang, 2004; Haythornethwaite, Kazmer, Robins, & Shoemaker, 2000; Kanuka & Jugdev, 2006; Motteram & Forrester, 2005).

Developing and supporting learning communities is crucial to overcoming these concerns about online learning (see, among others, Hiltz, 1994; Palloff & Pratt, 1999; Rovai, 2001; Stepich & Ertmer, 2003; Tu & Corry, 2002a, 2002b). The term "learning communities" refers to

the social context of learning (Vygotsky, 1978). As people are involved with other people in practice, their interactions and relations with those people become a crucial part of their learning (Lave & Wenger, 1991). Learning is situated in the practice, relations and culture with which the individuals are a part (Greeno, 1998) and that learning becomes a community process (Wenger, 1998).

The Promise of OLCs for Distance Education

According to Benbunan-Fich, Hiltz and Harasim (2005), being in a community influences both the cognitive and socio-emotional aspects of learning. Social interactions within a community enable learners to access multiple perspectives and diverse expertise, which provide opportunities for learners to reflect on and extend their own knowledge. In addition, as compared to working alone, learners working in groups tend to experience less anxiety and uncertainty when facing complex or new tasks, which increases motivation and satisfaction in the learning process (Harasim, 1990).

In particular, the research literature suggests that online learning communities (OLCs) can play the following roles in addressing some of the concerns with distance education:

OLCs promote deep and reflective learning through dialogue. Students in OLCs commonly engage in text-based dialogue (Paulus, 2007). Garrison, Anderson and Archor (2000) suggested that the reflective and explicit nature of written communications within an OLC can faciliate thinking about complex issues. To express oneself in writing involves three processes: to connect, analyze, and make sense of information; to determine where to focus the writing efforts to make the learning process personally meaningful; and to carefully reflect on one's own thought through critical dialogue (Kanuka & Garrison, 2004). Interactions with different perspectives provides opportunities for questioning, reasoning, connecting ideas, diagnosing

misconceptions, challenging accepted beliefs, and developing problem-solving techniques, which are essential to deep and meaningful learning (Lipman, 1991). It appears that online discussions in OLCs may promote students' deep learning and critical thinking skills (Stein et al., 2007), and proper instructor support can further faciliate the process (Bai, 2009; Pisutova-Gerber & Malovicova, 2009).

OLCs enable social construction of knowledge. Members of OLCs naturally have different experiences and viewpoints. Dialogue and collaboration enable the differences to be identified and reconciled, through which the community establishes a shared and synthesized understanding that may not be like the understanding of any one individual (Stepich & Ertmer, 2003). In the process, knowledge is co-constructed by the learners through the negotiation of meaning (Gunawardena, Lowe, & Anderson, 1997). Learners engaging in the community process of knowledge construction are able to achieve learning that would not have been achieved by any single individual alone (Bereiter, 2002; Stahl, 2006).

OLCs transform learner identities through enculturaion. Brown, Collins, and Duguid (1989) posited that learning involves use of "a domain's conceptual tools in authentic activities" (p. 34). In other words, to learn is to learn the way expert practitioners engage in their practice. Because OLCs very often include participants with different skill levels, novices have the opportunity to observe the behaviors of more experienced participants and interact with them (Bryant, Forte, & Bruckman, 2005). In the process, the novice members pick up the language of the experienced members, imitate behaviors, and start to act according to the norms --the community's way of doing things (Lave & Wenger, 1991). Learning becomes a matter of engaging in the practice and culture of the community, through which an inexperienced, novice learner transforms into a knowledgeable, central member of the community (Gray, 2004). As

learners adopt the identity of community member, they continue to actively participate in the OLC and contribute to sustaining its culture, which plays a crucial role in the current and future learning of the community (Renninger & Shumar, 2004).

OLCs provide access to diverse expertise, activities and resources. Because learners across time or space can participate in online learning activities together, OLCs can potentially have a much broader member base with a wide range of diverse expertise. As discussed above, when multiple viewpoints interact, it creates more opportunities for learners to reflect on their own views and for the community to construct knowledge. Moreover, less knowledgeable learners can learn from more knowledgeable learners, and the latter can also gain insights into their own understanding working with the former (Brown & Campione, 1990). In addition to providing access to diverse expertise, OLCs also provide access to rich activities and resources (Manouselis, Vuorikari, & Van Assche, 2010). Many activities enable learners to engage in collaborative problem solving and learning *in-situ* (Cuthbert, Clark, & Linn, 2002; Ketelhut, Dede, Clarke, Nelson, & Bowman, 2007). When the OLC offers many choices of activities, learners are able to choose the ones that best suit their learning needs, making their learning personally meaningful (Renninger & Shumar, 2004). Efficiency is improved as tools and resources are shared among community members and those become part of the community heritage (Barron et al., 1995).

OLCs increase motivation, participation and satisfaction. Motivation to engage in online dialogue can be both intrinsic and extrinsic. While intrinsic motivation largely depends on learner characteristics, the social climate of an OLC can influence learners' extrinsic motivation to participate in community activities (Ryle & Cumming, 2007). When positive community dynamics make learners feel like "insiders," their motivation to contribute improves and

participation increases (Oren, Mioduser & Nachmias, 2002). A sense of community within an OLC also decreases students' feelings of isolation and disconnection (Rovai, 2002b; Shea, Li & Pickett, 2006) and increases satisfaction, retention, and learning achievement (Drouin, 2008; Ouzts, 2006; Swan, 2002).

Due to these benefits that OLCs can bring to online learning, they have drawn much research attention (see, for example, Barab, Kling, & Gray, 2004; Garrison, 2011; Haythornthwaite & Andrews, 2011; Preece, 2000). However, it seems the relationship between OLCs and learning has not always been straightforward. Tu and Corry (2003) pointed out that if learners do not see the value of collaborative learning, they will not engage effectively in community activities. In some studies, both online students (Cameron, Morgan, Williams, & Kostelecky, 2009; Liu, Magjuka, Bonk, & Lee, 2007) and online instructors (Conrad, 2004) have reported they do not particularly value OLCs, indicating little desire for a heightened sense of community in their courses (Drouin & Vartanian, 2010). Anderson (2004) pointed out that distance education has traditionally provided a form of independent learning with a freedom from constraints of time and place that appeals to many learners. For these learners, the contradiction between participation in a community and learner independence may cause tension. Indeed, some learners prefer less interactive learning environments to interactive OLCs (Nagel, Blignau, & Cronje, 2009; Zhan, Xu, & Ye, 2011). Furthermore, other researchers have argued that the importance of social interactions and incorporating a community approach to online learning is overrated (Annand, 2011; Rourke & Kanuka, 2009), as some studies find the social aspect of OLCs to have little impact on perceived learning or learner satisfaction (Akyol & Garrison, 2008; Shea & Bidjerano, 2008; Shea et al. 2010).

Clearly, knowing whether community contributes to learning in distance education and how much impact it has are questions of great importance. Before we rush to identify and investigate strategies aimed at creating and supporting community, we must first be certain such practice positively influences learning. In particular, if OLCs contribute to learning differently in different situations, then we should adjust our design priorities accordingly in order to achieve our purpose to enhance learning. However, it seems that even defining the term "OLC" has not been as simple a task as it might appear.

Definitional Problems for OLCs

There have been many definitions of OLC in literature and the approaches to define them are vastly different as well. For example, Kowch and Schwier (1997) defined OLCs as an emergent phenomenon that occurs when people come together to learn; conversely, Riel and Polin (2004) defined OLCs as intentional, a design approach to support learning. Tu and Corry (2002a) defined learning communities as a place for problem-solving activities, emphasizing cognition; Palloff and Pratt (1999) and Rovai (2002a) emphasized emotional attachments as a crucial part of OLCs. Other scholars have sought to be inclusive and incorporate everything into their definitions: For example, Barab, MaKinster and Scheckler (2004) defined an OLC as a "persistent, sustained socio-technical network of individuals who share and develop an overlapping knowledge base, set of beliefs, values, history and experiences focused on a common practice and/or mutual enterprise" (p. 23). Ke and Hoadley (2009) defined OLCs as activity systems (Engeström, 1999) in which learners share a common cause, supportive virtual environment, emotional connectedness and engage in collaborative learning. They argued that their definition illustrated the "multifaceted nature of the OLC by integrating people, space, emotional ties, and incremental online development while still allowing a degree of flexibility

with respect to what characterizes an online learning community" (p. 489). This argument over the very definition highlights the difficulty researchers have faced in defining OLCs.

While the meaning of words "online" and "learning" are relatively clear within the term "online learning community," the meaning of "community" is ambiguous and requires more discussion. Community is a sociology term with its own history and complexity. A long line of literature contributes to defining and identifying characteristics of community (see, for example, Ayers & Counts, 1992; Gusfield, 1975; Lowe, 2000; Shaffer & Anundsen, 1993). According to Williams (1973), when the term "community" entered the English language in the fourteenth century, it referred primarily to a geographically localized group of people. Only later (between the seventeenth and nineteenth centuries) did "community" expand to include groups of people who share common things, such as common interests or identities. In addition, a community is considered to be a more intact and more emotionally connected social unit in contrast to a society (Tönnies, 2001). Moreover, a community is not only an externally defined social structure, but is also internally perceived by its members (Ohl & Cates, 2006). A community gives its members a sense of community, "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together" (McMillan & Chavis, 1986, p. 9).

Thus, it appears the term "community" has at least four possible connotations: a group of co-located people, a group of people with something in common, a group of people with emotional attachments, or simply a social unit of analysis that is smaller than society. These different connotations for community may be contributing to OLCs underlying definitional problems. Because community has multiple meanings, some OLC researchers may combine different meanings without realization or clarification, and readers may interpret community

differently than what is intended. At the very least, a clarification of the term "community" is needed before we can begin to explore the relationships between community and learning from online courses. Additionally, the many definitions that exist in the literature may indicate that an OLC is not one "thing," but rather a system containing multiple interrelated elements. Therefore, to gain a better understanding of OLCs, it becomes important to find out what the elements are and how they interact.

Conceptual Problems for OLCs

Developing a conceptual model of what constitutes an OLC might help to answer definitional questions and represent the structural relationships among the key elements (Garrison, 2000). However, like OLC definitions, multiple OLC models exist as well, each identifying different elements and relationships (Anderson, 2004; Garrison, Anderson & Archer, 2000; Tu & Corry, 2002b; Schwier, 2001, 2011). As a result, the elements of OLCs have not been clearly identified and their interactions not fully explored (Barab, Kling, & Gray, 2004).

According to Garrison (2000), concepts, models and frameworks are essential building blocks of theories. A theoretical framework represents a broad paradigmatic set of assumptions regarding the field of inquiry, and serves as a more fundamental basis to a theory than concepts or models. As a theoretical framework provides a systematic way to think about an issue, it can guide both concept definition and model development. Therefore, it appears that identifying a theoretical framework of OLCs is crucial to building an understanding of OLCs.

A theoretical framework can also guide quantitative research. To investigate the relationship between OLCs and learning, it becomes necessary to measure OLCs, or at least some of their dimensions. Currently, tools to measure OLCs are lacking. After an extensive search of the existing literature, it appears there are only two instruments that measure some

constructs of an OLC, one by Rovai (2002a) and the other by Arbaugh et al. (2008). Both instruments have their weaknesses: Arbaugh et al.'s (2008) *Community of Inquiry Framework Survey Instrument* is based solely on the Community of Inquiry framework (Garrison, Anderson & Archer, 2000) and may not be applicable to other contexts. Rovai's (2002a) *Classroom Community Scale* measures the single indicator of students' perceived sense of community, which may not be sufficient to reflect the multifaceted nature of OLCs. Therefore, it appears there is a need for new instruments to measure OLCs. Once OLCs are operationally defined, the underlying theoretical framework can further guide the development of instrument(s) to measure OLCs.

As part of the theoretical framework, an OLC model will be invaluable for guiding hypothesis generation as well. According to Apostel (1960), a model demonstrates hypothesized interactions among key elements, and at times, offers potential explanations for such interactions. Through hypothesis testing, the study of the relationship between OLCs and learning becomes more informed and systematic. Moreover, it allows the theoretical framework to be empirically verified and thus further completes our understanding of OLCs.

Ultimately, inquiry into OLCs is connected to the goal of supporting learning in distance education. In particular, this dissertation seeks ways to support online learning more systematically and effectively. Many of the current studies on the design and support of OLCs seem have one of two problems. Some studies focus on supporting one aspect of OLCs --for example, Jarvenpaa, Shaw, and Staples (2004) focus on trust, or Slagter van Tryon and Bishop (2009) focus on social connectedness. While it is safe to assume that trust and social connectedness contribute to the development of community, without specifying how these aspects fit into the larger system of OLCs, it remains unclear to what degree they have played

significant roles in the support of learning. The second problem arises when studies suggest strategies intended to support OLCs under all circumstances (Snyder, 2009; Tu & Corry, 2002a; Wilson, Ludwig-Hardman, Thornam & Dunlap, 2004). By suggesting that general strategies will universally support OLCs, these studies make the unverified assumption that OLCs always have a positive influence on learning. These studies overlook the fact that the practice of supporting OLCs in all circumstances may not be effective if the assumption proves to be false. An OLC model, however, would guide the exploration of how OLCs impact learning under different contexts and serve to guide design practice regarding how OLCs should be treated and supported in online learning.

Purpose

In order to support online learning more systematically and effectively, this dissertation seeks to explore the theoretical foundations of OLCs and their interaction with learning. It develops an instrument to measure key element of OLCs, which enables the examination of the relationships between OLCs and learning under different contexts. To achieve these purposes, I took the following steps:

In Chapter 2, I explore the theoretical foundations of OLCs to identify a theoretical framework to support our understanding of OLCs. From that framework, I derive an OLC model that represents its key components and the relationships among those components. With the model derived, I am then able to define "OLC" more precisely and identify some of its key components for further study.

Chapter 3 describes the process I used to develop an instrument based on the model derived in Chapter 2 to measure the dimensions of OLCs and explore how those dimensions are related to learning. In addition, I describe the procedures I used to determine the reliability and

validity of the OLC measurement instrument, and the procedures to explore quantitative relationships between OLC and learning.

In Chapter 4, I report my findings from the data gathered using the process described in Chapter 3. I discuss the data analysis process to finalize the instrument, the validation process of the instrument, and the exploration of the possible quantitative relationships between OLC and student learning.

Chapter 5 discusses implications of the findings presented in Chapter 4. It then summarizes the dissertation's key findings, discusses the study's limitations, and draws implications for future research.

Chapter 2: Review of Literature

Chapter 1 discussed the lack of a single definition for OLCs. Part of the reason may be that the body of literature regarding OLCs is scattered among a number of diverse lines of inquiry, in which definitions of shared terms like "community" are often conflicting and vague. Therefore, the first half of this chapter reviews that literature crucial to the definition of OLCs, specifically focusing on clarifying confusions involved in the definition process in order to build a common ground for further discussion and investigation. The second half of the chapter aims to synthesize previous OLC models and theories in order to establish a unified theoretical foundation to guide further OLC research. This chapter concludes by establishing a conceptual model and a definition of OLCs, which will enable interactions among OLC elements and learning to be further explored.

Theoretical Foundations of OLCs

Two lines of inquiry in the literature, *learning communities* and *virtual communities*, have intertwined to influence how "community" is defined and interpreted in the context of OLCs. Those two bodies of literature are briefly reviewed below.

Learning communities. Regardless of how OLC is defined, the term itself suggests there is a relationship between learning and community. However, the existence of such relationship is not always self-evident. At one time, learning was viewed as a function of individual minds; only later did theorists become concerned with the impact on learning of social interactions within a community (Resnick, 1987). Vygotsky (1978) demonstrated how learning develops in social interactions, using examples mainly of children and their caregivers. Obviously, the social environment of learning is not limited to such one-on-one interactions. Situated learning theory, as an extension of the Vygotskian school, stresses that learning cannot be separated from doing (Brown, Collins, & Duguid, 1989). Whether in school or later in one's

profession, people do not do things in isolation. As they are involved with other people in practice, their interactions and relations with other people become a crucial part of their learning (Lave & Wenger, 1991). Learning is no longer considered to be solely within individuals, but is rather situated in the practice, relations and culture of which the individuals are a part (Greeno, 1998). Particularly, Wenger (1998) stressed that learning is a community process and should only be understood in relation to its community.

According to Wenger (1998), learning occurs in "communities of practice." The term Community of Practice (CoP) has been defined as groups of people sharing common interests or concerns by interacting with each other in ways that deepen their related knowledge or expertise (Barab & Duffy, 2000; Wenger, 1998). In CoPs, members engage in practice at different levels with different approaches, and eventually each develops a unique identity through interactions with one another (Bryant, Forte, & Bruckman, 2005; Lave & Wenger, 1991). Through this mutual engagement, members share experiences and make sense of those experiences in pursuit of shared purposes (Wenger, 1998). In addition, a CoP has a set of shared resources, including tools, procedures, routines, and languages. The resources are developed over time, and stay flexible to respond to new situations that the community faces (Viégas, Wattenberg, & McKeon, 2007).

Wenger's CoP framework is among the earliest and most influential theories to explore the relationship between learning and community. However, it is worth noting that he did not use the phrase "learning community." As the name indicates, Wenger's focus is more on practice than learning. The theory is also applied more often applied to research on workspace interactions than formal education (see, for example, Brown & Duguid, 1991; Kimble, Hildreth, & Wright, 2000; Schwen & Hara, 2004; see Kimble, Hildreth, & Bourdon, 2008 for an

exception). Because school students participate in learning for only a limited period of time and their participation is mandatory, Riel and Polin (2004) argued that classrooms are different from CoPs where participation is over a prolonged period of time and voluntary (see also Wilson, Ludwig-Hardman, Thornam, & Dunlap, 2004). It appears that research on educational settings calls for theories beyond CoP.

At approximately the same time when CoP theory gained in popularity, researchers had also incorporated the idea of communities in classrooms. Community of learners (Brown & Campione, 1990) and knowledge-building communities (Scardamalia & Bereiter, 1994) were among the earliest ideas explored. Brown and Campione (1990) described classroom communities of learners that are based on reciprocal teaching and collaborative learning. In small learning groups, each student takes turns to be the content expert of part of the curriculum and teaches the content to other students in the group. The student expert is responsible for leading group discussions by asking questions at the start and by summarizing what has been learned in the end. Students engage in dialogues that clarify misunderstandings and promote comprehension. The learning process takes advantage of a cognitive apprenticeship approach, as novices can learn from the contributions of more experienced learners (Rogoff, 1990). The groups are jointly responsible for their understanding and construction of meaning. As a result, the collaborative learning process promotes the development of a community of learners acquiring and sharing a common knowledge base.

Another important line of research on classroom learning communities was conducted by Scardamalia, Bereiter and colleagues (Scardamalia & Bereiter, 1994; Scardamalia, Bereiter, Brett, Burtis, Calhoun, & Smith, 1992). They argued classrooms and schools needed to become knowledge-building communities that create (rather than reproduce) knowledge. In knowledge-

building communities, students work on problems of interest and collectively build databases of information about the problem. Students are encouraged to pose hypotheses, draw connections, suggest solutions, and generate new ideas. As all students work to add information and ideas to the database, it creates a decentralized, open knowledge environment for collective understanding. The database is the product of all knowledge-building activities, and serves to represent cumulative, collective knowledge that can be shared with other knowledge communities. Scardamalia and Bereiter (2006) distinguished knowledge building and learning explicitly. They argued that while learning occurs as part of knowledge building, learning itself is not the sole goal of the knowledge-building activities. Discarding "learning" in favor of "knowledge building," Scardamalia and Bereiter actually rejected the idea of learning as a mental activity. Instead, they adopted the term "knowledge building" to refer to learning as practice. In this sense, we can say that a knowledge-building community is a specific form of CoP whose practice is knowledge building (Hoadley & Kilner, 2005).

Here again, neither Brown and Campione (1990) nor Scardamalia and Bereiter (1994) used the term "learning community." But it does appear that the research on CoP, community of learners and knowledge building community are among the first to specifically explore how learning is developed and shared in groups of interacting people. Nonetheless, these lines of inquiry, at least in their early stages, focused only on "face-to-face" communities. To understand learning communities mediated by online technologies, we must also explore how the Internet has changed our perspectives on "community."

Virtual communities. As mentioned earlier, when the term "community" first entered the English vocabulary, it referred to a geographically localized group of people (Williams, 1973). Perhaps due to the historic use of the term, an implied sense of "common place" always

lingers when we talk about communities, and one of the earliest issues regarding virtual communities is whether community can be formed by geographically separated people at all (Wellman & Gulia, 1999).

Virtual communities are made possible by two major phenomena. First, although a virtual community is not bounded to a physical place, it exists in "cyberspace" (Rheingold, 1993). Cyberspace is the space in which technology-mediated communications occurs (most often via a networked computer). Cyberspace resembles a physical space in that it allows for interactions, relationships and identities (Slater, 2002). Second, as technology has enabled communications and access to information regardless of location (McLuhan, 1964; Meyrowitz, 1985), the development of personal relationships at a distance becomes possible (Fernback & Thompson, 1995). Rheingold (1993) argued that virtual communities emerge from the Internet "when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace" (p. 5). A sense of community as well as emotional ties among participants are central to Rheingold's definition of virtual communities. Wellman and Gulia (1999) also found virtual communities are able to provide emotional support, companionship, a sense of belonging, and strong, intimate personal relationships in ways similar to "real" face-to-face communities. In short, it appears virtual communities share the sense of "placeness" and personal relationships similar to "real" communities.

Lee, Vogel and Limayem (2003) reviewed definitions of virtual communities and found they share the following four elements. First, virtual communities exist in computer-mediated spaces, or cyberspace. Second, activities within virtual communities are supported by technology. Third, communication and interactions are the main focus of virtual communities, and the content of the interactions are driven by the participants. Fourth, participants develop

relationships after a period of sustained communication. The last two characteristics are worthy of special attention when comparing virtual communities to learning communities. It appears that both interactions and relationships play a more important role in virtual communities than in learning communities. While personal relationships may develop in learning communities, they are not part of the formal purpose of those groups. Similarly, while communications and interactions occur in learning communities, they are more likely to be considered as facilitating learning (Palloff & Pratt, 1999), rather than the focus of learning.

Hagel and Armstrong (1997) classified virtual communities by the type of participants' needs they meet. Virtual communities may meet four needs: interest, relationship, transaction and fantasy. Interest communities attract people sharing an interest or expertise in a specific topic. Relationship communities enable people to form meaningful relationships and seek social support. Transaction communities allow participants to trade information. Fantasy communities engage fantasies and provide entertainment. Kozinets (2002) also classified virtual communities, presenting only two categories: information exchange or social interaction. Once again, in most types of virtual communities (with the possible exception of fantasy communities), interactions among participants are central to the community.

Ellis, Oldridge and Vanconcelos (2005) noted similarities between virtual communities and CoPs. Both harbor differentiated behaviors and participation (Burnett, 2000), support the development of identities, and are based on reciprocity of communications (Teigland, 2000). And, because CoPs are defined by shared practice rather than geographic closeness, there is compatibility between the CoP and virtual community definitions. Similar to virtual communities, therefore, CoPs can also be distributed across different locations (Daniel, Schwier & McCalla, 2003; Kimble, Hildreth & Wright, 2000; Wenger, McDermott, & Snyder, 2002).

The research on virtual communities as well as the research on learning communities has contributed much to the theoretical foundations of OLC research. However, it appears an OLC may be greater than the simple "sum" of learning community and virtual community "parts." In OLCs, the elements of people, learning and technology engage in complex interactions, which call for further exploration.

Existing OLC Models

OLCs are complex systems with multiple elements and interactions (Ludwig-Hardman, 2003). Theoretical models contribute to our understanding of OLCs by illustrating such elements and interactions. In this section I will review four different OLC models in the literature: the Garrison, Anderson, and Archer Community of Inquiry Model, the Tu and Corry Model, the Schwier Model, and the Ludwig-Harman Model. These do not represent all of the OLC models available in the literature (see Anderson, 2004; Benbunan-Fich, Hiltz, & Harasim, 2005; Haythornthwaite & Andrews, 2011; Hoadley & Kliner, 2005; Palloff & Pratt, 1999 for more examples). I have chosen these four because, unlike other models proposed, these attempt to identify what constitutes an OLC and will therefore usefully contribute to a new, integrated model that might serve as the basis for more precisely defining OLCs.

Community of Inquiry. Garrison, Anderson, and Archer (2000) defined an educational Community of Inquiry (CoI) as a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct personal meaning and confirm mutual understanding. The CoI model suggests that a deep and meaningful learning experience is shaped through three interdependent elements –social presence, cognitive presence and teaching presence. Social presence refers to the ability of participants to communicate purposefully in a learning environment, to develop inter-personal relationships, and to identify with the community

(Garrison, 2009). Cognitive presence refers to learners' ability to construct meaning through reflection and discourse (Garrison, Anderson, & Archer, 2001). Teaching presence is the design, facilitation, and direction of cognitive and social processes for purposeful learning (Anderson, Rourke, Garrison, & Archer, 2001). As illustrated by Figure 1, the CoI model assumes that learning occurs within the community through the interaction of three core elements. Teaching presence supports cognitive presence by selecting course content as part of course design, and enhances social presence by setting the overall climate of the course interactions. In addition, cognitive presence is better sustained when social presence, in the form of socio-emotional interactions, is established. Educational experience is enriched when the three elements are aligned.

Figure 1. The Community of Inquiry model (Garrison, Anderson & Archer, 2000).

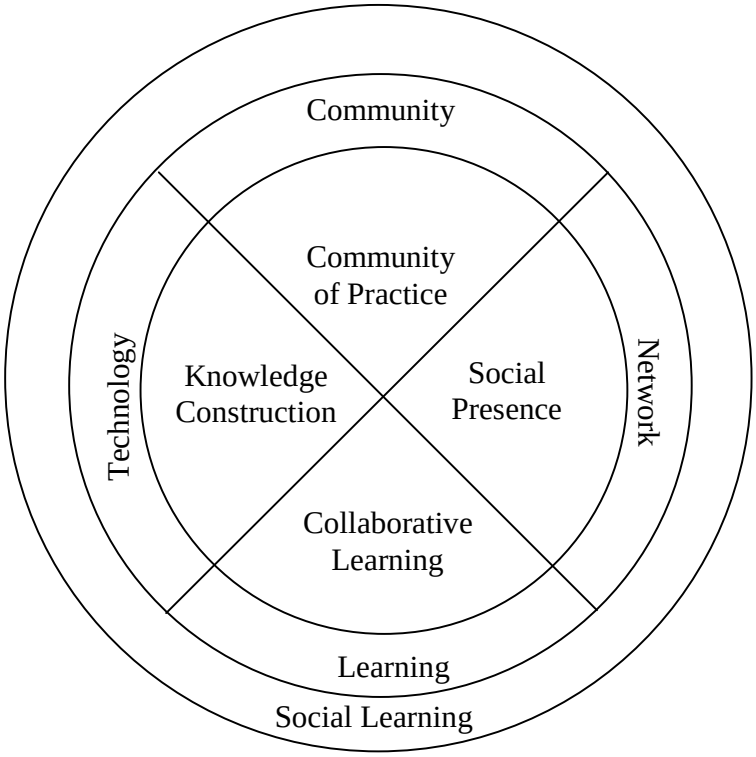
The CoI model is probably the most established OLC model, with approximately 1,500 citations by 2011. It has several strengths. First, the elements of CoI are better defined than some

of the elements of other OLC models. Other models incorporate elements such as trust, diversity or autonomy, which require operational definitions themselves. Second, an instrument by Arbaugh et al. (2008) is available to measure social, cognitive and teaching presence, making quantitative studies possible. Last but not least, CoI is one of the few models that emphasizes the importance of the teacher's role in an OLC. Ke (2010) concluded that because teaching presence is central to students' learning experience, the role of teacher should not be overlooked in OLC models.

However, the CoI model also has limitations. The model was developed in studies of text-based asynchronous learning, and may not easily be applied to other online learning environments. Xin (2012) pointed out that cognitive, social and instructional aspects of learning almost always take place simultaneously in real communication, whereas the CoI model draws absolute distinctions among the three. In addition, Xin examined indicators of social presence proposed by Garrison, Anderson and Archer (2000) and argued that the indicators mixed actions (such as "affective expressions") with outcomes of the actions (such as "group cohesion"). Rourke and Kanuka (2009) also criticized the CoI model for confusing explanation with design, and outcomes with process (see also Akyol et al., 2009).

Tu and Corry Model. Tu and Corry's (2002b) model started by examining four elements of OLCs as proposed by the Office of Learning Technologies (1998): community, network, learning and technology. The authors then drew connections among the four elements and Vygotsky's (1978) social learning theory to generate their own model of OLCs as illustrated in Figure 2. The model shows the four elements of an OLC to be community, network, learning and technology (the middle circle). Particularly, the community should be understood as Wenger's (1998) *CoP*; the learning that takes place in such OLCs is *collaborative learning*;

technology used in OLCs enables *knowledge-construction*, and *social presence* connects networks of people (italics show the elements of the inner circle). The OLC model is based upon social learning theory (outer circle).



Online Learning Community

Figure 2. The Tu & Corry (2002b) OLC model.

The Tu and Corry (2002b) model's strengths lie in its alignment with social learning principles. Shared practice, collaboration, social context, and knowledge construction are important elements of the model. It learns from and incorporates results of the most important OLC research at the time, including Wenger's (1998) CoP, Scardamalia and Bereiter's (1994) Knowledge Building Community and Garrison, Anderson and Archer's (2000) CoI. It is also relatively simple with few elements. Its weaknesses are similar to the next two models: its elements, such as "knowledge construction" and "collaborative learning," require further definition and are not easily measurable.

Schwier Model. Schwier (2011) identified 11 elements of an OLC. The model started with seven important elements of community as identified by Selznick (1996): historicity, identity, mutuality, plurality, autonomy, participation, and integration. In addition, he added four elements that are particularly relevant to OLCs: an orientation to the future, social capital, technology, and learning. In his model, historicity refers to the community's history and culture. Identity refers to participants' identification with the community. Mutuality refers to interdependence and reciprocity of interactions. Plurality refers to community's multiple connections with other communities. Autonomy refers to individuals' capacity and freedom to participate or withdraw from participation without penalty. Participation refers to social participation of the community. Future orientation is related to the community's goal and future direction. Social capital refers to the value of social networks within the community. Technology plays a role to facilitate or inhibit the growth of community. Learning serves as the purpose of the OLC. In the end, all of the elements are integrated in shared norms, beliefs and practices.

It appears that Schwier's model is more of a system model, while the other models discussed are primarily learning models. Schwier (2001, 2011) started his conceptual work

considering what elements exist when learning occurs, rather than what conditions make learning happen. This decision is consistent with his viewpoint that learning is emergent (Kowch & Schwier, 1997), not transmitted. Schwier's systems perspective constitutes both the model's strength and weakness. The strength is that Schwier's model is more neutral in terms of learning theory and does not assume that learning should take place in a predefined way, like Tu and Corry's model does. However, this neutrality is also a weakness; by being less prescriptive than others, the model gives less direction about how OLCs can be designed or supported.

Ludwig-Hardman Model. Ludwig-Hardman (2003) reviewed the learning community literature and summarized eight elements of learning communities: a) shared goals, b) safe and supporting conditions, c) collective identity, d) collaboration, e) progressive discourse, f) focus on knowledge-building, g) diversity and h) mutual appropriation. The two elements that were unique in Ludwig-Hardman's model as compared to the others discussed were progressive discourse and mutual appropriation. Bereiter (1994) used the term *progressive discourse* to describe the knowledge-building process of sharing, questioning and revising ideas to generate collective understanding. *Mutual appropriation* builds upon the reciprocal nature of learning, and involves diverse learners providing ideas and knowledge that are appropriated by different learner's expertise, needs and context (Brown & Compione, 1994).

Based on the eight elements, Ludwig-Hardman (2003) built her OLC model as illustrated in Figure 3. Knowledge building is the focus of the OLC and lies at the center. Knowledge building is supported by, which are further supported by safe and supportive conditions and shared goals. The boundary of OLC is defined by collective identity. The author did not explain the relationships among mutual appropriation, diversity, progressive discourse and collaboration.

It appears, through the two-way arrows indicated, that the four elements account for each other, while the one-way arrows indicate that knowledge building is accounted for by the four elements.

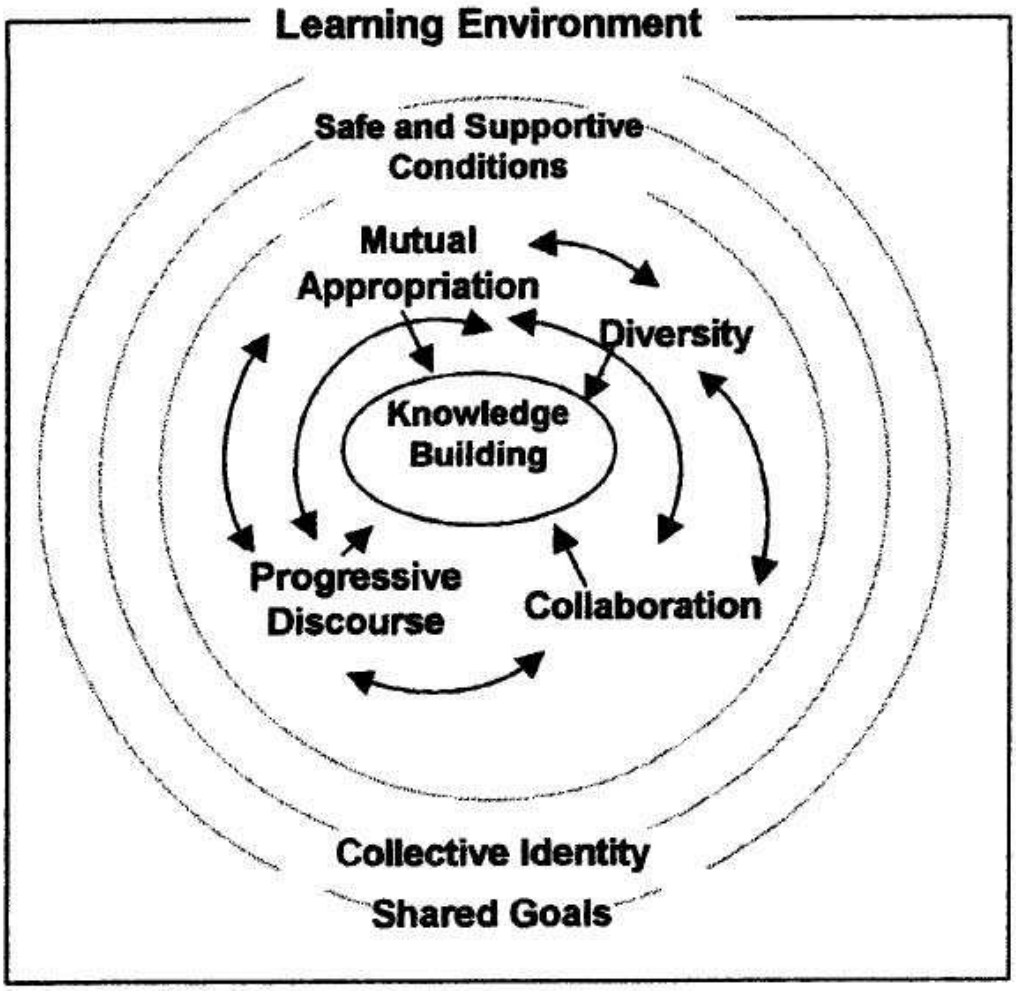


Figure 3. A conceptual model of OLC by Ludwig-Hardman (2003).

The strength of the Ludwig-Hardman (2003) model is its eclecticism. Unlike Schwier's (2011) model, which was primarily derived from one resource, Ludwig-Hardman's model has synthesized multiple sources from the learning community literature. Wilson, Ludwig-Hardman, Thornam and Dunlap (2004) further suggested the elements identified by Ludwig-Hardman serve as features that facilitate the development of an OLC in formal courses. In particular, they defined OLCs in formal courses as bounded learning communities constrained by required

participation and fixed time restraints. The proposed term “bounded learning community” is quite valuable as it captured the restricted nature of OLC in online courses, which had not been brought up by previous researchers.

The four OLC models have overlapping elements, as shown in Table 1. All models share an element of learning, with some models specifying the form of learning as collaborative, knowledge construction/building, or progressive discourse. All models indicate there is a relationship between individual members and the community at large, in which the individuals identify with the community and develop relationships with other members (social presence), and the community provides safe and supporting conditions to its members. Three of the four models include elements associated with interactions and participation. In these models, learning is established through reciprocal interactions and shared participation or collaboration in common practice. Both Schwier’s model and Ludwig-Hardman’s model suggest an OLC has diverse members and shared purposes. In addition, both the CoI and Schwier’s models have unique elements of their own.

Table 1 synthesizes the OLC elements suggested by existing models; however, it does not explain how the elements interact within an OLC. An analytical tool that further reveals the underlying connections among the elements might help describe these relationships. As a theoretical framework, activity theory may hold some promise for this purpose in that it is able to capture the dynamic, collective nature of learning, while also further consolidating the OLC elements identified in this section. The next section introduces activity theory and then demonstrates how it might be used as the foundation of a synthesized OLC model.

Table 1. Overlapping OLC elements from existing OLC models.

	CoI	Tu & Corry	Schwier	Ludwig-Hardman
Learning	Cognitive presence	Collaborative learning; knowledge construction	Learning	Progressive discourse; focus on knowledge-building
Community	Social presence	Social presence	Identity;	Collective identity; safe and supporting conditions
Interaction		CoP	Mutuality	Mutual appropriation
Participation		Collaborative learning	Participation	Collaboration
Members	-	-	Plurality	Diversity
Goals and purposes	-	-	Future orientation	Shared goals
Other	Teacher presence	-	Integration; social capital; technology	-

Activity Theory as a Unifying Framework for OLCs

Activity theory (AT) is a meta-theory aimed at explaining complex, socially situated human activities (Engeström, 1999). It looks beyond a single person or action and takes into account the social, cultural, and historical context of the surrounding people, the environment, and the mediating tools in order to understand the complexity of real-life activities. The unit of analysis in AT is an activity system, which consists of multiple elements and their interactions within an activity.

AT originates from Vygotsky's model of human development and cognition (Figure 4). In this model, Vygotsky (1978) proposed that the interactions between human (subject) and environment (object) are mediated by cultural tools. AT furthers Vygotsky's model by emphasizing that human activities are collective (Cole, 1996). Therefore, in the AT model

community (multiple people) is introduced as another element of activity. Within a community, individual behaviors are regulated by rules (both explicit and inexplicit). People participate in collective activity taking different roles, which is referred to as division of labor. Figure 5 illustrates the model of an activity system, as proposed by Engeström (1987). Russell (2001) explained how learning in an online course can be understood within the framework of activity theory, as described below.

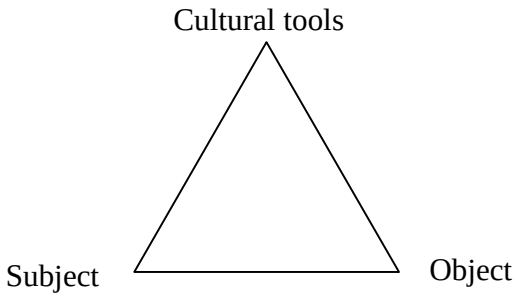


Figure 4. Vygotsky's mediational model (Adapted from Russell, 2001)

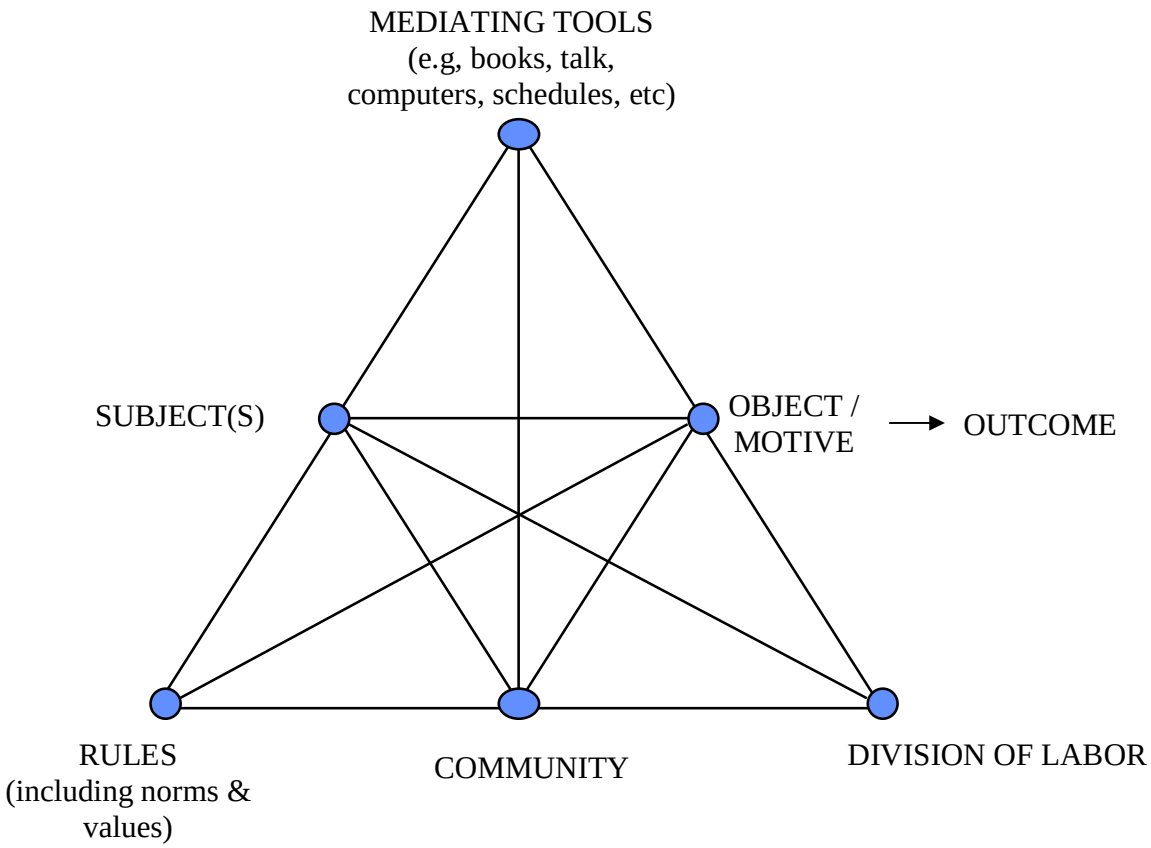


Figure 5. An activity system (Russell, 2001)

Viewing online courses from an activity theory perspective. According to Russell (2001), in the activity system of the online course, the subjects (middle left side of Figure 5) are the individuals engaging in the activity of learning – in this case the students and the teachers. Each of the participants brings a different history into the activity system, and one must understand their diverse history and backgrounds in order to understand their involvement in the current activity. The object of the activity system (middle right side of Figure 5) is learning about the online course content. Kaptelinin (2005) pointed out that subject(s) can have multiple, even conflicting motives, and the object results from the interactions of those diverse motives. In this way, students often come into the online course with different motives to learn (which again are

related to different personal histories), and both the instructor and the students need to establish a shared understanding of the object in order for the desired learning to take place.

In the activity of learning, people use the physical mediating tools of pens, books, and computers, as well as the Vygotskian cultural artifacts: language, symbols and ways of doing things (top of Figure 5). Each tool has its own history: for example, in order to understand how computers impact the online learning activity as a mediating tool, it is necessary to understand how computers have been historically used by education, by the organization, and by the people involved. Moreover, mediating tools can change the way activities are carried out, while people themselves are also changed in the process (Viégas, Wattenberg, & McKeon, 2007). As people spend time working together, they find ways to adapt mediating tools to new situations and develop new procedures and rules.

The subjects do not act in isolation; they form (or are part of) a larger community (bottom center of Figure 5). Russell (2001) posited that people acting together on a common object with a common motive will, over time, form a community, even if they are separated by space. In this regard, the definition is quite similar to the definition of a CoP (Wenger, 1998). However, it might be an oversimplification to say the community of the online course is the students and the instructor(s), since we already know from earlier discussions that the concept of "community" has complex implications. I will discuss the issue of community in activity theory in detail later.

The interaction between community and object is mediated by a division of labor (bottom right corner of Figure 5). People act on the same object by taking different roles and carrying out different tasks. In the classroom, the labor is traditionally divided between the teacher (the role of teaching) and students (the role of learning). However, the division of labor can shift when other nodes within the activity system bring new changes. For example, the use of technology

can often bring change to the role of teacher and students, as computer-mediated communications afford more peer-to-peer interaction and call for more teacher facilitation (Berge, 2007; Easton, 2003; Williams, Morgan, & Cameron, 2011).

The interaction between community and subject is mediated by rules (bottom left corner of Figure 5). Rules can be explicit; but according to Wenger (1998), the tacit rules --values, norms, routines and procedures-- are often more important to a community than explicit rules. Especially in online learning, establishing norms can be crucial to the success of group communication (Slagter van Tryon & Bishop, 2009). In an activity system, rules serve to regulate individuals' behaviors, but they are also subject to change in response to changing situations.

Finally, an activity system has an outcome (right side of Figure 5). In an online course, the outcome is learning. Here learning is viewed as expanded involvement, improved practice, or renewed (collective) consciousness regarding the course content --rather than the internalization of discrete information or skills (Brown, Collins & Duguid, 1989). The learning outcome is driven by the contradictions and interactions within the elements of the activity system.

Cole (1996) identified several key strengths of activity theory. First, although the framework focuses on activity, or doing, it does not overlook the elements of mind and consciousness --one critical issue in psychology, learning theory, and philosophy. Activity theory explains human consciousness as something that emerges from people's joint activity with shared tools. Because people engage in joint activity together, one's thoughts are always engaged with the thoughts of others. In this way, minds can be seen as distributed within activity system rather than isolated and internal (Hutchins, 1995). As activities are mediated by cultural tools,

the subjects and their minds are always situated in the history and culture of a community. Mind and culture are thereby entwined and inseparable.

Activity theory emphasizes tool mediation, development and change, and everyday life events. This makes AT an especially valuable framework for understanding learning, and particularly learning with technology (Jonassen, 1999; Oncu & Cakir, 2011; Roth & Lee, 2007; van Oers, 2008). The focus on tool mediation prompts us to avoid treating technology as an isolated element, and instead encourages us to explore the interactions between technology and other elements within the activity system. These interactions can take place over a wide range of scales: activity system can encompass historical change, individual development and moment-to-moment change (Cole, 1996). Accordingly, we can examine learning at both the collective and the individual level, and both the large picture and temporal changes. As learning is situated in everyday life (Brown, Collins, & Duguid, 1989), AT is especially powerful in analyzing learning as the situated activity of people interacting with each other using tools over time.

In addition to these fundamental strengths of activity theory for exploring online learning, it may also help synthesize earlier OLC models and their disparate elements. The next section explores how AT might serve as a unifying framework for thinking about OLCs.

Consolidating OLC models within an activity theory perspective. Earlier I reviewed four important OLC models: the Community of Inquiry Model (Garrison, Anderson & Ancher, 2000), the Tu and Corry Model (2002b), the Schwier Model (2011), and the Ludwig-Hardman Model (2003). When working to consolidate similar elements in the four OLC models, it appears all elements present in the four models can be mapped to some elements in AT. Stated differently, it seems AT may be able to integrate the four different OLC models. Table 2 illustrates how elements in the various OLC models correspond with AT elements.

Table 2. Mapping OLC elements to AT elements.

AT	CoI	Tu & Corry	Schwier	Ludwig-Hardman
Activity (Learning)	Cognitive presence	Collaborative learning; knowledge construction	Learning	Progressive discourse; focus on knowledge-building
Subject	-	-	Plurality	Diversity
Object	-	-	Future orientation	Shared goals
Tools	-	(CoP)	Technology	-
Community	Social presence	CoP Social presence	Mutuality	Mutual appropriation
Community - subject	Social presence	Social presence	Identity;	Collective identity; safe and supporting conditions
Community - subject -object	-	-	Social capital	-
Division of Labor	Teacher presence	Collaborative learning	Participation	Collaboration;
Activity system	-	-	Integration	-

Activity. In OLCs, the activity is learning. Schwier includes *learning* as an element in his model. The Tu and Corry model includes *collaborative learning* and *knowledge construction*, the Ludwig-Hardman model includes *progressive discourse* and *knowledge-building*, all are specified formats of learning. The CoI model is less specific --its definition of *cognitive presence* is closer to learning ability, rather than learning. However, Arbaugh et al. (2008) did measure perceived learning and learning motivation in their instrument to measure cognitive presence. In addition, Garrison, Anderson and Archer (2000) coded students' postings in threaded discussions by different stages of inquiry (recognizing the problem, demonstrating divergence, connecting ideas, testing solutions, and the like) in order to measure cognitive presence. It seems the CoI model's *cognitive presence* belongs to the category of learning.

Subject. The Schwier Model has *plurality* and the Ludwig-Hardman Model has *diversity*. Both emphasize that the diversity of historic and cultural backgrounds of learners has an influence on learning.

Object. In OLCs, the object is the learning objective, or learning goal. Ludwig-Hardman was specific to include *shared goals* in her model. Schwier mentioned *future orientation*, a direction towards which the OLC moves, which is closely related to the idea of object. The Tu and Corry model incorporates the element of CoP, which also includes a shared goal.

Tools. The Schwier model is the only one that distinctly includes *technology* as an element. The Tu and Corry model incorporates the idea of CoP, which includes a shared repertoire, but the role of tools is only implied. This omission of technology actually reflects an important difference in how researchers treat OLCs: Is an OLC an activity system, or just an element (the people) within an activity system? This is a key issue in defining OLCs, as I will discuss later.

Division of Labor. Division of labor refers to different roles within the OLC. The CoI model stresses *teacher presence*, which is an important component of division of labor. The Tu and Corry model and Ludwig-Hardman model contains *collaboration* (or *collaborative learning*), the Schwier model contains *participation*, all describing how they believe labor should be divided within the community.

Rules. Both CoI's *social presence* and *teaching presence* are related to rules. Norms are inexplicit rules about what behaviors are expected, and social presence is linked with norm development in online learning (Slagter van Tryon & Bishop, 2009). In teaching presence, the teacher sets rules about how the learning process is to be carried out. Schwier's *historicity* refers

to group history and culture, of which rules are a subset. Tu and Corry's *CoP* also contains aspects of rules.

Community. Clearly, the Tu and Corry model's *CoP* belongs here. Schwier's *mutuality* and Ludwig-Hardman's *mutual appropriation* have the common theme of reciprocity and interaction, which are only possible within a community.

Subject-community. One common element across the OLC models is identity (*social presence* includes one's ability to identify with the community, see Garrison, 2009). Polletta and Jasper (2001) defined identity as an individual's cognitive, moral, and emotional connections with a community. Therefore, identity is related to the interaction between individual and the community and the personal perceptions of such interactions. The Ludwig-Hardman model's *safe and supporting conditions* is also one component of the individual (subject) --community interaction.

Subject-community-object. Social capital is an element in Schwier's model. Definition of social capital varies, but most have three ideas in common: that social capital arises in social networks (Putnam, 2000), that social capital brings value to individuals (Lin, 2001), and that social capital facilitates actions or influences the potential to act (Bourdieu, 1996). Therefore, social capital reflects the interactions among subject-community-object: Being socially situated within the community and its social network, subjects' actions on the object are (potentially) changed.

Activity System. The Schwier model's *integration* refers to integration of all other elements in his model. It represents the complex interactions of different elements in an activity system.

Corresponding elements of AT and OLC models are listed in Table 2. As can be seen, all the elements of different OLC models can find their place within the AT framework. If anything that has been identified as an OLC element corresponds to some element or relationship within an activity system, it becomes logical to conceive of an OLC as an activity system. For an OLC model with n elements, we have:

$$OLC = \{A_1, A_2, \ldots A_n\}$$

in which A_x represents an element of the OLC. Because we started our analysis with four models, we have:

$$OLC = \{A_1, A_2, \ldots A_n\}=\{B_1, B_2, \ldots B_m\}=\{C_1, C_2, \ldots C_p\}=\{D_1, D_2, \ldots D_k\}$$

There is also the model of activity system, in which E_1-E_6 are the six elements (nodes in Figure 6) and R_1-R_i represents relationships among E_1-E_6:

$$Activity\ System = \{E_1, E_2, \ldots E_6, R_1, R_2, \ldots R_i\}$$

Since all OLC elements (A_x, B_x, C_x, D_x) correspond with some element or relationship within an activity system (E_y or R_y), but some relationships within an activity system (for example, the subject-technology relationship) are not presented in the OLC models, we have:

$$\{A_1, A_2, \ldots A_n, B_1, B_2, \ldots B_m, C_1, C_2, \ldots C_p, D_1, D_2, \ldots D_k\} \in \{E_1, E_2, \ldots E_6, R_1, R_2, \ldots R_i\}$$

Therefore,

$$OLC \subset Activity\ System$$

In conclusion, the concept of OLC is a subset of the concept of activity system. Or in plain language, an OLC is one kind of activity system. Therefore, it appears that AT can serve as an appropriate framework to analyze OLCs for purposes of this dissertation. The next section explores a preliminary conceptual model of OLC that is based on AT with the addition of the synthesized elements from the four significant OLC models discussed earlier. From this

conceptual model it appears we may also find some additional clarity around the meaning of "community."

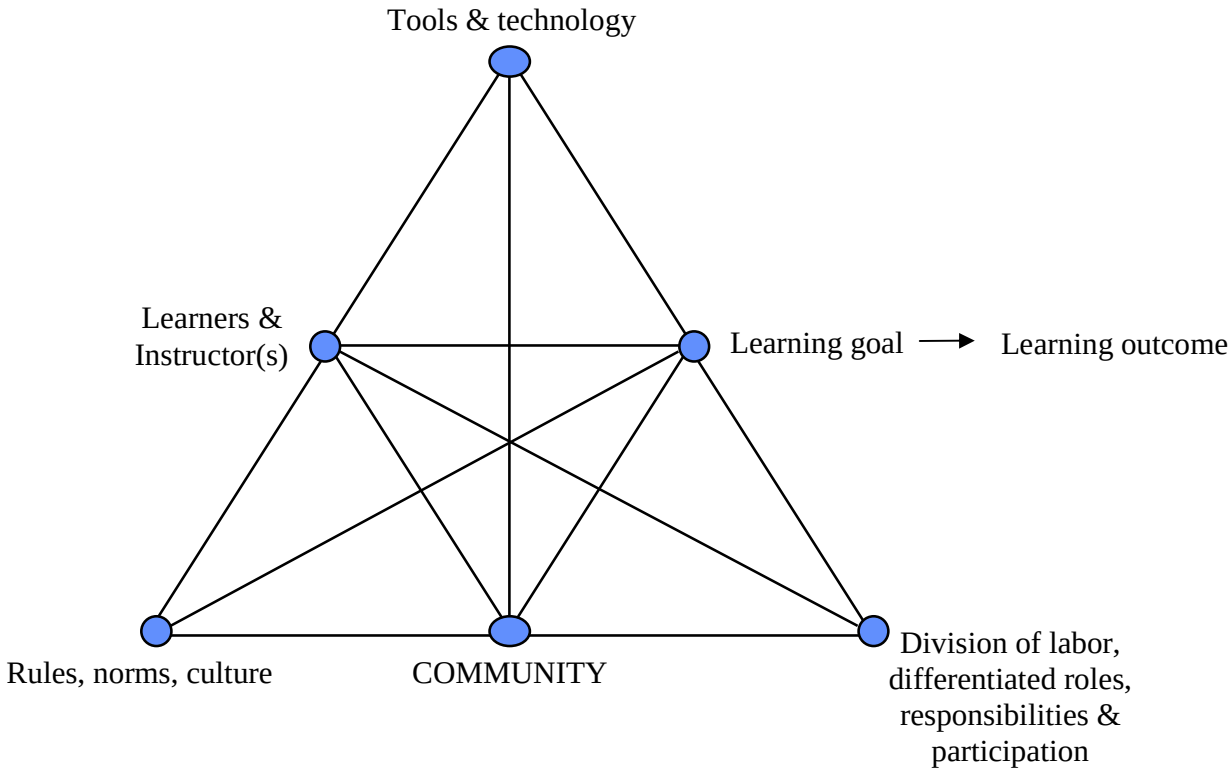


Figure 6. An OLC model based on activity theory.

Figure 6 illustrates my proposed conceptual model for OLCs based on discussion above. In the activity system of an OLC, the subjects are the students and instructor(s) engaging in the learning activity. The tools include technologies that afford and restrain online interactions, but also include other tools shared by the subjects. There is the object of shared learning goals; but "shared" does not necessarily mean that each individual goal is the same. Rather, the shared goal emerges from diverse individual learning needs and motives. Then there is the community, which is sometimes conveniently defined as "the people," but most possibly contains other things that we have not yet fully discussed. What we do know is that the community has explicit

and inexplicit rules to regulate individual behaviors, and that people within the community take different roles and responsibilities in the learning activity.

Elements within an OLC have dynamic interactions, as represented by the lines between the elements in Figure 6. For example, identification represents an interaction between community and individual learners. Motivation is another possible interaction between community and individuals, as being in a community often motivates individuals to participate more (Kollock, 1999; Zhao & Bishop, 2011). Task-technology fit, a measure of whether certain technology is suitable for the user to perform certain tasks (Goodhue & Thompson, 1995), is related to the interaction between tools/technology and learning goal. Much research that examines the impact of individual learning styles in online learning actually has looked into learner/rules and learner/division of labor interactions. For example, Battalio (2007) and Ke and Carr-Chellman (2006) concluded that reflective learners may not respond well to highly interactive learning environments. This can represent a conflict between the learner (reflective learning style) and the rules (high interactivity being an expectation of class), also a conflict between the learner and the division of labor (interdependency). In this way, it appears the proposed OLC model may offer a systematic way to identify important interactions within an OLC. The framework appears to accommodate much previous research and provides a new perspective for discovering underlying relationships among the findings of those studies.

However, the model still is not complete. Within the OLC activity system there remains the element of "community," which seems to lead to a circular definition of OLCs. This is a very important issue, which is probably the sole reason why OLCs have been so difficult to define in the first place. In Chapter 1, I pointed out that the term "community" has several implications in the literature. It may refer to a group of people in the same location, a group of

people with something in common, a group of people with emotional attachments, or just a social unit of analysis. It is often unclear which implication we have adopted when talking about "online learning communities."

The AT framework helps to clarify the issue. An OLC indeed shares common things -- including the activity, the object, the tools, and the culture. And there are also social and emotional connections among people within an OLC, which matter most during person-to-person interactions rather than person-to-object interactions. This is "community" in the narrow sense, the community defined as emotionally attached people, and the community element in an OLC. As the activity system, an OLC incorporates various elements, including "community" in the narrow sense. But the "C" in "OLC" refers to community in the broad sense, or the social unit of analysis. An OLC is not a community (in the narrow sense), rather it *contains* community (in the narrow sense). From now on, whenever I use the term community, it will refer only to community in the narrow sense, or the community element of OLCs.

After demonstrating the difference between community and OLC, it becomes possible to find out what community really is. Since the OLC is the activity system, anything within the activity system that is not the subjects, the object, the tools, the rules, or the division of labor is the remaining community. We also know from earlier discussion that community is related to social presence, community of practice, identity, mutuality, safe and supporting conditions, and social capital.

Several themes emerge from further analysis of these concepts. The first theme is social interaction. Interactions are foundational to OLCs (Anderson, 2004; Wallace, 2003). Without interactions, physically separated learners will not be able to engage in collective activity, nor will they establish shared goals, rules, or division of labor. In CoPs, learning and practice takes

place through interactions. However, interactions are not exactly learning and practice. Interaction is not part of the system objective; rather, it emerges in collective action (Zhao & Bishop, 2011). Similarly, interactions are not part of division of labor, as the latter only mediates the interactions between people and task, while interactions represent an interaction between person and person. Therefore, interactions appear to be among the characteristics of "community." It is the interactions that distinguish a community from a collection of people.

The second theme of community is emotional connection. Identification with a community is often associated with a sense of belonging (McMillan & Chavis, 1986) and having emotional connections with the community (Melucci, 1989). To have safe and supporting conditions (Ludwig-Hardman, 2003) requires that a community provide emotional support to its members. In addition, Shea et al. (2010) confirmed affect as a construct of social presence. It appears that emotional connections are generally supported as being a characteristic of community.

Within the concept of a community's emotional connection, participants' sense of *trust* is also discussed in the literature. Daniel and Schwier (2007) and Rovai (2001) both identified trust as an important element of community. According to Moorman, Zaltman and Deshpande (1993), trust is the feeling that community members are trustworthy and represents a willingness to rely on other members of the community in whom one has confidence. Mayer, Davis, and Schoorman (1995) distinguished trust, trust propensity, and trustworthiness: Trust refers to the situational state in which one demonstrates trusting behaviors or intentions; trust propensity refers to the likelihood that a person will trust; while trustworthiness describes the characteristics of the trustee upon which a trustor determines whether to trust. A participant's perceived trustworthiness is determined by three characteristics of the trustee: benevolence, integrity, and

ability (Mayer, Davis, & Schoorman, 1995). Benevolence is the extent to which a trustee is perceived to want to do good to the trustor in their relationship aside from an egocentric profit motive; integrity refers to the extent to which a trustee is perceived to adhere to a set of acceptable principles; and ability is the extent to which a trustee is perceived to possess a set of skills and competencies that enables the trustee to have influence within some specific performance domain. Both integrity and ability are cognitive indicator of trustworthiness and contributes to cognition-based trust, while benevolence is an affective indicator of trustworthiness and contributes to affect-based trust (Colquitt, LePine, Zapata, & Wild, 2011; McAllister, 1995). Thus it appears trustworthiness, or at least part of it (benevolence), belongs to emotional connections within a community.

The third possible theme is interpersonal relationships. The ability to develop and maintain relations with other learners has been identified as a component of social presence (Garrison, 2009; Oztuk & Brett, 2011) and online participation (Hrastinski, 2009). Interpersonal relationships enable access to resources and contribute to social capital (Lin, 2001). However, whether interpersonal relationships are necessary to develop trust and a sense of community is not entirely clear. For example, while Preece (2000) suggested interpersonal relationships are important for trust development, Wade, Cameron, Morgan and Williams (2011) found interpersonal relationships unnecessary. In addition, as interpersonal relationships in online learning have both social and emotional dimensions (Han & Johnson, 2012), it is possible that interpersonal relationships are not an independent construct of community, but rather a function of interaction and emotional connection. However, because more proof is needed to exclude it, I will include interpersonal relationships as a characteristic of community at this phase of my study.

It appears that these three themes, which can be considered as three characteristics of community, are hierarchical – A community can have plenty of interactions without developing substantial emotional connections. Similarly, people may be sociable and friendly with each other without developing sustained interpersonal relationships. On the other hand, when a community has flourishing personal relationships, one can expect it to have rich emotional connections and many interactions. A similar hierarchy was found by Brown (2001), who identified three stages of learning community development. In the first stage, students interact on a regular basis and make online acquaintances. In the second stage, students develop a kinship with fellow students as they deeply engage in course discussions and contribute to each other's learning. In the third stage, "camaraderie" is developed after long-term personal communication. The third stage represents the highest level of community, which not all OLCs are able to achieve. Brown's findings are parallel with my position that interactions, emotional connections and interpersonal relationships are three hierarchical characteristics of communities.

A community of interactions, emotional connections and interpersonal relationships influences both the actions (learning) and the motivation to act (learning motivation). Interactions have been found to facilitate students' higher order thinking (Garrison, Anderson, & Archer, 2000) and deep and reflective learning (Berge, 2002). Emotionally connected learners share the belief that they matter to one another and to the group, and that they have duties and obligations to each other and to learning (Rovai, 2002b). Interpersonal relationships promote a willingness to participate in personal exchanges (Kehrwald, 2008). Once students benefit from others' contribution to the learning, they become more motivated to contribute because they get a return on their investment in the group (Kollock, 1999).

The final model of OLCs is illustrated in Figure 7. Based on the model, I define an OLC as *an activity system of socially and emotionally connected learners participating in regulated learning activities towards shared learning goals through tool-mediated online interactions.* A community, as an element of OLC, is defined as *socially and emotionally related people whose learning is influenced by such social and emotional relations.*

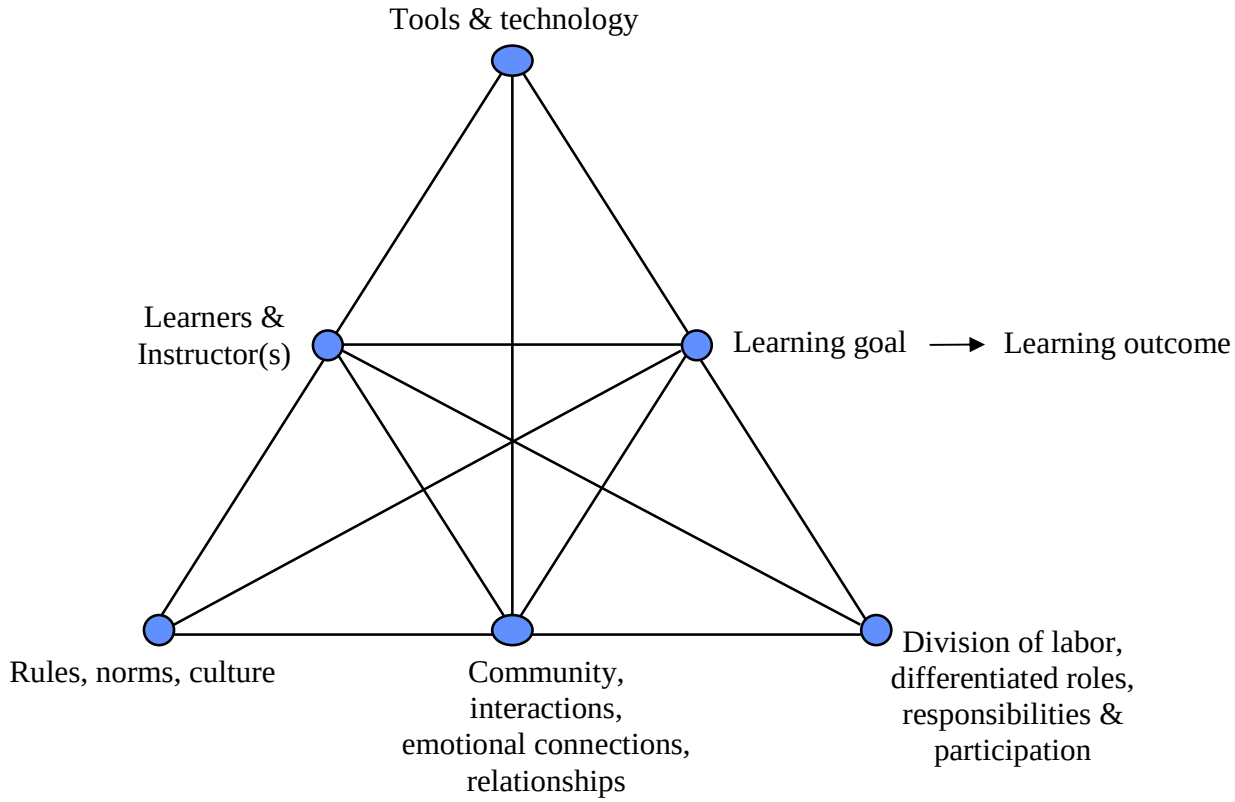


Figure 7. Finalized OLC model based on activity theory.

Chapter 3 Methodology

Rationale and Research Questions

After Chapter 2 explored the qualitative relationship of OLC and learning, the next step is to investigate the nature of OLCs by examining how they relate to learning quantitatively. However, before attempting to measure OLCs quantitatively, one question needs to be considered first --exactly which dimension(s) of OLCs should be measured?

Throughout this dissertation, I have stressed the measurement of *dimensions* of OLCs rather than the measurement of OLC itself. This emphasis is deliberate. First, measuring OLCs may not be theoretically sound. Because activity theory provides a cultural historical perspective to examine learning, each OLC is situated in its own historical and cultural context, and our understanding of such an activity system is only meaningful within its context. Measuring OLCs runs the risk of reducing OLCs to decontextualized numbers, which is contrary to the fundamental assumptions of the AT framework. Second, measuring OLCs is difficult. According to Chapter 2, an OLC is a system. With multiple elements and interactions, it is impractical to treat an OLC as one variable. Furthermore, even if treating an OLC as one variable is possible, it may not serve our purposes. By examining how certain variables affect learning, eventually we attempt to control some variables while manipulating others in some way to obtain desired learning outcomes. However, given the complexity of the system, an OLC is nearly impossible to control, whether as a whole or in part: changes in one element will affect other elements, bringing unexpected results to the output. On the contrary, it is both more meaningful and practical to measure individual dimensions (elements) of an OLC. It is more manageable and logical to adjust one element within the system and see how it affects the system output –which is learning in this case.

For the purpose of this dissertation, therefore, the element I chose to measure is community. As discussed in Chapter 2, community has been a key issue in further understanding OLCs. Community's influence on online learning requires further investigation (Cameron, Morgan, Williams, & Kostelecky, 2009; Liu, Magjuka, Bonk, & Lee, 2007; Shea et al., 2010). The support of community, or the social context of OLCs, remains central to the issue of supporting OLCs (Charalambos, Michalinos & Chamberlain, 2004; Jonassen, Peck, & Wilson, 1999; Ryman, Burrell, Hardham, Richardson, & Ross, 2009; Tifous, Ghali, Dieng-Kuntz, Giboin, Evangelou, & Vidou, 2007). Therefore, measuring community becomes an important first step in discovering the interactions between OLCs and learning, which then allows for research to further optimize OLC design.

Few studies have been devoted to the quantitative measurement of community. Ke and Hoadley (2009) conducted a meta-analysis of 42 studies on OLC evaluations, within which only four measured "community-ness" quantitatively (Johnson, Suriya, Yoon, Berrett, & Fleur, 2002; Rovai, 2001; Rovai 2002b; Shea, Swan, Li, & Pickett, 2005). One instrument consistently used to measure community is Rovai's (2002a) *Classroom Community Scale* (CCS) (Drouin, 2008; Graff, 2003; Ouzts, 2006; Rovai, Wighting, & Liu, 2005; Shea, Li, & Pickett, 2006; Wighting, Liu, & Rovai, 2008). The instrument measures students' perceived sense of community using 20 Likert-scale items, and has two subscales of connectedness and learning. Scores of the two subscales were found to be moderately correlated (r=.60). The instrument was reported to have high validity and reliability by Rovai (2002a), but Barnard-Brak and Shiu (2010) found an exception and questioned its construct validity.

Another instrument to measure OLC is based on the CoI model (Arbaugh et al., 2008). It has 34 Likert-scale items measuring teaching presence, cognitive presence and social presence

respectively. The scores of the three subscales are less correlated (ranging from r=.318 to .568) than CCS's two subscales (r=.60). Unlike CCS, the developers did not suggest combining scores of subscales, making the instrument measurement of three individual dimensions rather than one uniform measurement of community-ness. The validity of the instrument was supported by Bangert (2009) and Carlon et al. (2012).

Nevertheless, the two instruments are based on different theoretical frameworks and assumptions, and are therefore not suitable as tools to measure community in this dissertation. In order to explore the quantitative relationship between community and learning, this dissertation takes a two-step process: First, it looks to develop and validate a new instrument to measure community based on the theoretical framework of OLCs presented in Chapter 2. Second, it explores the relationship between community and learning with the aid of the instrument developed in step one. The research questions of the first part, addressing solely the development and validation of the instrument, were as follows.

Research question 1. How is the Community Measurement Instrument (CMI) developed?

Research question 2. How valid and reliable is the CMI?

For the second part, exploring the relationship between community (as measured by the final version of the CMI) and learning, the research questions emerged from consideration of premises. If an OLC is a sociocultural activity system, any relationship within, including the community-learning relationship, varies by context. Since community is only one element within a system, and it interacts with many other system elements to generate output (learning), the relationship between community and learning may depend on many other elements. There are at least five other elements in the OLC model illustrated by Figure 7, and to investigate the effects of all is beyond the scope of this dissertation. However, as the model identifies division of labor

as directly mediating the process of community learning, it becomes natural to first explore how the division of labor may affect the community-learning relationship.

Division of labor describes how things are done in an OLC, which may be translated to a level of interdependency – or whether learning is conducted independently, interactively, or collaboratively. A simplest indicator of division of labor, perhaps, is the intended pattern of interactions in the course. If a course (or its instructor) requires a high level of student-to-student interaction, such as discussions and collaborations, it indicates that the course is interdependent. On the contrary, if a course requires minimal student-to-student interactions, most of the learning is then established individually. Therefore, different patterns of class interactions may affect community, learning, and their relationships differently.

One thing worth noting is that learning outcomes are not the only indicator of learning. Student satisfaction (SS) is a variable traditionally important to distance education (Bolliger & Wasilik, 2012; Sahin & Shelley, 2008), and is also a measure indicating students' perceptions of the overall learning experiences. Therefore, both perceived learning (PL) and SS were examined in this study as measures of learning.

The following research objective, then, guided the exploration of the relationship between community and learning: *To explore the relationships among community, PL, SS and division of labor in OLCs*. Because the study used a convenience sample in exploration of such relationships, the primary goal was not to draw generalizable conclusions. Rather, it sought to suggest directions for further research by identifying applicable research questions, methodologies and designs. Implications of the study are discussed in Chapter 5.

Developing and Validating an Instrument to Measure Community

This section discusses the process to develop and validate the *Community Measurement Instrument* (CMI), an instrument to measure community in OLCs. The development and validation of the CMI was conducted in four phases, as described below. Each phase was guided by the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999) for the development of psychometric measures.

Phase I: Initial development. As discussed in Chapter 2, the literature on community emphasizes three constructs: interactions, emotional connections and interpersonal relationships. The initial draft of CMI was developed to measure the three constructs respectively. To create this draft, I consulted seven existing, validated instruments that addressed one or more of these constructs (see Table 3). These instruments had 101 items combined; I evaluated each of these items one by one and determined that 34 were not appropriate for measuring interactions, emotional connections or relationships. After excluding these 34 items, I had a working set of 67 items. By collapsing similar items, I condensed these 67 items into 35 for inclusion in the CMI. Finally, based on my review of the literature, I developed six additional items not covered in the original seven instruments that I believed to measure interactions, emotional connections and relationships. The process is illustrated in Figure 8. Accordingly, the CMI has a total of 41 items. Sixteen items were to measure interactions, with items numbered I1-I16; 16 items measured emotional connections and numbered E1-E16; 9 items measured relationships and numbered R1-R9. For the complete draft, please see Appendix A. For details regarding the excluded items, added items, and how the draft items were related to the original items, please see Appendix B. The rationale of the item development is discussed below.

Table 3. Seven instruments upon which the CMI is developed.

Instrument	Construct Measured [as Aligned with CMI]	No. of items	Items incorporated—in some form—in the CMI	Items excluded
Arbaugh and Rau (2007)	Interactions	11	11	0
Sher (2009)	Interactions	10	10	0
Swan (2002)	Interactions	2	2	0
Kim (2011)	Social presence [Emotional connection]	19	14	5
Arbaugh et al.(2008)	Cognitive, social and teaching presence [Emotional connection]	34	10	24
Rovai (2002a)	Sense of community [Emotional connection]	20	15	5
Wade, Cameron, Morgan, & Williams (2011)	Relationships	5	5	0

Note. The scale's authors sometimes used terms different from the CMI; the second column, therefore, identifies in [brackets] the CMI construct to which the scale was applied. Also note that the items incorporated into the CMI (fourth column) includes items that were merged due to redundancy. See Appendix B for complete details of the process

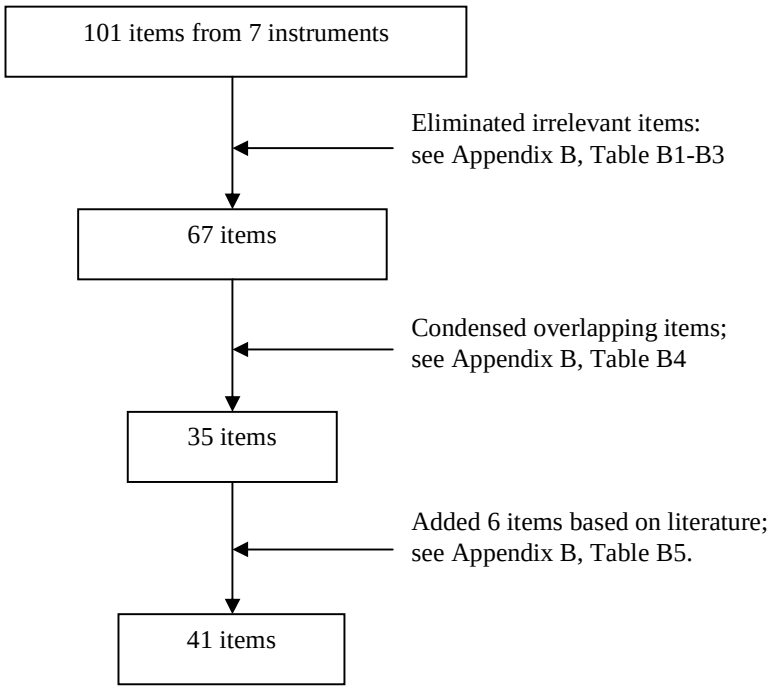


Figure 8. The process of initial item development.

Interactions. Moore (1989) identified major types of interactions within distance learning to be student-instructor interaction, student-student interaction, and student-content interaction. Although later research identified more varieties of interactions, including student-interface interaction (Hillman, Willis, & Gunawardena, 1994), teacher-teacher interaction, teacher-content interaction, and content-content interaction (Anderson & Garrison, 1998), student-instructor and student-student interactions remain the major *interpersonal* interactions of online learning that are relevant to community (Anderson, 2008). Johnson, Aragon, Shaik, & Palma-Rivas (2000) developed the *Course Interaction, Structure and Support Instrument*, which includes 11 items to measure student-student and student-instructor interactions. The instrument has been used and adapted by a number of studies, including Glenn, Jones, & Hoyt (2003), Sher (2009) and Yukselturk and Yildirim (2008). Arbaugh and Rau (2007) adapted an instrument developed by Sherry, Fulford, & Zhang (1998), which includes seven items measuring student-instructor and

four items measuring student-student interaction. Swan (2002) used a single item to measure each interaction. The *CMI* interaction items I3-I13 were developed based on these instruments.

Wagner (1994) defined interactions as "reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence each other" (p. 8). In this perspective, a learner initiates an action and the learning environment responds to it in a way that changes the learner's behavior. In an interpersonal interaction, the "object" which responds to a learner is another person in the social learning environment. For two people to engage in reciprocal exchanges, one person needs to be able to perceive the other person for the interaction to take place. Social presence can be defined as the degree to which people can perceive others as "real" in a technology-mediated environment (Gunawardena, 1995), and can affect people's capabilities to interact effectively (Kehrwald, 2008). Items I1 and I2 address the role of social presence in interactions. Being aware of others is probably the minimum required social presence for interactions to occur (Schwier, 2011), and being able to form distinct impressions of others reflects a moderate degree of social presence that supports learning (Arbaugh et al., 2008).

In Wagner's (1994) definition of interaction, he also brought out that an interaction influences those involved in the interaction. *CMI* items I14-I16 measure whether learners perceive their interactions with other course participants as having an influence on their learning. If the influences are small, the interactions may be less effective and meaningful as compared to situations where the influences are large.

Emotional connections. Individuals within a community share a feeling that they belong to the group and are connected to others within the group. This feeling is defined as a sense of community (McMillan & Chavis, 1986). Rovai (2002a) summarized a sense of community to

include feelings of connectedness, cohesion, spirit, trust and interdependence among its members. He developed the Classroom Community Scale (*CCS*), which is one of the most commonly used instruments to measure community in online learning.

Social presence is widely regarded as an element of OLC (Garrison, Anderson, & Archer, 2000; Palloff & Pratt, 1999; Tu & Corry, 2002b). Social presence is related to affection and group cohesion (Garrison, 2009), and is important to the development of a sense of community (Aragon, 2003). Therefore, social presence can be an indicator of the degree to which community members are emotionally connected. There are two instruments available to measure social presence: The *Community of Inquiry Instrument* by Arbaugh et al. (2008) is based on the CoI framework and includes 9 items measuring social presence. Kim's (2011) 19-item instrument is based on a broader literature base than the *CoI Instrument*. Factor analysis reveals social presence measured by Kim's instrument to have four constructs, which are mutual attention and support, affective connectedness, sense of community and open communication. The *CMI* items of emotional connections are based on the three instruments above (i.e., Arbaugh et al., 2008; Kim, 2011; Rovai, 2002a).

Personal Relationships. Few studies have examined the development of interpersonal relationships within online learning environments, with the exception of Wade, Cameron, Morgan, & Williams (2011). Wade, Cameron, Morgan, & Williams's instrument of online group behaviors distinguished surface-level relationships and deeper relationships. It is worth noting that the surface-level relationship items are identical to some of the *CCS's* connectedness items, such as "I felt members of my group cared about each other" or "I felt that other members of my group were supportive." It appears Wade, Cameron, Morgan, & Williams regarded the feelings of connectedness and sense of community as indicators of surface, rather than deep,

relationships. Three of the CMI's interpersonal relationship items (R5, R6, R8) were based on Wade, Cameron, Morgan, & Williams's instrument.

Granovetter (1973) proposed the strengths of interpersonal ties are "a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal services which characterized the tie" (p. 1361). Marsden and Campbell (1984) found closeness is the most important indicator of strong interpersonal relationships, with duration and frequency of interactions somewhat less important. Berscheid, Snyder, & Omoto (1989) measured closeness in three subscales: the frequency of the impact that one has on the other, the diversity of activities through which one can impact the other, and the strengths of the impact. CMI items R1, R2/R3, R4, R7 were designed to measure duration of interactions, closeness, diversity of activities and intimacy/self-disclosure respectively (frequency and strengths of personal impact are measured in items of interactions and emotional connections). In addition, Ma and Yuen (2011) brought out that commitment to relationship is an important determinant of personal relationships, which is measured by R9.

Phase II: Expert panel review. The initial instrument was sent to a panel of three subject-matter experts to evaluate its content validity. The experts were professors in education, instructional technology and sociology. Each expert was asked to evaluate the relevance of the items, and to make suggestions to omit or add items as they deem necessary.

In response, Expert 1 did not make suggestions to modify any items. Expert 2 expressed reservations about items I3-I8, which aimed to measure student-instructor interactions. She suggested that the items concerning facts (i.e., *the teacher provided timely feedback*) and the items concerning feelings (i.e., *I felt connected to other course participants*) created an inconsistency in what the items attempted to measure. Expert 3, however, strongly suggested

keeping all items in order to gather maximum information at earlier stage of the study, and to rely on data analyses for further item selection.

Because no expert recommended to add more items, and experts had different opinions on whether to remove some items, I decided it was safer to keep as many items as possible at this stage of study. Therefore, no items were deleted after the expert review.

Phase III: Validation study. The CMI was then administered to a group of online learners in order to test its validity and reliability.

Participants. Participants were recruited from undergraduate and graduate students taking online courses at a private university in the northeastern U.S. The link to a Web-based survey was sent to 403 students who took online courses in the 2013 Summer and Fall semesters by emails. The emails were distributed by the distance education administrators who coordinated the online courses. In each semester, the emails were sent three weeks before the semesters ended, then weekly reminders were sent for three weeks. To encourage participation, 10 participants were randomly selected to receive a $25 gift card of Amazon.com. One hundred sixty-eight students participated, generating 148 complete responses for factor analysis. The response rate was 36.7%.

There were 63 online courses offered in both semesters. The 148 participants were distributed across 43 courses taught by 38 different instructors. The largest course had 25 online students, and the smallest course had 2 online students. Participants per course ranged from 0-9. The highest response rate per course was 66.7% and the lowest response rate per course was 0. 61 participants took business courses, 33 participants took engineering courses, and 54 participants took science courses; the response rates of business, engineering and science were 37.2%, 31.1% and 40.6 %, respectively.

There were more male (84) than female (64) participants. More than half of the participants (54.7%) were between the ages of 26 and 35. The majority (89.2%) of the participants were graduate students enrolled in a master's program; others were graduate students enrolled in a certificate program, undergraduate students or non-degree students. Most participants had taken at least one distance courses before the current one, with only 16.2% participants never having taken a distance course before. Table 4 lists the detailed demographic information for the participants.

Table 4. Participant demography

	Number	Percentage
Gender		
Male	84	56.8
Female	64	43.0
Age		
18-25	38	25.7
26-35	81	54.7
36-45	18	12.2
46-55	9	6.1
56 and up	1	0.7
Registration status		
Graduate students in a degree program	132	89.2
Graduate student in a certificate program	3	2.0
Undergraduate	8	5.4
Non-degree	5	3.4
Distance courses taken before		
0	24	16.2
1-2	35	23.6
3-5	54	36.5
6 or more	35	23.6
Course discipline area		
Business	61	41.2
Engineering	33	22.3
Science	54	36.5

Instrument. In addition to demographic questions, the survey contained 60 items to which participants were required to select from choices of strongly agree, agree, neither agree nor

disagree, disagree or strongly disagree. The CMI comprised 41 out of the 60 items. In addition to the 41 CMI items, 15 items were drawn from the CCS (Rovai, 2002a) for comparison of the results between CMI and CCS. (The CCS has 20 items, 5 of which were already covered in the CMI, so only the remaining 15 items were added to the survey). There were also three items to measure perceived learning (PL) and three items to measure student satisfaction (SS). The PL and SS items were intended to examine the relationship between community and learning, which are discussed in the next section of the dissertation. The survey and scoring guide is provided in Appendix C.

Phase IV. Data analyses and instrument finalization. Factor analysis allows researchers to identify fewer underlying factors from a large number of observed variables (Kim & Mueller, 1978). Both explanatory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to examine whether factors identified from the data correspond with the theoretical framework upon which the CMI was developed. Factor analysis results, along with the comparison between CCS and CMI, were used to judge the instrument's validity. Reliability of the instrument's sub-scales was estimated using Cronbach's alpha. The specific process and findings of Phase IV are presented in Chapter 4, below.

Exploration of the Relationship between Community, Learning and Student Satisfaction

Triangulation refers to the use of multiple research methodologies in a study. Adapting multiple observations, data sources, theories, and methodologies, triangulation helps us to understand a phenomenon more fully from more than one perspective, gives a more balanced view of the situation, thereby reducing bias and increasing validity of a study (Patton, 1990). To triangulate, both a student survey and an instructor survey were used to explore the Research

Objective. The student survey was used to collect quantitative data on community, learning and student satisfaction, while the instructor survey collected qualitative data on community, learning, and giving insights on instructors' perspectives on the relationship between community and learning in OLCs.

The student survey. At the time of the instrument pilot, additional data were also collected from the online students who responded to the survey, in order to examine the relationship between community and learning. The data collected were division of labor, perceived learning (PL), and student satisfaction (SS), as described below. (For the full survey, see Appendix C.) The data were handled separately from the CMI instrument-development analyses.

Instrument.

Community. Community was measured by the finalized version of CMI (25 items).

Learning. Perceived learning (PL) was measured by three items adapted from Eom, Wen and Ashill (2006). Cronbach's alpha for the three items was 0.88.

Student satisfaction. SS was measured by three items adapted from Arbaugh (2000) and Kim (2011). Cronbach's alpha for the three items was 0.96.

Division of Labor. In the student survey, participants were asked to identify the course they took. The patterns of interactions of the course were then determined, based on course descriptions and course syllabi published at the university's Website. In this particular distance education program, if a course was labeled "online" in the course syllabus, it indicated the course was asynchronous, used pre-recorded video lectures, and required students to work independently. If a course was labeled "Classroom Live" in the course syllabus, it indicated the course had some synchronous sessions which required certain degree of student-student

interactions. In addition, I consulted the university's distance education administrators who were familiar with the courses to confirm the class interactions patterns were identified correctly. Based on the syllabi and information obtained from the administrators, the courses were divided into two groups: courses that required no student-student interactions (interaction=0), and courses that required at least some student-student interactions (interaction=1). The PL, SS, and interaction level are summarized in Table 5, below.

Table 5. Participant PL and SS by class interaction pattern

	PL	SS
Whole cohort (n=148)	11.86	11.78
Low-interaction only (n=92)	11.76	11.40
High-interaction only (n=56)	12.02	12.41

Data analyses. To explore the research objective, community, PL and SS in different groups were compared using a t-test. In addition, I examined whether the regressions of PL and SS on community were different across groups.

The instructor survey. To gather information from the instructors, phone interviews were planned initially. However, distance education administrators who facilitated my communications with the instructors suggested that the instructors were more likely to respond to email communications. Therefore, I opted to send out a survey of three open-ended questions to the instructors by email. The three questions were:

1. Overall, how do you feel about the level of learning your students achieved in this course?

2. In online learning, community may refer to a socially and emotionally connected group of learners. How would you describe the level of learning community in your course?

3. Did the level of learning community in your course (whether it is strong, not-so-strong, or non-existent) have any impact on teaching and learning? What are the impacts like?

The survey was sent to 33 instructors who taught online courses in the Fall 2013 semester. Five instructors responded, yielding a response rate of 15%.

This chapter presented the research questions and methodology. I also reported the development of the initial version of the CMI, first working from the literature and then submitting it to expert review. I described the population from which I drew the data to answer the research questions, including descriptive statistics of their demographics and course outcomes (perceived learning and student satisfaction). The following chapter details the analysis and findings, organized by research question.

Chapter 4 Results and Data Analyses

This chapter is divided into three sections. The first section addresses research question 1 and describes the process to refine the Community Measurement Instrument (CMI). The second addresses research question 2 and demonstrates the data analyses process to verify the CMI's validity and reliability. The third section deals with research questions 3 and 4 to examine the quantitative relationships between learning and community as measured by the CMI.

Refining the Community Measurement Instrument

This section described the process to finalize the CMI after the initial review by experts. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to expose additional items that could be winnowed and show connections within and across the constructs. During the data analyses process, 16 items were eliminated from the initial 41 items of the instrument, resulting in a finalized CMI with 25 items. The process is detailed in this section.

Preliminary item analysis. The original CMI consisted of 41 Likert-scale items. Before factor analysis, a correlation matrix was generated to check for extremely high and low correlation among items. If an item correlates too high ($r>0.8$) with other items, it carries little additional information and causes multicollinearity. If an item hardly correlates with any other items ($r<0.3$), it fails to measure the same constructs as other items and causes extraction of too many unnecessary factors. Based on these criteria, five items were removed from further analysis. Items I12 (*I exchanged opinions with other course participant*) and I13 (*I worked with other course participants to accomplish learning tasks*) were removed because they both correlated highly with I11 (*I engaged in discussions and/or collaborations with other course participants*). Item R3 (*I became friends with some course participants during this course*) correlated highly with R5 (*I got to know some course participants on a personal level during this*

course) and was also removed. In addition, item I15 (*interactions with other course participants contributed little to my learning*) and E16 (*I felt reluctant to speak openly in this course*) correlated too low with most other items ($r<0.3$) and were also excluded. The eliminated items, along with the items eliminated later, are listed in Table 10, and the decision to remove these items is discussed later in this chapter.

The remaining 36 items were now analyzed with an EFA. The results indicated that five items had overall low communality (<0.4), meaning they cannot be explained by the extracted factors: item E11 (*I felt uncertain about others in this course*), E12 (*I felt secure in this course*), R1(*I already knew some course participants before I started taking this course*), R8 (*I avoided developing close relationships with other course participants*) and R9 (*I doubt I will maintain relationships with other course participants now that the course is over*). In re-reading these five items, one can speculate that they related more with the participants' personalities rather than the learning environment they were in. In addition, the following four items cross-loaded on more than one factors, which meant that variances in these variables cannot be explained by a single factor: E2 (*I felt isolated in this course*), E9 (*I felt the people in this course shared a spirit of community*), E10 (*I felt the course participants shared a commitment to learn*) and R7(*I felt comfortable sharing personal information with other course participants*). To improve interpretability, the nine items were removed from further analysis. Another round of EFA was then conducted with the remaining 27 items.

Exploratory factor analysis. As the next step to reveal the CMI's factor structure, EFA was conducted using SPSS 20. The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was 0.939, and Barlett's test of sphericity is significant ($p<.001$), indicating the data set

was appropriate for factor analysis. Principal axis factoring and direct oblimin rotation were used because I expected factors of community to correlate with each other.

Scree plot (Cattell, 1978) and eigenvalue (Kaiser, 1960) are two commonly used rules to determine the number of factors in EFA. In this study, scree plot (Figure 9) suggested a 2-factor solution while Kaiser's rule of eigenvalue suggested a 4-factor solution. Based on recommendations of Costello and Osborne (2005), I compared 2-, 3-, and 4-factor solutions by specifying the number of factors in SPSS and found a 4-factor solution preferable in terms of interpretability. The four factors cumulatively accounted for 73.1% of the total variance. The pattern matrix is shown in Table 6.

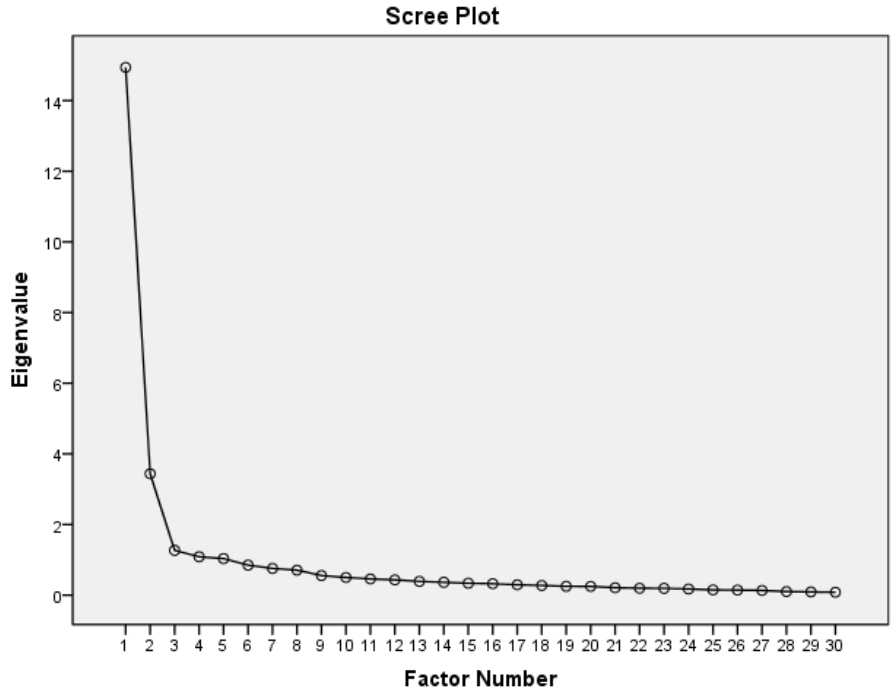


Figure 9. Scree plot of exploratory factor analysis.

Table 6. Pattern matrix of exploratory factor analysis.

Pattern Matrix				
	Factor			
	1	2	3	4
I1	**.795**	.049	-.041	-.160
I2	**.720**	.056	-.015	.128
I8	**.588**	.288	.025	.201
I9	**.402**	.223	.100	.334
I10	**.676**	-.086	.127	.339
I11	**.785**	-.028	-.047	.135
I14	**.831**	-.016	-.243	-.095
I16	**.724**	-.091	-.054	.103
E1	**.651**	.177	-.048	.135
E8	**.584**	.138	-.185	.117
E13	**.554**	.021	-.151	.226
E14	**.610**	-.117	-.272	.003
E15	**.437**	.074	-.125	.156
I3	.061	**.847**	.069	.084
I4	-.043	**.764**	-.100	-.086
I5	-.102	**.802**	-.025	.000
I6	-.083	**.865**	-.025	-.064
I7	.351	**.675**	.079	.014
E7	.219	**.520**	-.203	.131
E3	.090	.115	**-.686**	.191
E4	.296	-.031	**-.593**	.068
E5	.120	.106	**-.636**	.196
E6	.081	.099	**-.582**	.144
R2	.110	-.016	-.107	**.698**
R4	-.078	.042	-.189	**.751**
R5	.024	-.035	-.080	**.874**
R6	.193	-.052	-.067	**.611**

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

In the earlier part of this dissertation, I proposed a three-factor model of community, with the three factors being interactions, emotional connections and personal relationships. In the original CMI, items I1-I16 were designed to measure interactions, items E1-E16 were designed to measure emotional connections, and items R1-R9 were designed to measure personal relationships. Comparing with the result of factor analysis, it appeared all remaining R-items (R2, R4, R5, R6) loaded on one single factor (Factor 4). The I-items were further divided into two categories: those related with student-student interaction (I1, I2, I8, I9, I10, I11, I14, I16) loaded on Factor 1, and the items dealing with student-instructor interactions (I3, I4, I5, I6, I7) loaded on Factor 2. The E items were scattered among factors; however, four items (E3, E4, E5, E6) loaded significantly on Factor 3. The correlations among F1, F3 and F4 were relatively high, while F2 correlated less with other factors (Table 7).

Table 7. Factor correlation matrix of exploratory factor analysis.

Factor	1	2	3	4
1	1.000	.330	-.593	.689
2		1.000	-.271	.206
3			1.000	-.536
4				1.000

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

Confirmatory factor analysis. Next, CFA was conducted using Amos 22 software to verify the previously identified factor structure. Because EFA results showed the possibility for a 2- or 3-factor model, the fit of the alternative models was examined. Commonly used methods to evaluate model fit include TLI (Tucker Lewis Index), CFI (Comparative Fit Index) and RMSEA (root mean square error of approximation). A model is considered to have good fit if TLI and CFI are > 0.90 (Tucker & Lewis, 1973; Bentler, 1990). In addition, RMSEA < 0.05 indicates a close fit, 0.05-0.08 a reasonable fit, 0.08-0.10 a mediocre fit, and > 0.10 an unacceptable fit

(MacCallum, Browne, & Sugawara, 1996). Table 8 lists the model fit parameters of the models. The results showed that although the 4-factor model had better model fit than 2- or 3-factor models, its TLI, CFI and RMSEA did not meet the criteria of an acceptable model. It appeared though, by eliminating two more items (E7 and E14), the model fit could be greatly improved. The 25-item model illustrated in Figure 10 had TLI of 0.916, CFI of 0.925 and RMSEA of 0.078, indicating a reasonable fit. Details regarding the decision to eliminate E7 and E14 are discussed in a later section ("Items deleted," below).

Table 8. Model fit indices of alternative factor models.

	TLI	CFI	RMSEA
2-factor model	0.827	0.841	0.110
3-factor model	0.878	0.890	0.098
4-factor model (27 items)	0.883	0.894	0.089
Revised 4-factor model (25 items)	0.916	0.925	0.078

Factor structure and factor loadings of the 25-item CMI are listed in Table 9. Unlike EFA, CFA usually assumes items do not load on more than one factor, except where explicitly suggested by factor structure. The remaining items had high communality: other than two items that had factor loadings at 0.6-0.7 (I9 and E15), all other items had factor loadings above 0.7.

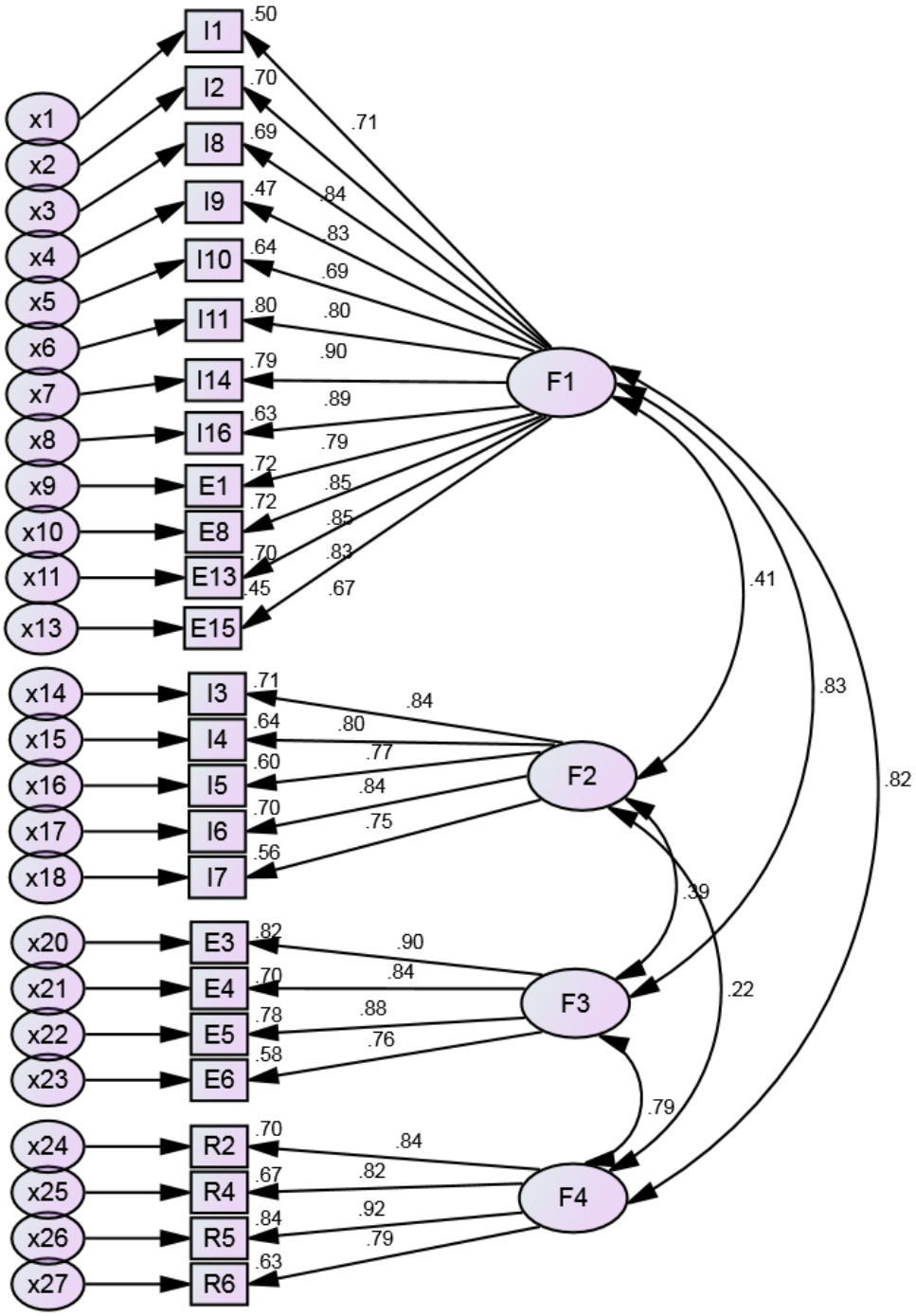


Figure 10. Factor structure of the CMI based on confirmatory factor analysis

Table 9. Factor loadings of CMI items by confirmatory factor analysis.

Factor		Item	Factor loadings
F1	I1	1. I was hardly aware of the existence of other course participants.	.710
	I2	2. I was able to form distinct impressions of some course participants.	.838
	I8	3. The instructor encouraged me to interact with other course participants.	.832
	I9	4. I had sufficient interactions with other students in this course.	.688
	I10	5. I shared my learning experiences with other course participants.	.799
	I11	6. I engaged in discussions and/or collaborations with other course participants.	.895
	I14	7. I learned from other course participants.	.887
	I16	8. I was not involved in the learning of other course participants.	.793
	E1	9. I felt connected to other course participants	.847
	E8	10. I felt like I was part of a cohesive group in this course even though we were not physically together in a classroom.	.850
	E13	11. I felt my participation mattered to other course participants.	.834
	E15	12. I felt comfortable interacting with other course participants.	.669
F2	I3	13. I had sufficient interactions with the course instructor.	.845
	I4	14. The instructor provided timely feedback.	.800
	I5	15. The instructor provided individualized feedback that helped me to learn.	.772
	I6	16. The instructor was responsive to my questions and needs.	.837
	I7	17. The instructor encouraged me to become actively involved in the learning process.	.749
F3	E3	18. I felt the course participants care about each other.	.904
	E4	19. I felt the course participants were supportive of each other.	.836
	E5	20. I felt the course participants can rely	.881

		on each other.	
	E6	21. I trusted others in this course.	.759
F4	R2	22. I developed close relationships with some course participants during this course.	.837
	R4	23. I interacted with some course participants on topics unrelated to the learning of this course.	.821
	R5	24. I got to know some course participants on a personal level during this course.	.918
	R6	25. I made efforts to make myself known to other course participants on a personal level.	.795

Interpretation of the factor structure. EFA and CFA revealed and confirmed a 4-factor structure of the CMI items (see Table 9). It appears that Factor 1 (F1) is a construct that measures student-student interactions, or class interactions. Items such as I11 (*I engaged in discussions and/or collaborations with other course participants*) and I14 (*I learned from other course participants*) directly examine the pattern of class interactions of the specific online course. Items such as E1 (*I felt connected to other course participants*) and E8 (*I felt like I was part of a cohesive group in this course even though we were not physically together in a classroom*) are different though, because these focus on the participants' feelings. Since E1 and E8 loaded highly on F1, or student-student interactions, it suggested that the feelings of connectedness (E1) and cohesion (E8) are associated with student-student interactions among students.

Obviously, correlational relationships do not indicate cause and effect. Therefore, it could not be concluded that student-student interactions caused the sense of connectedness or cohesion. However, the role of interactions and emotions (senses) are distinct in OLCs. The pattern of interactions—including how often interactions are supposed to occur, who is supposed to interact

with whom, and through which formats such interactions are to be established—are largely pre-defined in an OLC, most likely by the instructor. On the other hand, emotional connections develop later, most likely after interactions occur. Therefore, one might hypothesize that interaction is a more fundamental characteristic of the OLC that determines the OLC's dynamics, while emotional connections *emerge* from such dynamics. Furthermore, if emotional connections are emergent characteristics, it becomes understandable that the original emotional connection items (E- items) fell under different factors, since emergent characteristics *are* influenced by multiple factors.

Factor 2 (F2) is a construct that measures student-instructor interactions. All items were directly related with the interactions between the student and the instructor.

Factor 3 (F3) items (E3-E6) were slightly different from other E- items. While other E-items involved the participants' feelings, E3-E6 involved the participants' judgment of others - the judgment of whether other course participants were caring, supportive, reliable and trustworthy. F3 can be seen as a measure of the perceived benevolence of other learners, similar to benevolence in determining the trustworthiness of others. F3 correlated moderately with F1 (see Table 7), but only a small portion of the variance in F3 could be explained by F1 (student-student interactions among students). Other elements, such as the learners' personalities, may have an influence on F3.

Factor 4 (F4) is a construct that describes personal relationships among learners. Similarly, although F4 correlated moderately with F1, less than half of the variance of F4 could be explained by F1. Among F4 items, R4 (*I interacted with some course participants on topics unrelated to the learning of this course*) was worth noticing. The fact that R4 was an indicator of F4, but not F1, suggested that F4 was probably more associated with non-learning-related

interactions, while F1 was associated more with learning-related interactions. This also provided an explanation for the non-negligible loadings of I9 (*I had sufficient interactions with other students in this course*) on both F1 and F4 in EFA (see Table 6), as interactions included both learning-related and non-learning related interactions.

During CFA, two more E-items (E7 and E14) were eliminated. If the E- items were emergent, it meant that other more fundamental items already carried the information that determined the E-items. Therefore, to eliminate E- items may pose only a relatively small effect to the overall instrument. It then became justified to remove the two items for a better fitting model.

Based on factor structure revealed by EFA and CFA, the proposed model of community was modified. The proposed and empirical models of community are illustrated in Figure 11. The proposed and empirical models have two major differences: First, the empirical model made a distinction between student-student interactions and student-instructor interactions. Second, the empirical model suggests emotional connections as emerging characters of OLCs that were influenced by multiple factors.

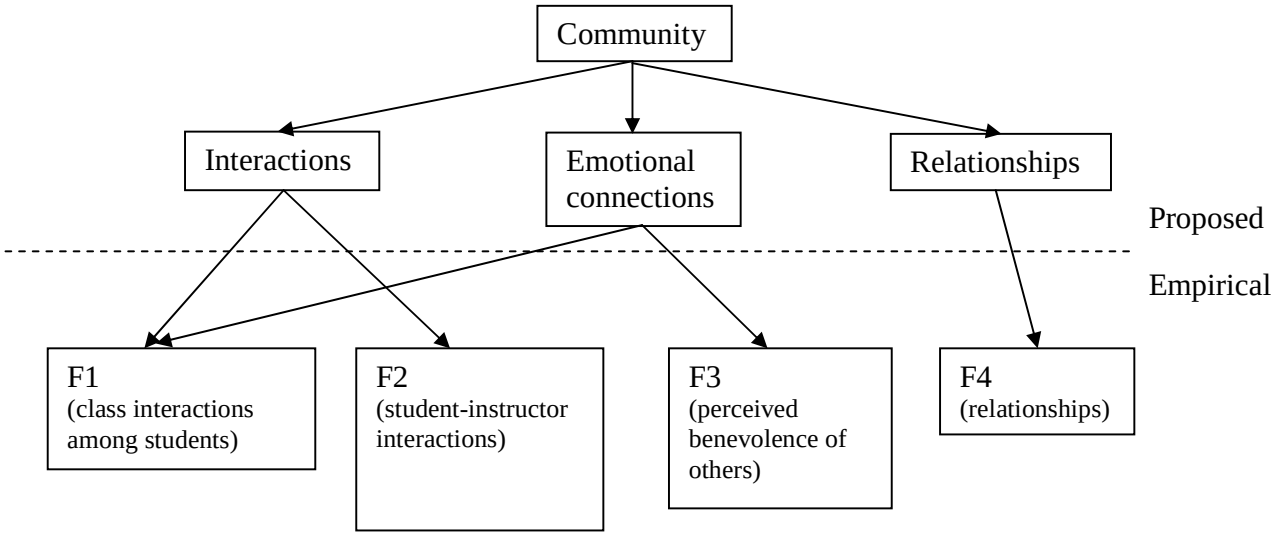


Figure 11. Proposed and empirical models of community.

Items deleted. This section discusses the items removed along the process to refine the CMI in details. The removed items, the data analyses stage in which they were removed, and the reason why they were eliminated are listed in Table 10. I12 and I13 were eliminated because they correlated highly with I11. It appeared that "I engaged in discussions and/or collaborations with other course participants" (I11) covered the contents of "I exchanged opinions with other course participants" (I12) and "I worked with other course participants to accomplish learning tasks" (I13). Therefore, I12 and I 13 were redundant, and were eliminated.

R3 (*I became friends with some course participants during this course*) was eliminated because it correlated highly with R5 (*I got to know some course participants on a personal level during this course*). Comparing R3 with R5, it appeared the term "friends" in R3 was ambiguous and could be interpreted differently by different respondents. Therefore, the less ambiguous R5 was retained.

I15 and E16 were eliminated because they correlated too little with most of other items. I15 (*interactions with other course participants contributed little to my learning*) might be more

related to the participant's personal learning philosophy rather than the learning environment he/she is in. E16 (*I felt reluctant to speak openly in this course*) might be related to the participant's personal traits and communication styles.

E11, E12, R1, R8 and R9 were eliminated because they had low communality in the preliminary EFA. Similarly, E11(*I felt uncertain about others in this course*) and E12 (*I felt secure in this course*) might be more related to the respondents' personalities, and R8 (*I avoided developing close relationships with other course participants*) and R9 (*I doubt I will maintain relationships with other course participants now that the course is over*) more related to the respondents' communication styles than the learning environment. R1 (*I already knew some course participants before I started taking this course*) measured a prior condition of the learning community and may not contribute to the actual community level in the online course.

E2, E9, E10 and R7 cross-loaded on more than one factor, meaning multiple factors contributed to the variance in these items. For E2 (*I felt isolated in this cours*e), it appeared that the feeling of isolation was influenced by both student-student interactions and student-instructor interactions. For E9 (*I felt the people in this course shared a spirit of community*) and E10 (*I felt the course participants shared a commitment to learn*), it appeared the participants' overall perceptions of the community were influenced by both student-student interactions and the perceived benevolence of others. For R7 (*I felt comfortable sharing personal information with other course participants*), whether a participant felt comfortable sharing personal information was influenced by the participant's relationship with others and perceived benevolence of others. It was thus difficult to assign these items to one single factor. As each factor already had at least 4 items, removing the cross-loaded items would pose little threat to the reliability of the factors,

and would increase the interpretability of the overall instrument. Therefore, the cross loaded items were eliminated as well.

Table 10. List of removed items during the CMI refinement process.

Data analysis stage	Removed item	Reason
Preliminary factor analysis	I12. I exchanged opinions with other course participants.	Correlated highly (r=0.889) with I11 (I engaged in discussions and/or collaborations with other course participants)
	I13. I worked with other course participants to accomplish learning tasks.	Correlated highly (r=0.852) with I11 (I engaged in discussions and/or collaborations with other course participants)
	R3. I became friends with some course participants during this course.	Correlated strongly (r=0.822) with R5 (I got to know some course participants on a personal level during this course)
	I15. Interactions with other course participants contributed little to my learning.	Low correlation with other items (correlations lower than 0.3 for 33 out of 40 items)
	E16. I felt reluctant to speak openly in this course.	Low correlation with other items (correlations lower than 0.3 for 34 out of 40 items)
Preliminary EFA	E11. I felt uncertain about others in this course.	Low communality during preliminary EFA (λ=0.288)
	E12. I felt secure in this course.	Low communality during preliminary EFA (λ=0.249)
	R1. I already knew some course participants before I started taking this course	Low communality during preliminary EFA (λ=0.378)
	R8. I avoided developing close relationships with other course participants.	Low communality during preliminary EFA (λ=0.211)
	R9. I doubt I will maintain relationships with other course participants now that the course is over	Low communality during preliminary EFA (λ=0.315)
	E2. I felt isolated in this course.	Cross loaded on F1(*r*=0.369) and F2 (*r*=0.328)
	E9. I felt the people in this course shared a spirit of community.	Cross loaded on F1(*r*=0.442) and F3 (*r*=0.309)
	E10. I felt the course participants shared a commitment to learn.	Cross loaded on F1(*r*=0.603) and F3 (*r*=0.437)
	R7. I felt comfortable sharing personal information with other course participants.	Cross loaded on F3 (*r*=0.355) and F4 (*r*=0.308)
CFA	E7. I felt a sense of belonging in this course.	Removed in CFA to improve model fit
	E14. I felt the participation of other course participants mattered to me.	Removed in CFA to improve model fit

E7 and E14 were removed during CFA. As mentioned earlier, the model fit indices of the 27-item model were not optimal. To adjust the model, I examined the modification indexes

suggested by Amos. Table 11 shows Amos output, suggesting how adding certain regression weights between items and/or factors would improve model fit. For example, the first row indicated that if we add an arrow between E7 and F3 (making F3 an indicator of E7), the total χ^2 of the model can be reduced by 33.484, and the correlation between E7 and F3 would be approximately 0.530. (χ^2 is a model fit index in which a smaller χ^2 indicates a better fit.) Table 11 suggested that making E7 correlate with F1, F3, and F4 would reduce χ^2 considerably, thereby improving model fit. The suggestion indicated that E7 (*I felt a sense of belonging in this course*) could be accounted for by F1 (student-student interactions), F3 (perceived benevolence of others) and F4 (relationships), in addition to F2 (student-instructor interactions), with which it had the highest correlation. It actually supported my previous point that E-items were likely to be emerging characters that were affected by multiple factors. However, making E7 relate with all factors would create undesirable, cross-loading items and thus complicate the construct model of community. If E7 can be accounted for by multiple factors, removing the item is unlikely to harm the overall validity of the instrument. Eliminating E7 both streamlines the instrument and improves the clarity of the model.

After eliminating E7, CFI and TFI rose to 0.902 and 0.911. However, RMSEA was 0.083, still above the 0.08 threshold. Once again I referred to the modification index. Table 12 is similar to Table 11, and shows the covariances Amos suggested to add in order to improve model fit. Again, the most χ^2 was associated with x12, the error of E14 (*I felt the participation of other course participants mattered to me*). The error of an item is supposed to be random; it violates the assumptions of CFA for an error to correlate with other errors or other factors. To reduce χ^2 and improve model fit, it made more sense to remove E14 rather than to manipulate

x12. Once again, to avoid cross-loading and increase interpretability and model fit, E14 was eliminated. After eliminating E14, RMSEA was reduced to 0.078, indicating an acceptable fit.

Table 11. Suggested modification indices of regression weights in CFA

			M.I.	Par Change
E7	<---	F3	33.484	.530
E7	<---	F1	30.257	.579
E7	<---	F4	33.136	.370
E7	<---	R2	5.455	.066
E7	<---	R5	6.821	.072
E7	<---	E5	4.907	.051
E7	<---	I2	4.262	.048
E7	<---	I14	4.351	.044
E7	<---	E1	5.574	.056
E7	<---	E8	5.709	.053
I4	<---	F1	4.417	-.211
I4	<---	F4	4.998	-.137
I5	<---	F3	4.441	-.193
I5	<---	F1	7.442	-.287
I5	<---	F4	5.330	-.148
I6	<---	F3	6.731	-.194
I6	<---	F1	10.613	-.281
I6	<---	F4	11.803	-.181
I7	<---	F3	4.006	.171
I7	<---	F1	13.392	.359
I7	<---	F4	7.932	.169
I8	<---	F2	15.330	.303
I10	<---	F2	6.023	-.199
I16	<---	F2	5.282	-.196
E1	<---	F2	4.672	.169

M. I. = modification indices, changes in χ^2 when suggested regression weights are added.

Par change = estimated regression weight of such relationships.

Table 12. Suggested modification indices of covariances in CFA

			M.I.	Par Change
x12	<-->	F2	5.613	-.128
x24	<-->	x12	5.460	-.111
x27	<-->	x12	6.599	.119
x21	<-->	F2	4.035	-.083
x21	<-->	F1	4.269	.037
x21	<-->	x12	4.270	.088
x22	<-->	x27	6.947	-.100
x15	<-->	x26	5.034	-.079
x17	<-->	x15	14.519	.138
x18	<-->	F2	4.182	-.111
x18	<-->	F1	17.730	.101
x18	<-->	x14	9.177	.129
x18	<-->	x17	14.242	-.157
x1	<-->	F1	4.084	.059
x1	<-->	F4	9.485	-.175
x3	<-->	F2	21.413	.215
x3	<-->	x12	7.146	-.127
x3	<-->	x26	6.028	.084
x3	<-->	x14	4.330	.077
x4	<-->	F2	6.784	.144
x4	<-->	x12	9.316	-.173
x4	<-->	x26	4.363	.085
x4	<-->	x21	4.994	-.097
x4	<-->	x3	11.030	.162
x5	<-->	F3	10.385	-.090
x5	<-->	F4	9.085	.124
x5	<-->	x27	12.046	.145
x6	<-->	x5	7.791	.111
x7	<-->	F3	6.691	.062
x7	<-->	F4	13.055	-.128
x7	<-->	x12	29.766	.234
x7	<-->	x24	12.107	-.129
x7	<-->	x18	4.021	.087
x8	<-->	F2	5.665	-.121
x9	<-->	F2	6.494	.119
x9	<-->	x24	5.150	.094
x9	<-->	x1	18.498	.257
x10	<-->	x6	5.573	-.088
x10	<-->	x9	7.009	.108
x11	<-->	x12	6.817	.130
x11	<-->	x24	5.415	.100
x11	<-->	x1	6.295	-.156
x13	<-->	x14	4.146	.079
x13	<-->	x6	4.417	.083

M. I. = modification indices, changes in χ^2 when suggested covariances are added.

Par change = estimated regression weight of such relationships.

Finalizing the CMI. The finalized 25-item CMI is included in Appendix C. Items 1 and 8 were negatively worded and reverse scored (SA=1, A=2, N=3, D=4 and SD=5). For all other items, SA=5, A=4, N=3, D=2 and SD=1. The total score of community is the sum of all item scores. Factor 1 (F1) is calculated as the sum score of items 1-12, F2 the sum score of 13-17, F3 the sum score of items 18-21, and F4 the sum score of items 22-25. The value of the scores are discussed in later sections.

To examine whether much information was lost during the 41-to-25 item reduction, I calculated the total sum score of the initial 41-item version of CMI as community_raw, and examined the relationship between the 25-item CMI and the 41-item CMI via a linear regression. Table 13 and Figure 12 show the regression of community_raw on community. There was an almost perfect linear relationship between community_raw and community, with a standardized coefficient of 0.992. Community was able to explain 98.5% of the total variances of community _raw, which indicated that not much information was lost in the process of item reduction.

Table 13. Regression coefficients of community on community_raw

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.962	1.175		9.332	<.001
	community	1.509	.015	.992	97.588	<.001

a. Dependent Variable: Community_raw

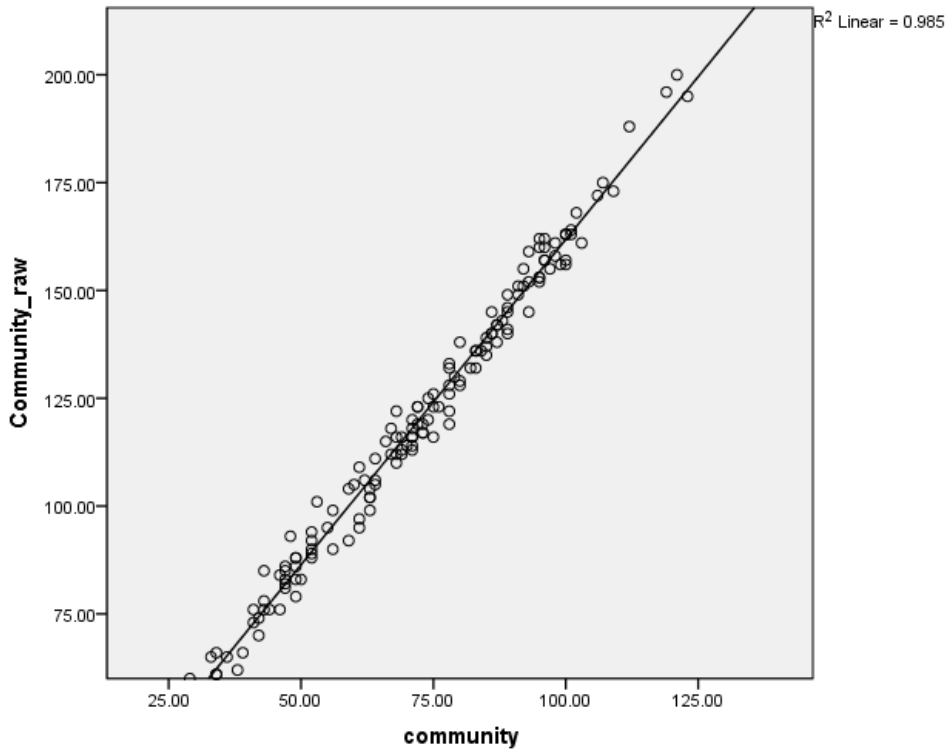


Figure 12. The regression of community on community_raw.

Validity and Reliability of the CMI

Validity and reliability are key criteria of any educational or psychological test. Validity refers to the degree to which a test actually measures what it claims to measure, while reliability refers to the degree to which the test can produces stable and consistent results (AERA, APA, & NCME, 1999). Validity and reliability confirmations of the CMI are discussed below.

Content validity. Classic validity theory divides validity into three categories: content, criterion and construct validity (Messick, 1989). Content validity refers to the degree to which an instrument measures all aspects of a given construct. In this study, content validity was supported by my literature review of the theoretical foundations of OLCs, careful selection and synthesis of instrument items based on seven related instruments from the literature, and an expert review of the items.

Criterion validity. Criterion validity refers to the extent to which the measures are consistent with empirical observations. Criterion validity can be divided into concurrent and predictive validities. Concurrent validity examines whether an instrument correlates well with a previously validated instrument that measures the same construct, while predictive validity describes the degree to which the construct as measured by the particular instrument can predict future performances or behaviors (McIntire & Miller, 2005). In this study, it is yet unclear to what extent the measure of community can be appropriately used to predict performances or behaviors. Therefore, I focused on concurrent validity as a means to determine criterion validity.

Concurrent validity. In this study, the concurrent validity of CMI is determined by comparing with the Classroom Community Scale (CCS) by Rovai (2002a). CCS was developed to measure sense of community of an online course. It has two subscales, CC_{total} and CL_{total}, measuring classroom connectedness and classroom learning respectively. The correlations between CMI and CCS, also CCS's both subscales, are listed in Table 14.

Table 14. Correlation between community (as measured by CMI) and CCS

	Correlation with community as measured by the CMI	Sig.(2-tailed)
CCS	0.851**	<.001
CCtotal	0.909**	<.001
CLtotal	0.549**	<.001

The results showed that the community score measured by CMI correlated highly with CCS (r=0.851) and CC_{total} (r=0.909), and moderately with CL_{total} (r=0.549). Such results were expected. In Chapter 2, I defined community as socially and emotionally connected people whose learning is influenced by such social and emotional connections. Therefore, connectedness becomes crucial to community and one might expected that a measurement of community was well correlated with a measurement of connectedness (CC_{total}). However, unlike

CCS, the CMI does not attempt to measure learning, so it was not well correlated with learning (CL_{total}). Affected by the CL_{total} subscale, the correlation between CMI and CCS was slightly lower than the correlation between CMI and CC_{total}. Nevertheless, at r=.851, the CMI still correlated reasonably well with the CCS, demonstrating good concurrent validity.

Construct validity. Construct validity examines whether the instrument measures the hypothetical constructs proposed by theory (Cronbach & Meehl, 1955; Messick, 1995). Construct validity can be determined by convergent, discriminant and nomological validity (Hair, Black, Tatham, & Anderson, 1998): Convergent examines the extent to which indicators of a specific construct "converge" or share a high proportion of variance in common. Discriminant validity tests the extent to which a construct is truly distinct from other constructs. Nomological validity examines whether the correlations between the constructs in the measurement are supported by theory.

The results of the CFA can help to determine convergent, discriminant and nomological validity. To establish convergent validity, factor loadings should be at least 0.5, and preferably above 0.7. In addition, average variance extracted (AVE) of each individual construct should be larger than 0.5. AVE is calculated as:

$$AVE = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$$

In the formula above the λ represents the standardized factor loading, and i is the number of items within a factor. An AVE of above 0.5 indicates that more than half of the variances in the factor can be accounted for by the variances of the items. In this study, the AVE of F1, F2, F3 and F4 were 0.651, 0.642, 0.717, and 0.712 respectively, all above 0.5. High AVE along with high factor loadings (Table 9) supported convergent validity of the CMI.

Discriminant validity. Discriminant validity is established when all constructs' AVE are larger than the corresponding squared interconstruct correlation estimates (SIC). If they are, this indicates the measured variables have more in common with the construct they are associated with than they do with the other constructs. Table 15 lists AVE and SIC of each construct. While most AVE met the criterion above, due to high correlation between F1, F3 and F4, the AVE of F1 was lower than the square of the F1/F3 correlation and the F1/F4 correlation. This may suggest that F1, F3 and F4 had little differences and could be merged. However, previous results had shown that a 4-factor model better described the data than 2- or 3-factor models. Therefore, I believe the decision to keep F1, F3 and F4 distinct is justified and that the AVE of F1 did not cause overall threat to CMI's validity. Based upon this judgment call, the CMI has acceptable discriminant validity.

Table 15. Interconstruct correlation estimates and average variances extracted of the CFA factors.

		Correlation	SIC	AVE
F1	-F1	-	.	.651
	-F2	.408	0.166	
	-F3	.834	0.696	
	-F4	.819	0.671	
F2	-F1	.408	.166	.642
	-F2	-		
	-F3	.392	.154	
	-F4	.222	.049	
F3	-F1	.834	.696	.717
	-F2	.392	.154	
	-F3			
	-F4	.788	.621	
F4	-F1	.819	.671	.712
	-F2	.222	.049	
	-F3	.788	.621	
	-F4			

Nomological validity. Nomological validity examines the correlations among constructs against theory or model – in this case, the correlations should conform to the empirical model of community shown in Figure 11. Factors were expected to correlate in the model. Table 15 indicated that F1, F3 and F4 had high correlations with each other, while F2 had medium-to-low correlations with other factors. As previously discussed, F3 captured the perceived benevolence of other course participants, and F4 measured relationships. It was apparent that student-student interactions (F1) had a large influence on students' perception of others and interpersonal relationships: When there were more interactions, students were more likely to perceive others as caring, supportive or trustworthy (assuming that such interactions were positive; responses would run together in the opposite direction if the interactions were negative), and more likely to develop personal relationships with other learners. On the other hand, student-instructor interactions were less related to student-student interactions. It was perfectly possible, maybe

even common, to have an online course in which the instructor frequently interacted with each student but the students hardly interacted with each other. Overall, the correlation pattern of factors was consistent with the model of community, showing evidence of nomological validity.

Reliability. Cronbach's alpha (Cronbach, 1951) was calculated to examine the internal consistency of each of CMI's constructs. Cortina (1993) and Schmitt (1996) emphasized that Cronbach's alpha is a measure of interrelatedness, rather than unidimensionality of items. Multidimensional items can still be relatively interrelated, and Cronbach's alpha actually underestimates reliability if items are multidimensional. In such cases, it is more appropriate to report internal consistency of each construct, rather than the instrument as a whole. For the CMI, Cronbach's alpha of Factors 1, 2, 3, and 4 were 0.96, 0.90, 0.91 and 0.91 respectively, indicating excellent reliability.

Summary of evidence for validity and reliability. The validity and reliability of the CMI are established from multiple sources. The content validity of the CMI begins with the conditions of its creation, an extensive literature review of theoretical foundations of OLCs, a careful analysis of previously validated instruments, and an expert review of the items. Concurrent validity of the CMI was supported by comparison with another instrument, the CCS, that measured the same construct, albeit based on different theoretical framework. Additionally, the CMI demonstrated a clear construct structure that is compatible with the proposed theoretical framework of OLCs. Internal consistency, or reliability, of each of the CMI's constructs was high. Therefore, the CMI shows potentials as a tool to measure community in online courses.

Exploration of the Relationship of Community and Learning in Online Courses

Community, PL and SS.

The next step was to use the CMI data to explore possible relationships between the elements of the theoretical model: community, learning, and the patterns of interaction within online courses. For this purpose, the data constitutes a convenience sample: it was collected for the purpose of testing and validating the CMI and not for the purpose of testing and validating the theoretical model. Accordingly, any findings from this data are taken as potential directions for future research rather than a claim about the theoretical model and the interaction of its components. This exploration took place in two phases: examination of the relationship between community and learning, then examination of relationships among community, learning, and division of labor (class interaction patterns).

Table 16 lists the item scores, factor scores, total scores of the CMI, PL and SS. The mean of the community score was 72.98 (against a possible score range of 25-125), indicating a moderate level of community. Students did not display differences in community based upon gender, age, registration status or prior online learning experiences. On average, the F2 (student-instructor interactions) items scored the highest while the F4 (relationships) items scored the lowest, suggesting that the instructor-student interactions were relatively high and personal relationships were relatively low in the online courses taken by the participants. The means of PL and SS were 11.86 and 11.78 respectively (against a possible score range of 3-15), indicating that students generally perceived learning to be high and were satisfied with the online courses.

Table 16. Mean and standard deviation of the CMI's item scores, factor scores, factor scores, PL and SS

	Mean	Std. Deviation
	(*N*=148)	
1/I1	3.16	1.419
2/I2	2.61	1.323
3/I8	2.90	1.211
4/I9	2.97	1.131
5/I10	2.65	1.200
6/I11	2.95	1.374
7I14	2.92	1.348
8/I16	2.67	1.248
9/E1	2.53	1.269
10/E8	2.76	1.260
11/E13	2.73	1.312
12/E15	3.42	.976
13/I3	3.63	1.045
14/I4	3.85	1.115
15/I5	3.53	1.175
16/I6	3.93	1.004
17/I7	3.46	1.174
18/E3	2.72	1.074
19/E4	3.09	1.062
20/E5	2.63	1.252
21/E6	3.02	1.007
22/R2	2.07	1.184
23/R4	2.24	1.123
24/R5	2.14	1.188
25/R6	2.41	1.068
F1	34.26	12.43
F2	18.40	4.64
F3	11.46	3.90
F4	8.86	4.03
community	72.98	21.23
PL	11.86	2.700
SS	11.78	3.093

Table 17 lists the correlation among the CMI and its factors, CCS and its factors, and PL and SS. Community and all of its factors significantly correlated with PL and SS, with the exception of the F4/PL correlation. Among all of CMI's factors, F2 (student-instructor interactions) had the highest correlation with PL and SS (r=0.606, 0.690). CCS and its subscale CL_{total} had higher correlation with PL and SS than community, but CC_{total} was comparable with community in predicting PL or SS. In addition, PL and SS were strongly correlated (r=0.894).

Table 17. Correlation among community, CCS, PL and SS.

	Correlation with PL	Correlation with SS
community	.371**	.470**
F1	.299**	.384**
F2	.606**	.690**
F3	.255**	.325**
F4	.090	.194*
CCtotal	.377**	.428**
CLtotal	.783**	.792**
CCS	.643**	.675**
PL	1	.894**
SS	.894**	1

**: Correlation is significant at the 0.01 level (two-tailed).
*: Correlation is significant at the 0.05 level (two-tailed).

Community, PL and SS by different class interaction patterns. Table 18 lists the means of community, PL and SS, and differences of the variables by groups of different patterns of division of labor, or class interactions. The results of the t-test indicated that there were significant difference in community by groups. The effect size as measured by Cohen's *d* (Cohen, 1988) was 1.20, indicating a large effect size. The two groups also had significant differences in SS, but the effect size was quite small (Cohen's *d* =0.32). There were no significant differences in PL by groups.

Table 18. Community, PL and SS by different class interaction patterns.

	Mean by group		t-test		
	Interaction=0 (*N*=92)	Interaction =1 (*N*=56)	t	dF	Sig. (2-tailed)
community	64.65	86.66	-7.463	135.861	<.001
PL	11.76	12.02	-.606	142.090	.545
SS	11.40	12.41	-2.090	139.786	.038

The relationship among community, PL and SS by different class interaction patterns. Table 19 and Figure 13 show the regression of PL on community by different class interaction patterns. PL was higher in the no interaction group than the some-interaction group when holding community as a constant; or, the some-interaction group had higher community than the no-interaction group of the same PL. At higher levels of PL, the differences in community scores between groups grew larger. For example, a PL of 11.00 corresponded to a community score of 52.56 in the no-interaction group, or 67.13 in the some-interaction group. A PL of 13.00 corresponded to a community score of 84.82 in the no-interaction group, or 105.60 in the some-interaction group.

Table 19. Regression coefficients of PL on community by groups.

Coefficients[a]							
interaction	Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
			B	Std. Error	Beta		
0	1	(Constant)	7.741	.982		7.885	<.001
		community	.062	.015	.411	4.281	<.001
1	1	(Constant)	7.509	1.508		4.978	<.001
		community	.052	.017	.382	3.037	.004

a. Dependent Variable: PL

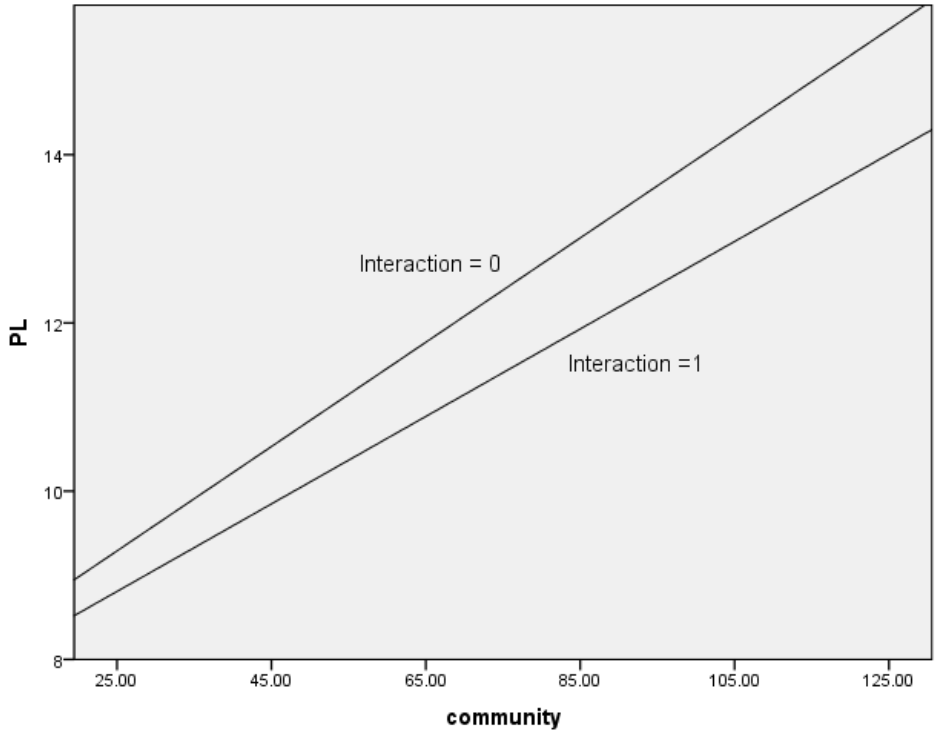


Figure 13. Regression of PL on community by different class interaction patterns.

Whether the two regression lines in Figure 13 were statistically different can be tested as follows: Moderation refers to the situation when the relationship between two variables depends on a third variable (Cohen, Cohen, West, & Aiken, 2003). In the next equation, X represents the dependent variable, M represents the moderator, and Y represents the independent variable. The regression coefficient b_3 would be significant if the moderation exists.

$$Y = b_0 + b_1X + b_2M + b_3XM + \varepsilon$$

Therefore, to determine whether the relationships between community and PL differed by interaction, the regression of PL on community, interaction (dummy variable), and community*interaction was examined. The results are listed in Table 20. The coefficient of community*interaction was not significant (p=0.686), indicating that the relationships between community and PL did not differ by groups.

Table 20. Moderation effect of class interaction patterns on the PL-community relationship.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.741	.891		8.686	<.001
	community	.062	.013	.489	4.716	<.001
	interaction	-.231	2.080	-.042	-.111	.912
	community*interaction	-.010	.025	-.163	-.405	.686

a. Dependent Variable: PL

Table 21 and Figure 14 show the regression of SS on community by different class interaction patterns. SS was higher in the no interaction group than the some-interaction group when holding community as a constant; or, the some-interaction group had higher community than the no-interaction group of the same SS. The higher the SS score, the smaller the differences between groups' community scores. For example, a SS of 11.00 corresponded to a community score of 59.57 in the no-interaction group, or 68.36 in the some-interaction group. A SS of 13.00 corresponded to a community score of 86.24 in the no-interaction group, or 94.00 in the some-interaction group.

Table 21. Regression coefficients of SS on community by groups.

Coefficients[a]							
interaction	Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			B	Std. Error	Beta		
0	1	(Constant)	6.532	1.088		6.005	<.001
		community	.075	.016	.444	4.675	<.001
1	1	(Constant)	5.668	1.658		3.419	.001
		community	.078	.019	.490	4.132	<.001

a. Dependent Variable: SS

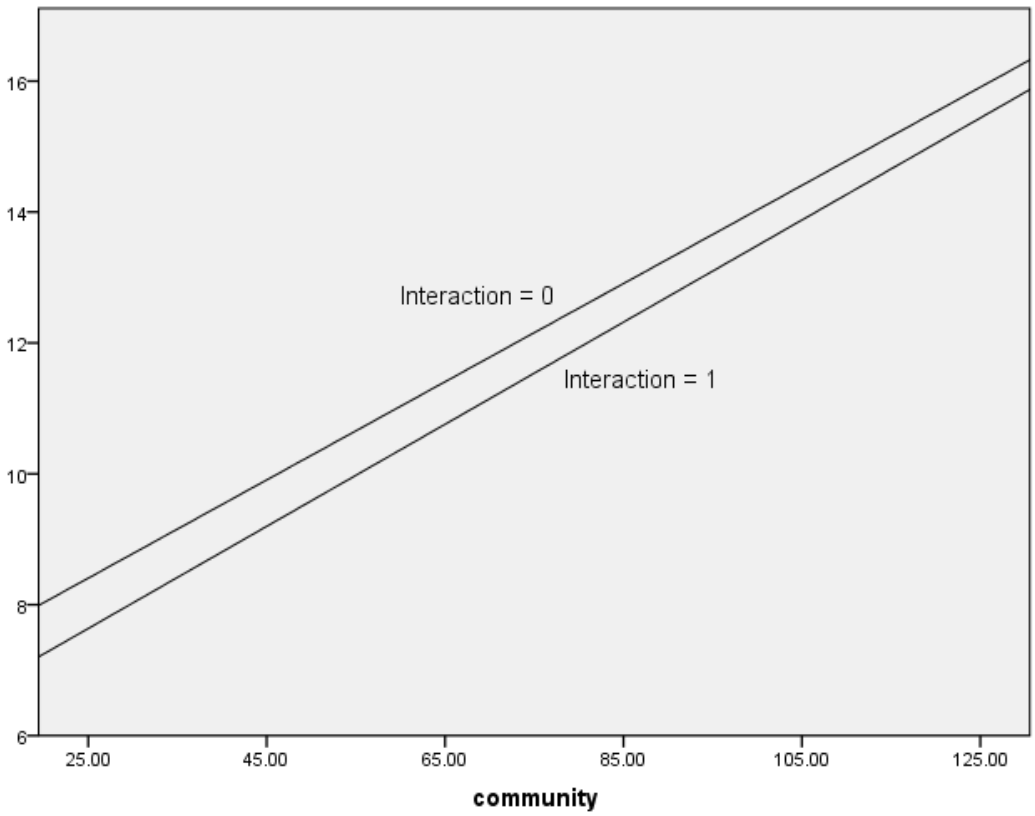


Figure 14. Regression of SS on community by different class interaction patterns.

Similarly, the moderation effect of class interaction patterns on the community-SS relationship was examined, and the results are listed in Table 22. Again, the coefficient of (community*interaction) was not significant, indicating that the relationship between SS and community did not have significant differences by different class interaction patterns.

Table 22. Moderation effect of class interaction patterns on the SS-community relationship

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.532	.986		6.627	<.001
	community	.075	.015	.515	5.159	<.001
	interaction	-.864	2.293	-.136	-.377	.707
	community*interaction	.003	.028	.038	.099	.922

a. Dependent Variable: SS

To further explore the relationship among community, PL and SS, regression of SS on PL and community was examined. The results are shown in Table 23. For the no interaction group, the coefficient of community is not significant, and the regression equation was,

$SS = b_0 + 1.006\ PL + \varepsilon$

For the some-interaction group, the regression equation was,

$SS = b_0 + 0.853\ PL + 0.033\ community + \varepsilon$

The regression results indicated that at higher interaction situations, SS was less affected by PL and more affected by community.

Table 23. Regression coefficients of student satisfaction (SS) on community and perceived learning (PL) by groups.

Coefficients[a]							
interaction	Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			B	Std. Error	Beta		
0	1	(Constant)	-1.159	.585		-1.980	.051
		PL	1.006	.049	.898	20.687	<.001
		community	.012	.007	.068	1.571	.120
1	1	(Constant)	-.740	1.274		-.581	.564
		PL	.853	.095	.732	8.970	<.001
		community	.033	.013	.210	2.578	.013

a. Dependent Variable: SS

The instructor survey. To learn about the online instructors' perspectives of community, and to validate the data collected in the student survey, an instructor survey was sent to 33 instructors who taught online courses in the Fall 2013 semester. Five instructors responded to the survey. Instructor 1 taught business courses, Instructor 2 and 5 taught science courses, and Instructor 3 and 4 taught engineering courses, which covered all content areas of the courses investigated in this study. Instructors 1, 2, 3, and 4 taught courses that required some student-student interactions. Their courses also had a group of on-campus students who took the same

course as the distance students. The class videos were recorded and watched by distance students either synchronously or asynchronously. Instructor 5 taught a course in which no student-student interactions were required. There were no on-campus students in Instructor 5's course. Lecture videos were pre-recorded and available to the students throughout the semester. The responses of the instructor survey were hand-coded and compared with the data gathered from the student survey.

To Question 1 (*Overall, how do you feel about the level of learning your students achieved in this course),* Instructors 1-4 compared learning of their distance and on-campus students. Instructor 1 said that distance students learned less well than in-class students due to "failures in technology (e.g., connection drops, screen size, delays in transmission)" and distractions. Instructors 2 and 3 held that distance students learned about as much as in-class students. Instructor 4 explained that his distance students were demographically different from the on-campus students, and were more mature, experienced learners:

> My on-line [d]istance students are generally much more mature than on-campus students, some even in their fifties - they communicate well, usually punctilious about meeting deadlines and communication requests, forum posts etc. [They] work well on teams and do fine work. I enjoy working with these students and learn a lot from their projects that diffuses into my work with first year [undergraduates]; and other [undergraduates] that I have in on-campus classes.

Instructor 5 did not have an on-campus group to compare to, and estimated that about half of class gained significant learning while the other half struggled.

To Question 2 *(In online learning, community may refer to a socially and emotionally connected group of learners. How would you describe the level of learning community in your*

course?), all instructors suggested that community was low among distance students. Instructor 3 rated the connectedness of the class to be 6 on a 0-10 scale. Instructor 2 brought that the level of community varied from learner to learner, but for distance students this level was likely to be on the low end – "For some it is very low to non-existent, for others it is low to only moderate." Both Instructor 1 and 2 mentioned that only a few technologies (chat rooms, online forums, synchronous Q-and-A sessions) were available for distance students to communicate with others, and the opportunities to use these technologies were limited. Instructor 3 mentioned that his distance students explicitly told him that it was more challenging to achieve the sense of community in the online courses. He had tried various means to address the issue, incorporating phone communications with the distance students, informal study groups, more synchronous sessions, and group projects that required distance/campus student collaborations. Similarly, Instructor 4 also tried to have students of different geographic locations and backgrounds to work together for team projects. Instructor 5 was limited by the asynchronous nature of the course: "I dealt with each one as an individual, although my answers to their questions were always shared with the class at large by email." He concluded there was not much opportunity for community formation in his class.

To Question 3 *(Did the level of learning community in your course have any impact on teaching and learning? What are the impacts like?),* the instructors tended to agree that learning was hindered by a lack of community and facilitated by an interactive community. It was interesting, though, that the instructors seem to be quite cautious in expressing their opinions. For example, Instructor 3 said, "I believe lack of community would hinder learning, but I don't have any evidence to support this." Instructor 2 used the expression "*if anything*, a higher level of community helped learning." (Emphasis added by the researcher.) Instructor 5 also said, "*in*

my view, a more interactive learning community would have helped all the students, especially those who were struggling." (Emphasis added by the researcher.) Instructor 1 found distance students to have disadvantages in team projects, and Instructor 2 observed that on-campus students had more opportunities to work with peers, which were helpful to their learning. On the contrary, Instructor 4 described a positive community experience in which the whole class, including the instructor, learned from the distance students who shared their experiences and expertise with the class:

> I am frequently in receipt of links and discussion items from students in one course that are worth sharing with students my other courses that are not on-line. The Distance Ed. community with interests in manufacturing affords extremely valuable information, experiences and anecdotes that really enrich my work with on-campus students whether first year, or juniors and seniors. Students that get the opportunity of being on teams with full-time working professionals claim to gain appreciable experience and enjoy their collaborations.

Instructor 5 spoke of the need for more community, "I am not sure how to accomplish [a more interactive community] via distance learning, but it would be worth investing time to develop it."

Table 24 lists means of community, PL and SS as reported by the instructor's students. It appeared that the students in the no-interaction course (Instructor 5) did report lower community, PL and SS, which was consistent with the student survey results. However, the instructors' evaluations of class learning and the level of community were not always consistent with what were reported by the students. Among Instructors 1-4, Instructor 1 rated student learning and level of community to be the lowest, while Instructor 4 rated the highest. However, Instructor 1's students actually reported higher community, PL and SS than Instructor 4's students. It could be

possible that Instructor 1 held a higher standard for student learning and class community. In addition, because both instructors had only a few students who participated in the study, the participants may not represent the class well, thereby skewing the data.

Table 24. Mean of community, perceived learning (PL) and student satisfaction (SS) reported by individual instructor's students.

	Interaction	Number of students responded	Mean		
			Community	PL	SS
Instructor 1	1	3	100.00	13.67	13.67
Instructor 2	1	2	81.50	11.50	13.00
Instructor 3	1	2	86.00	12.00	11.00
Instructor 4	1	2	98.50	11.50	11.00
Instructor 5	0	2	47.50	8.50	7.50

Summary

This chapter reported the detailed data analyses process used to finalize the CMI. The number of items on the CMI were reduced from 41 to 25 items during the process, and the conceptual model of community in OLCs was adjusted, based on the construct structure of the finalized CMI. The validity and reliability of the CMI were supported by various statistical analyses. A preliminary study of the relationship among community, PL, SS and division of labor showed there were significant differences in community and SS in online courses of different class interaction patterns: in courses that required at least some student-student interactions, students reported significantly higher level of community and higher SS than students in courses that required no student-student interactions. However, the relationships between community and learning appeared to make no significant differences in different class interaction patterns. Implications and limitations of these results are discussed in the next chapter.

Chapter 5 Discussion

The following questions are crucial to our understanding regarding community in online learning: What is community and what are its components? How important is community to learning? And how does community affect learning in different online learning contexts? This chapter summarizes findings of this study and discusses their implications to the inquiry of these questions. Limitations of the study and an agenda for future research are also discussed in this chapter.

Community and Its Factors

To understand what community is, this study first proposed a conceptual model of community guided by the activity theory theoretical framework. CMI, a tool to measure community, was developed, based on the conceptual model. Correspondingly, the process to develop and validate the CMI guided the verification and adjustment of the factor structure of community.

A model of community supported by empirical data was illustrated in Figure 11. Results of the CMI revealed community to have four factors: student-student interaction, student-instructor interaction, perceived benevolence of others, and relationships with others. The factor structure shares similarities, while also having distinctions, with both the CoI model (Garrison, Anderson & Archer, 2000) and Rovai's (2002a) conception of learning community. For example, the factor of student-instructor interactions appears to have a connection with the CoI construct of teacher presence (Figure 1), which refers to the design, facilitation, and direction of learning by the instructors. The CoI's definition of teacher presence is broader though: Because I defined community to only concern interpersonal interactions, rather than subject-object interactions (see Figure 4), the teacher's direct involvement in the learning activities was not considered as part of community.

The CoI model also identified the construct of social presence, which refers to the ability of participants to communicate purposefully, to develop interpersonal relationships and group identities in a learning environment (Garrison, 2009). The concept of social presence seems to be parallel with my community factors of student-student interactions and relationships. In addition, my factor of perceived benevolence of others is closely linked to indicators of connectedness in Rovai (2002a)'s CSS instrument.

The three factors of student-student interactions, perceived benevolence of others and relationships were highly correlated. Trust, defined as one's willingness to rely on other members of the community (Moorman, Zaltman & Deshpande, 1993), might be a latent variable that connects interactions, benevolence and relationships. For trust and interactions, McKnight, Cummings, and Chervany (1998) suggest that personal interactions are among the important factors to form trust. Benevolence is one of the three factors (integrity, benevolence, and ability – see Mayer, Davis, & Schoorman, 1995) upon which one's trustworthiness is determined. As for trust and personal relationships, Eastlick, Lotz, and Warrington (2006) found that trust is an important antecedent for individuals to maintain relationships with the community. Wu, Chen, and Chung (2010) found shared values of community to have a positive impact on both trust and relationship among members, and satisfaction with previous interactions increases both the level of trust and relationships. Therefore, it appears the variables of interactions, trust, benevolence and personal relationships are entwined. Both positive interactions and perceived benevolence of others are factors contribute to determine trust, and trust further enhances personal relationships among community members. If trust correlates with interactions, perceived benevolence, and relationships, it gives a possible explanation of why the latter three community factors were

highly correlated. More research is needed on the issue to further explore the connections and differences among the three factors.

As shown in Table 17, within all of CMI's factors, F2 (student-instructor interactions) was best at predicting PL and SS. This is consistent with the line of CoI literature (Akyol & Garrison, 2008; Diaz, Swan, Ice, & Kupczynksi, 2010; Shea & Bidjerano, 2008, 2009b), which found teaching presence to be crucial to the overall learning experience. In this study, student-instructor interactions correlated with PL at r=0.61, similar to quantitative results reported by Garrison, Cleveland-Innes, and Fung (2010) and Shea, Li and Pickett (2006).

As shown in Table 15, on average, F2 (student-instructor interactions) items scored the highest (per number of items), indicating high student-instructor interactions in online courses investigated in this study. Shea and Bidjerano (2009a) reported that students who experienced low social presence but high teaching presence still reported high cognitive presence (learning). Therefore, the high PL and SS reported by participants in this study (Table 15) were likely due to the relatively high student-instructor interactions.

In comparison, F4 (relationships) items scored the lowest, indicating low relationships among students. Indeed, it appeared the development of relationships is difficult in online courses where time is limited, supporting Brown's (2001) conclusion that not all OLCs could enable the development of long-term relationships. The result is also consistent with Wade, Cameron, Morgan, & Williams (2011), who observed that deep relationships are not necessary to the development of OLCs. Therefore, it appears more research is needed to explore the role of relationship in communities.

The Role of Community in Online Learning

The constructivist theory of learning holds that learning is promoted by communities (see, among others, Barab, Kling, & Gray, 2004; Garison, 2009; Palloff & Pratt, 1999; Snyder, 2009). Results of this study supported the viewpoint, as community had a positive correlation with PL(r=0.371) and SS (r=0.470), or students tended to report higher PL and SS at higher community levels (Table 16). However, it is also worth noting that the correlations were not very large – the variances in community were only capable of explaining 13.7% of the variances in PL and 22.1% of the variances in SS. At first glance, it appeared that CCS was better at predicting PL and SS than CMI (Table 16). However, if we look at both of CMI's subscales, CL_{total} was excellent at predicting PL and SS (r=0.783, 0.792), while CC_{total} performed no better than CMI (r=0.377, 0.428). Given that CL_{total} is a measure of classroom learning, the high correlation between CL_{total} and PL was expected. The correlation between CCS and PL was inflated by the effect of CL_{total}. The fact that CC_{total} and the CMI performed about the same in predicting PL and SS actually confirmed that community and social connectedness were poor indicators of learning in this study.

It may appear then, that community had only a small influence on learning. However, qualitative data illustrated a different picture. The results of the instructor survey suggested that both the students and the instructors sensed a need for more community in their courses. Although I did not ask about students' opinions in the survey, Instructor 3 reported that his students explicitly told him it was challenging to achieve a sense of community in online courses. Even for instructors without such students, they made effort to incorporate community in their courses (Instructor 4), or expressed willingness to do so (Instructor 5). Some instructors described situations in which community promoted learning (Instructor 2 and 4) and lacking of

community hindered learning (Instructor 1). In short, it appeared that the instructors valued community, which suggests that there may be a link between community and learning.

Several limitations of the study prevented the drawing of a more solid conclusion. First, the surveys, and particularly the instructor survey, suffered from low response rates. The numbers of instructors who responded were unevenly divided between the no-interaction group and the some-interaction group: four instructors out of the 11 instructors from the some-interaction group responded, while only one instructors out of the 22 instructors from the no-interaction group responded. Therefore, the survey results better represent the opinions of the instructors from the some-interaction group than the no-interaction group. It is possible that the instructors who required student-student interactions in their courses were more aware of the importance of the communities. In contrast, the majority of the respondents to the student survey (92of 148, or 62.2%) were from the no-interaction group. This may be a possible explanation of why the student survey and the instructor survey suggested different relationships between community and learning.

In addition, discipline areas in which the participants take courses might play a role in the way learning and community were perceived by the participants. Neumann (2001) and Neumann, Parry, and Becher (2002) divided academic disciplines into “hard” or “soft”. A discipline is considered “hard” if it had a dominant paradigm, or “soft” if competing paradigms exist. Hard fields focus more on knowledge acquisition, in which learning is more linear and teaching features more direct instructions. On the contrary, learning in soft disciplines tend to be constructive and reiterative. In this study, more than half of the participants (58.8%) were in “hard” disciplines of science or engineering. As these courses were less likely to take a constructive approach (Arbaugh, Bangert, and Clevenland-Innes, 2010), communities played a

less important role in the learning process. Therefore, as the majority of the students are in hard areas, community likely played a relatively small role in their learning.

Limitations of the data can actually lead to more research questions. For example, what factors are associated with instructors' decisions of whether to incorporate student-student interactions in their online courses? To what degree do discipline areas play a role in such decisions? Or are instructors' personal beliefs regarding community the key? (The fact that instructors in the no interaction group hardly responded to the survey may not be a coincidence – it may suggest that these instructors were not interested in the topic of community and learning.) Do technical or institutional issues prevent instructors to incorporate more student-student interactions in the courses? (Instructor 1 complained about "technology failures" in his responses, and Instructor 5 mentioned he wanted to incorporate more community but didn't know how.) How can online faculty be better supported if they want to adapt a more interactive instructional design?

A similar line of research questions can be directed toward the online students. For example, it is not clear to what degree do discipline areas affect the relationship between community and learning. Additionally, students' beliefs on community in learning may play a role in students' perceptions of class community, learning and satisfaction, which calls for further exploration.

The study of the relationship between community and learning also raises questions regarding learning design. Results of the study suggested that there may be situations when additional efforts for incorporating community in learning do not translate into learning outcomes. Does it mean that building a sense of community is not worth the effort required? If this is the case, how can we identify such situations to optimize instructional design? Or can

community affect learning in ways other than learning outcomes? What if students' preferences for community contradict with the instructional design of the instructor's choice? While this dissertation did not result in definite conclusions on the role of community in online learning, it helps to identify questions that may guide further research on this issue. Many of these question calls for in-depth interviews of both the online students and instructors to find out more about their beliefs, needs, experiences and practice regarding OLCs.

The Relationship Between Community and Learning in Different Contexts

Using a convenience sample, this study made a provisional analysis of the relationship between community and learning in different contexts. Observations of the study were, (a) The some-interaction group had higher community than the no-interaction group of the same PL or SS; (b) the relationship between PL/community and SS/community did not have significant differences by class interactions patterns; (c) at higher interaction situations, SS was less affected by PL and more affected by community.

Observation (a) indicates that in comparison with the no-interaction group, the some-interaction group needed higher community to achieve the same level of learning. The result seemed natural: An instructor might require student-student interactions in his course because he or she sees such interactions as facilitating learning in the specific content area. However, simply because student-student interactions are required does not guarantee such interactions to be effective or productive. When community is low, the interactions may be infrequent and superficial, contributing little to learning. When community is high, students become more engaged in the interactions through which learning is enhanced (Drouin, 2008; Oren, Mioduser & Nachmias, 2002; Ouzts, 2006; Swan, 2002). Assuming this is true, it can be expected that

community becomes more important when learning heavily relies on interactions. It is likely that such courses can establish higher learning only when community level is high.

For observation (b), one possible reason is that courses studied in this study had overall low interactions. Even in the some-interaction group, the interactions were still low, as indicated by some instructor's testimonies. Therefore, the differences in class interaction patterns may be too small for us to detect any change in the relationship between learning and community. More research may be needed to further explore the issue.

Observation (c) could be explained as follows: when there was no student interaction required, learning activities were more likely to be limited to direct instructions and self-paced learning. As community-based learning did not matter, community (or lack thereof) did not play any role in the overall learning experience. As more interactions were required, more learning was involved with community; consequently, community had a greater effect on the overall learning experiences and students' satisfaction with their learning experiences. This may also help to explain why the SS-PL correlation in this study was particularly high (r=0.894), while the literature typically reported correlations between PL and SS ranging from 0.4 to 0.7 (Akyol & Garrison, 2008; Rovai, Wighting, & Liu, 2005; So & Brush, 2007; Sun, Tsai, Finger, Chen, & Yeh, 2008). Given the overall low interaction level in this study, SS was more affected by PL, yielding a high SS-PL correlation.

Again, the exploration of the relationship among community, learning and division of labor was largely limited by the sample used in this study. In addition to the response rate and effect of discipline area discussed earlier, two additional factors further limited the generalizability of the findings. First, the students were scattered among multiple courses, and within each course only a few students responded to the survey. Therefore, the data may be

distorted due to the heterogeneity of the sample. In addition, the learning environment of the participants in this study may be quite different from other online learning environments. As discussed before, the majority of the students participating in the study were in asynchronous online courses in which no student-student interactions were required. Even in the courses where some student-student interactions were required, the interactions tended to be minimal. Therefore, findings of this study may not apply in more interactive learning environments.

To overcome these limitations, a different sample may be more helpful at discovering the relationship between community and learning in different contexts. Each group in such sample should be homogeneous, preferably the participants of a single course. Across the groups there should be diverse range of interactions taking place. If groups of vastly varied level of interactions still show no significant differences in perceived learning or community-learning relationships, the observations of the current study will be reinforced.

Adjustment of the OLC Model

While this study worked within the model rather than seeking to validate it, the findings suggested several possible adjustments to the model. First, with the newly identified factors of community, the community element in Figure 7 could be modified to include factors of interactions, perceived benevolence and relationships. In addition, I included student satisfaction as a product of the activity system in addition to cognitive learning in this study. To avoid the tendency of translating "learning outcomes" (right side of Figure 7) only as objectively measured, cognitive learning achievements, the label could be expanded to emphasize that learning outcomes may include all domains of learning (cognitive, affective and psychomotor, Bloom, 1956), as well as transformed identities and participation (Lave & Wenger, 1991). Moreover, the top location of tools and technology in Figure 7 may lead to the misunderstanding that the model

views technology as the most important element in OLCs. By rotating the triangle in Figure 7, this potential misunderstanding could be minimized.

Summary of the Current Dissertation Research

In summary, the current research sought to provide a systematic way of thinking about online learning communities (OLC). Guided by an extensive literature review, I proposed a conceptual model of OLCs based on the theoretical framework of activity theory (Figure 7). The model then enabled identification of important elements and relationships in OLCs, and suggested approaches to examining such elements and relationships quantitatively. The model can guide and inform OLC research in two possible ways: As the model has identified key variables, or elements of the OLC, it enables the generation of a series of research questions. Researchers can start by investigating the role of each individual variable in learning, and moving to explore the interactions among two, three or more variables. Thereby, it offers a systematic research agenda following which we can accumulate our understandings of OLCs step by step. In addition, the model can serve to reveal underlying connections among previous research. It provides a scheme to categorize existing studies according to the variables or interactions of examination (see Ke & Hoadley, 2009), which helps to make comparisons across studies of the same category and identify research areas that calls for more attention.

The study investigated community as an element of OLC. Although a few instruments are available to measure community quantitatively, the instruments do not fit well into the theoretical framework of this study. In order to further explore the constructs of community and to assist the quantitative inquiry of community in OLCs, I developed the Community Measurement Instrument (CMI). The validation process of the CMI revealed a four-factor structure of community (Figure 11). In addition to a quantitative research instrument, the CMI

can also serve as a tool for instructors, administrators and designers to evaluate online learning programs.

The study then used the validated CMI as a tool to explore the relationship between community and learning in a sample of online students. The relationships between community and learning were compared in different class interaction patterns in an attempt to explore how division of labor, one element of the OLC framework, influences the community-learning relationship. Preliminary results indicated that while community and student satisfaction were significantly different in groups of different interaction patterns, perceived learning was not significantly different by group. In addition, groups of different class interaction patterns did not show significant differences in community-learning relationships. While the findings may not be generalized beyond the sample of this study, they help to identify future research questions regarding the relationship among learning and OLC elements.

Limitations of the Current Study

The limitations of the study can be divided into three parts: Limitations of the conceptual model of OLC and community, limitations of the CMI, and limitations of the quantitative study of community and learning. First, while I developed the OLC model based on an extensive literature review and strong theoretical foundations, it is possible that my personal background, bias and limitations in knowledge had brought limitations to the model.

The CMI was limited by both the conceptual framework and the process upon which it was developed. While the CMI items was subject to expert review, it is possible that my bias could have influenced how experts' opinions were interpreted and applied in selection of the CMI items. Although I followed customary procedures to refine and finalize the CMI, at times it was up to my personal judgment to determine which item was to keep and which to remove, and

my bias could have influenced the process. In addition, the validation process largely relied on post hoc analyses, and the results may not be generalized to other populations. Moreover, the sample size of 148 can be considered small for factor analysis. This study met de Winter, Dodou, & Wieringa's (2009) criteria that a smaller sample size is sufficient at high factor loading and high item to factor ratio; however, a larger sample of 200-300 could improve the power of the study.

Many limitations of the quantitative study of community and learning have been discussed previously in this chapter. In addition, the study uses self-reported learning, or perceived learning, as a measure of learning outcomes. The validity of using self-report data in research has been widely debated. While earlier studies generally support the accuracy and appropriateness of self-reported data (Berdie, 1971; Dumont and Troelstrup, 1980; Pohlmann and Beggs, 1974), later researchers have raised questions about the validity of self-reports (Bowman, 2010; LaNasa, Cabrera, and Trangsrud, 2009; Pascarella, 2001; Pike, 1996, 1999; Porter, 2013). Pike (1999) found self-reported learning gains are under the influence of halo effect – a cognitive bias in which one's judgment about a person's traits is influenced by his/her overall impressions of that person (Thorndike, 1920). Sitzmann, Ely, Brown and Bauer (2010) found self-reported learning to correlate strongly with affective learning but only moderately with cognitive learning. Therefore, using self-reported learning as a measure of learning outcomes has its limitations. Objective measures of learning, such as test scores, are less subject to bias and may be able to demonstrate more robust results in discovering the relationship between community and learning.

The methodology of the study is largely quantitative. Although I attempted to gather qualitative data by incorporating the instructor survey, the survey suffered from low response

rate, thereby providing only limited information. In addition, the survey only reflected the instructors' perspectives on community. A qualitative investigation into students' perspectives may help to better interpret the results of the study.

An Agenda for Future Research

To address the limitations and extend the current study, I expect to carry on the research in the following four areas:

The CMI. I will incorporate the committee's advice and comments on the CMI as part of the ongoing expert review process. To further validate the finalized 25-item CMI, I plan to carry out a larger-scale validity study with a sample size of 250 or above. I would prefer to work with a larger sample of online students with a more diverse range of interaction levels. If such a sample is not available, I will then take steps to continue data collection in the current setting to achieve a larger sample size. I will use the same data analyses process (EFA and CFA) to verify the CMI's construct validity. Specifically, I will investigate the possibility of removing more student-student interaction items and E-items. Right now the student-student interaction (F1) items significantly outnumber items of other factors, and removing some F1 items might improve the balance of the instrument. I also proposed that E-items were cross-loaded; if this is the case, removing E-items could further simplify the conceptual model of community as illustrated in Figure 8.

Distance education administrator's perspectives on community. Although not directly linked to this study, as a personal interest, I would like to investigate distance education administrators' perspectives on community. Distance students, instructors and administrators are main stakeholders of distance education (Power & Gould-Morven, 2009). Interestingly, although many studies examined online students' and instructors' perspectives on

communities, to my knowledge, no prior work had specifically investigated distance education administrators' perspectives. As a former distance education administrator myself, I believe administrators' attitude and practice regarding communities could greatly influence whether a community approach of learning can be adapted online, as such learning rely on the necessary technologies and resources supported by the administrators. In the process of conducting this study, I found distance education administrators varied greatly in their knowledge and beliefs regarding community in learning. Therefore, I am interested in the study of distance education administrators' perspectives of community and examination of how their perspectives affect online learning practice in their institutions.

The OLC model. The conceptual model of OLCs proposed in this dissertation opens wide possibilities for identification and examination of the complex relationship among OLC elements. Nevertheless, the model itself calls for further validation and consolidation. Design-based research, as a methodology that connects theory, practice, design, and context, shows promises for the task. Design-based research involves the iterative process of design, development and implementation of particular forms of learning and the systematic analysis of such learning in naturalistic context (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003). Design-based research implements theory-driven design, which allows theory to be evaluated by the extent to which it informs and improves practice. In addition, design-based theory examines learning in contexts and aims to produce contextually sensitive design theories and principles (Wang & Hannafin, 2005). These characteristics make design-based research especially appropriate for the validation and evaluation of the OLC model which aims to understand and support online learning in different context.

Design-based OLC research may involve the following process: Working with instructors, students and administrators to identify problems, issues, and OLC elements within the specific online learning context; making grounded design decisions in collaboration with the learning participants as well as other researchers and practitioners; continual redesigning and implementing in responses to emerging needs and issues; repeating the cycle to test and refine what works and what not; and connecting research findings with the design process, the context and theory. It will take more thorough investigations into OLCs before I can start research on such a scale. Such research in the future would contribute considerably towards the ultimate goal of systematic understanding and supporting of online learning.

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Appendices

Appendix A. The CMI (Initial version, 41 items)

Below you will see a series of statements concerning the online course you took. Please indicate your opinions on each statement by selecting from the following choices (SA=Strongly agree, A=Agree, N=Neither agree nor disagree, D=Disagree, SD=Strongly disagree).

I1. I was hardly aware of the existence of other course participants.

I2. I was able to form distinct impressions of some course participants.

I3 I had sufficient interactions with the course instructor.

I4. The instructor provided timely feedback.

I5. The instructor provided individualized feedback that helped me to learn.

I6. The instructor was responsive to my questions and needs.

I7. The instructor encouraged me to become actively involved in the learning process.

I8. The instructor encouraged me to interact with other course participants.

I9. I had sufficient interactions with other students in this course.

I10. I shared my learning experiences with other course participants.

I11. I engaged in discussions and/or collaborations with other course participants.

I12. I exchanged opinions with other course participants.

I13. I worked with other course participants to accomplish learning tasks.

I14. I learned from other course participants.

I15. Interactions with other course participants contributed little to my learning.

I16. I was not involved in the learning of other course participants.

E1. I felt connected to other course participants

E2. I felt isolated in this course.

E3. I felt the course participants care about each other.

E4. I felt the course participants were supportive of each other.

E5. I felt the course participants can rely on each other.

E6. I trusted others in this course.

E7. I felt a sense of belonging in this course.

E8. I felt like I was part of a cohesive group in this course even though we were not physically together in a classroom.

E9. I felt the people in this course shared a spirit of community.

E10. I felt the course participants shared a commitment to learn.

E11. I felt uncertain about others in this course.

E12. I felt secure in this course.

E13. I felt my participation mattered to other course participants.

E14. I felt the participation of other course participants mattered to me.

E15. I felt comfortable interacting with other course participants.

E16. I felt reluctant to speak openly in this course.

R1. I already knew some course participants before I started taking this course

R2. I developed close relationships with some course participants during this course.

R3. I became friends with some course participants during this course.

R4. I interacted with some course participants on topics unrelated to the learning of this course.

R5. I got to know some course participants on a personal level during this course.

R6. I made efforts to make myself known to other course participants on a personal level.

R7. I felt comfortable sharing personal information with other course participants.

R8. I avoided developing close relationships with other course participants.

R9. I doubt I will maintain relationships with other course participants now that the course is over.

Appendix B. Deleted, revised and added items during the initial development of the CMI

Five items in Kim (2011)'s instrument are not incorporated in the CMI, as listed below in Table B1:

Table B1. Items excluded from Kim (2011)'s instrument.

Instrument	Items excluded	Reason
Kim (2011)	I tried to concentrate on our discussion.	Vague
	I was influenced by the other participants' moods	Statement is too strong; most people would likely to disagree.
	I called the other participants by their names	Statement is too common; most people would likely to agree.
	My opinions were clear to the other participants	People cannot know whether this is true.
	I easily understood how the other participants reacted to my comments	While this statement is related to interaction, whether it is a strong enough indicator of good interaction is questionable. An interaction contains two events: the action and the reaction. This statement indicates there is an event first, then "I" make an reaction of making comments. "People" then make a reaction to my comments, and I need to make a further judgment regarding my reaction to their reactions. The situation might be too complex.

Twenty four items from Arbaugh et al.(2008)'s instrument are not incorporated in the CMI, as listed below in Table B2:

Table B2. Items exclude from Arbaugh et al.(2008)'s instrument.

Instrument	Subscale	Items excluded	Reason
Arbaugh et al.(2008)	Cognitive presence	Problems posed increased my interest in course issues. Course activities piqued my curiosity. I felt motivated to explore content related questions. I utilized a variety of information sources to explore problems posed in this course. Brainstorming and finding relevant information helped me resolve content related questions. Online discussions were valuable in helping me appreciate different perspectives. Combining new information helped me answer questions raised in course activities. Learning activities helped me construct explanations/solutions. Reflection on course content and discussions helped me understand fundamental concepts in this class. I can describe ways to test and apply the knowledge created in this course. I have developed solutions to course problems that can be applied in practice. I can apply the knowledge created in this course to my work or other non-class related activities.	Not related to interactions, emotional connections or relationships
	Social presence	Online or web-based communication is an excellent medium for social interaction. I felt comfortable conversing through the online medium.	Not related to interactions, emotional connections or relationships
	Teaching presence	The instructor clearly communicated important course topics. The instructor clearly communicated important course goals. The instructor provided clear instructions on how to participate in course learning activities.	Not related to interactions, emotional connections or relationships

		The instructor clearly communicated important due dates/time frames for learning activities. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking. The instructor helped keep the course participants on task in a way that helped me to learn. The instructor encouraged course participants to explore new concepts in this course. Instructor actions reinforced the development of a sense of community among course participants. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.

Five items from Rovai (2002)'s instrument are not incorporated in the CMI, as listed below in Table B3:

Table B3. Items exclude from Rovai (2002)'s instrument.

Instrument	Subscale	Items exluded	Reason
Rovai (2002)	Connectedness	I feel that this course is like a family.	Statement is too strong; most people would likely to disagree.
	Learning	I feel that this course results in only modest learning. I feel that I am given ample opportunities to learn. I feel that my educational needs are not being met. I feel that this course does not promote a desire to learn	Not related to interactions, emotional connections or interpersonal relationships

Thirty-five items of the CMI are developed based on items from the seven instruments. Some items are modified to better serve the purpose to measure interactions, emotional connections or relationships. Similar items are synthesized to form one single item in the CMI. Details are shown in Table B4, below.

Table B4. CMI items and modification from original items.

Items in the CMI	Original items
I2. I was able to form distinct impressions of some course participants	I was able to form distinct impressions of some course participants. (Arbaugh et al., 2008)
I3. I had sufficient interactions with the course instructor	I was able to interact with the instructor during the course discussions (Sher, 2009) Interaction between the instructor and the class was high (Arbaugh & Rau, 2007)) Perceived interaction with instructor [was a great deal, sufficient, insufficient, none] (Swan, 2002)
I4. The instructor provided timely feedback.	The instructor provided me feedback on my work through comments (Sher, 2009) The instructor provided feedback in a timely fashion (Arbaugh et al., 2008) I feel that I receive timely feedback (Rovai, 2002).
I5. The instructor provided individualized feedback that helped me to learn.	The instructor treated me as an individual (Sher, 2009), The instructor informed me about my progress periodically (Sher, 2009) The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives (Arbaugh et al., 2008).
I6. The instructor was responsive to my questions and needs.	Students often asked the instructor questions (Arbaugh & Rau, 2007) I feel it is hard to get help when I have a question (Rovai, 2002).
I7. The instructor encouraged me to become actively involved in the learning process.	The instructor encouraged me to become actively involved in the course discussions (Sher, 2009), The instructor frequently asked the students questions (Arbaugh & Rau, 2007)

	I feel that I am encouraged to ask questions (Rovai, 2002).
I8. The instructor encouraged me to interact with other course participants.	The instructor frequently attempted to elicit student interaction (Arbaugh & Rau, 2007) In general, the instructor was effective in motivating the students to interact in this course (Arbaugh & Rau, 2007), The instructor helped to keep course participants engaged and participating in productive dialogue (Arbaugh et al., 2008).
I9. I had sufficient interactions with other students in this course.	There was little interaction between students (Arbaugh & Rau, 2007) Perceived interaction with classmates [was sufficient] (Swan, 2002).
I10. I shared my learning experiences with other course participants.	I was able to share learning experiences with other students (Sher, 2009).
I11. I engaged in discussions and/or collaborations with other course participants.	I was able to communicate with other students in this course (Sher, 2009) Online discussions help me to develop a sense of collaboration (Sher, 2009).
I12. I exchanged opinions with other course participants.	The instructor frequently offered opinions to students (Arbaugh & Rau, 2007) Students often stated their opinions to the instructor (Arbaugh & Rau, 2007) In this class, students seldom stated their opinions to each other (Arbaugh & Rau, 2007) I enjoyed engaging in exchange of ideas with the other participants (Kim, 2011).
I13. I worked with other course participants to accomplish learning tasks.	I worked with the other participants to complete the task (Kim, 2011) This course encouraged me to work in small groups/teams (Sher, 2009).
I14. I learned from other course participants.	Increased contact with fellow students helped me more out of this course (Sher, 2009) What the others did affected what I did (Kim, 2011). Online group activities helped me learn efficiently (Kim, 2011).

I15. Interactions with other course participants contributed little to my learning.	What the others did affected what I did (Kim, 2011) I feel that other students do not help me learn (Rovai, 2002).
I16. I was not involved in the learning of other course participants.	Students seldom answered each other's questions (Arbaugh & Rau, 2007) Students seldom asked each other questions (Arbaugh & Rau, 2007).
E1. I felt connected to other course participants.	I feel connected to others in this course (Rovai, 2002).
E2. I felt isolated in this course.	I feel isolated in this course (Rovai, 2002).
E3. I felt the course participants cared about each other.	I feel that students in this course care about each other (Rovai, 2002)
E4. I felt the course participants were supportive of each other.	I feel confident that others will support me (Rovai, 2002) I feel it is hard to get help when I have a question (Rovai, 2002).
E5. I felt the course participants could rely on each other.	I feel that I can rely on others in this course (Rovai, 2002) I feel that members of this course depend on me (Rovai, 2002)
E6. I trusted others in this course.	I trust others in this course (Rovai, 2002) I felt comfortable disagreeing with other course participants while still maintaining a sense of trust (Arbaugh et al., 2008).
E7. I felt a sense of belonging in this course.	Getting to know other course participants gave me a sense of belonging in this course (Arbaugh et al., 2008).
E8. I felt like I was part of a cohesive group in this course even though we were not physically together in a classroom.	Even though we were not physically together in a traditional classroom, I still felt I was part of a group (Kim, 2011).
E9. I felt the people in this course shared a spirit of community.	I do not feel a spirit of community (Rovai, 2002) I was able to form a sense of community (Kim, 2011) I felt the other participants tried to form a sense of community (Kim, 2011)

	Sense of community existed with fellow students taking this course (Sher, 2009)
E11. I felt uncertain about others in this course.	I feel uncertain about others in this course (Rovai, 2002).
E12. I felt secure in this course.	I feel uneasy exposing gaps in my understanding (Rovai, 2002) I felt comfortable disagreeing with other course participants while still maintaining a sense of trust (Arbaugh et al., 2008).
E13. I felt my participation mattered to other course participants.	I felt my point of view was acknowledged by other course participants (Arbaugh et al., 2008) I felt the other participants respected my opinion in making decisions (Kim, 2011) I felt the other participants acknowledged my point of view (Kim, 2011).
E14. The participation of other course participants mattered to me.	I respected the others' opinions in making decisions (Kim, 2011) I feel that other students do not help me learn (Rovai, 2002).
E15. I felt comfortable interacting with other course participants.	I felt comfortable participating in the course discussions (Arbaugh et al., 2008) I felt comfortable interacting with other course participants (Arbaugh et al., 2008).
E16. I felt comfortable speaking openly in this course.	I feel reluctant to speak openly (Rovai, 2002)
R2. I developed close relationships with some course participants during this course.	I was able to be personally close to other participants in the class (Kim, 2011).
R3. I became friends with some course participants during this course.	I was able to be personally close to other participants in the class (Kim, 2011).
R5. I got to know some course participants on a personal level during this course.	I feel that getting myself to know other online group members on a personal level is [important] (Wade, Cameron, Morgan, & Williams, 2011) I got to learn a great deal about the other participants in the class (Kim, 2011).

R6. I made efforts to make myself known to other course participants on a personal level.	I feel that making myself known on a personal level is [important] (Wade, Cameron, Morgan, & Williams, 2011).
R8. I avoided developing close relationships with other course participants.	I avoided developing deep relationships with the group (Wade, Cameron, Morgan, & Williams, 2011).

Six items in the CMI (items I1, R1, R4, R7, R9, E10) are not directly derived from the seven instruments mentioned above. The six items are listed below in Table B5:

Table B5. Additional items not based on the seven instruments.

Construct	New items	Modification/Reason
Interactions	I1. I was hardly aware of the existence of other course participants	Based on Schwier (2011) that awareness is the basis of any interactions.
Emotional connections	E10. I felt the course participants shared a commitment to learn.	Measures task cohesion. Carron (1982) pointed out that group cohesion can be divided into social cohesion and task cohesion. Social cohesion is related to the feelings of closeness or connectedness among group members, while task cohesion refers to group members' commitment to accomplish the group's tasks and goals.
Relationships	R1. I already knew some course participants before I started taking this course.	Measures duration of interactions. Granovetter (1973) proposed the strengths of interpersonal ties are "a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal services which characterized the tie" (p. 1361). Marsden and Campbell (1984) found closeness is the most important indicator of strong interpersonal relationships, with duration and frequency of interactions somewhat less important.
	R4. I interacted with some course participants on topics unrelated to the learning of this course.	Measures diversity of activities. Marsden and Campbell (1984) found closeness is the most important indicator of strong interpersonal relationships. Berscheid et al. (1989) measured closeness in three subscales: the frequency of the impact that one has on the other, the diversity of activities through which one can impact the other, and the strengths of the impact.
	R7. I felt comfortable	Measures intimacy and self-

	sharing personal information with other course participants.	disclosure.
	R9. I doubt I will maintain relationships with other course participants now that the course is over.	Based on Ma and Yuen (2011) that that commitment to relationship is an important determinant of personal relationships.

Appendix C. Online student survey

Age (pull-down):

Under 18

18-25

26-35

36-45

46-55

56-65

65 and up

(Note: If a participant select “Under 18”, he/she will be redirected to another Webpage that informs him/her he/she is not eligible to participate in the study. The participant will not be able to take the rest of the survey.)

Gender (pull-down):

Female

Male

Which of the following best describes your status? (pull-down)

Non-degree student

Undergraduate student

Graduate student enrolled in a master’s or doctoral program

Graduate student enrolled in a graduate certificate program

Are you enrolled in an online program? (pull-down)

Yes

No

You are invited to take this survey because you are taking, or recently completed an online course. Please select the name of your course below. If you have taken several online courses recently, please select only one course, and answer all questions according to your experiences of this course.

(insert pull-down menu of all online courses offered in the semester)

How many online courses have you taken *before* you take this course? (pull-down)

0

1-2

3-5

6 or more

Below you will see a series of statements concerning the online course you took. Please indicate your opinions on each statement by selecting from the following choices (SA=Strongly agree, A=Agree, N=Neither agree nor disagree, D=Disagree, SD=Strongly disagree).

1. I was hardly aware of the existence of other course participants.	SA A N D SD
2. I felt connected to other course participants.	SA A N D SD
3. I already knew some course participants before I started taking this course.	SA A N D SD
4. I was able to form distinct impressions of some course participants.	SA A N D SD
5. I felt isolated in this course.	SA A N D SD
6. I developed close relationships with some course participants during this course.	SA A N D SD
7. I had sufficient interactions with the course instructor.	SA A N D SD
8. I felt the course participants care about each other.	SA A N D SD
9. I became friends with some course participants during this course.	SA A N D SD
10. The instructor provided timely feedback.	SA A N D SD
11. I felt the course participants were supportive of each other.	SA A N D SD
12. I interacted with some course participants on topics unrelated to the learning of this course.	SA A N D SD
13. The instructor provided individualized feedback that helped me to learn.	SA A N D SD
14. I felt the course participants can rely on each other.	SA A N D SD
15. I got to know some course participants on a personal level during	SA A N D SD

this course.

16. The instructor was responsive to my questions and needs. SA A N D SD

17. I trusted others in this course. SA A N D SD

18. I made efforts to make myself known to other course participants on a personal level. SA A N D SD

19. The instructor encouraged me to become actively involved in the learning process. SA A N D SD

20. I felt a sense of belonging in this course. SA A N D SD

21. I felt comfortable sharing personal information with other course participants. SA A N D SD

22. The instructor encouraged me to interact with other course participants. SA A N D SD

23. I felt like I was part of a cohesive group in this course even though we were not physically together in a classroom. SA A N D SD

24. I avoided developing close relationships with other course participants. SA A N D SD

25. I had sufficient interactions with other students in this course. SA A N D SD

26. I felt the people in this course shared a spirit of community.

27. I doubt I will maintain relationships with other course participants now that the course is over SA A N D SD

28. I shared my learning experiences with other course participants. SA A N D SD

29. I felt the course participants shared a commitment to learn. SA A N D SD

30. I engaged in discussions and/or collaborations with other course SA A N D SD

participants.

31. I felt uncertain about others in this course.	SA A N D SD
32. I exchanged opinions with other course participants.	SA A N D SD
33. I felt secure in this course.	SA A N D SD
34. I worked with other course participants to accomplish learning tasks.	SA A N D SD
35. I felt my participation mattered to other course participants.	SA A N D SD
36. I learned from other course participants.	SA A N D SD
37. I felt the participation of other course participants mattered to me.	SA A N D SD
38. Interactions with other course participants contributed little to my learning.	SA A N D SD
39. I felt comfortable interacting with other course participants.	SA A N D SD
40. I was not involved in the learning of other course participants.	SA A N D SD
41. I felt reluctant to speak openly in this course.	SA A N D SD
42. I feel that I am encouraged to ask questions.	SA A N D SD
43. I feel it is hard to get help when I have a question.	SA A N D SD
44. I do not feel a spirit of community.	SA A N D SD
45. I feel that this course is like a family.	SA A N D SD
46. I feel uneasy exposing gaps in my understanding.	SA A N D SD
47. I feel that this course results in only modest learning.	SA A N D SD
48. I feel that other students do not help me learn.	SA A N D SD
49. I feel that I can rely on others in this course.	SA A N D SD
50. I feel that members of this course depend on me.	SA A N D SD

51. I feel that I am given ample opportunities to learn.	SA A N D SD
52. I feel that my educational needs are not being met.	SA A N D SD
53. I feel confident that others will support me	SA A N D SD
54. I feel that this course does not promote a desire to learn.	SA A N D SD
55. I felt that I learned much in this online course.	SA A N D SD
56. I understood the content of this class well.	SA A N D SD
57. My level of learning that took place in this course was of high quality.	SA A N D SD
58. I am satisfied with my learning experiences in this course.	SA A N D SD
59. I am satisfied with my decision to take this course.	SA A N D SD
60. I would recommend this course to other students.	SA A N D SD

Scoring scheme:

For items 1, 5, 24, 27, 31, 38, 40, 41, 43, 44, 46, 47, 48, 52, 54, SA=1, A=2, N=3, D=4, SD=5.

For other items, SA=5, A=4, N=3, D=2, SD=1.

Community_raw is the sum of scores of items 1-41. Community is the sum of scores of items 1, 2, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 25, 28, 30, 35, 36, 39, 40.

CC_{total} is the sum of scores of items 2, 5, 8, 17, 31, 44, 45, 49, 50, 53. CL_{total} is the sum of scores of items 10, 41, 42, 43, 46, 47, 48, 51, 52, 54. CCS is the sum of CC_{total} and CL_{total}.

PL is the sum of scores of items 55, 56, 57. SS is the sum of scores of items 58-60.

Appendix D. The CMI (Final version, 25 items)

Below you will see a series of statements concerning the online course you took. Please indicate your opinions on each statement by selecting from the following choices (SA=Strongly agree, A=Agree, N=Neither agree nor disagree, D=Disagree, SD=Strongly disagree).

1. I was hardly aware of the existence of other course participants. SA A N D SD
2. I was able to form distinct impressions of some course participants. SA A N D SD
3. The instructor encouraged me to interact with other course participants. SA A N D SD
4. I had sufficient interactions with other students in this course. SA A N D SD
5. I shared my learning experiences with other course participants. SA A N D SD
6. I engaged in discussions and/or collaborations with other course participants. SA A N D SD
7. I learned from other course participants. SA A N D SD
8. I was not involved in the learning of other course participants. SA A N D SD
9. I felt connected to other course participants. SA A N D SD
10. I felt like I was part of a cohesive group in this course even though we were not physically together in a classroom. SA A N D SD
11. I felt my participation mattered to other course participants. SA A N D SD
12. I felt comfortable interacting with other course participants. SA A N D SD
13. I had sufficient interactions with the course instructor. SA A N D SD
14. The instructor provided timely feedback. SA A N D SD
15. The instructor provided individualized feedback that helped me to learn. SA A N D SD
16. The instructor was responsive to my questions and needs. SA A N D SD
17. The instructor encouraged me to become actively involved in the learning process. SA A N D SD
18. I felt the course participants care about each other. SA A N D SD
19. I felt the course participants were supportive of each other. SA A N D SD
20. I felt the course participants can rely on each other. SA A N D SD
21. I trusted others in this course. SA A N D SD
22. I developed close relationships with some course participants during this course. SA A N D SD

23. I interacted with some course participants on topics unrelated to the learning of this course. SA A N D SD

24. I got to know some course participants on a personal level during this course. SA A N D SD

25. I made efforts to make myself known to other course participants on a personal level.SA A N D SD

Biography

Xiaoli Zhao is scheduled to receive her PhD in Learning Sciences and Technology from Lehigh University in May 2014. Her research interests includes online learning, distance education, Web 2.0 and social media in learning, and learning theory. While pursuing her doctor's degree, she worked full time in instructional design, development and support for both distance education and classroom technology during 2004-2011. She received Master of Science in Instructional Design and Development from Lehigh University in 2004.

Before 2002, Xiaoli Zhao worked as a book editor. She received Master of Science in Chemistry in 2000 and Bachelor of Science in Chemistry in 1997, both from Peking University.