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RESEARCH ARTICLE

Evaluating online learning communities

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Abstract This article reviews recent evaluation studies of online learning communities to provide a systematic understanding of how such communities are evaluated. Forty-two representative studies were selected and categorized into a newly developed taxonomy of online learning community evaluations. This taxonomy is divided into four components: evaluation purpose, evaluation approach, measures for evaluation, and evaluation techniques. The findings suggest that it is inappropriate to conceptualize evaluation of such communities as a one-size-fits-all, generalizable measure of "good" or "bad." Instead, we recommend a comprehensive, on-going, diagnostic approach to measuring clusters of indicators, or *syndromes*, of a particular OLC and examining the causal relation assumed by the evaluators between what is measured and the success of OLC as an imputed outcome.

Keywords Online learning communities · Evaluation · Literature review · Sensitivity analysis

Introduction

Online learning communities (OLC) are a growing feature in the landscape of educational technology. These group-oriented counterparts to technologies for individual learning trace their roots to social constructivism as well as to the availability of appropriate technology (Herrington and Oliver 2000; Palloff and Pratt 1999; Squire and Johnson 2000). Recently,

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the expansion of a social view of learning, in addition to advances in the Internet and other communication technologies, has powered a paradigmatic shift to collaborative pedagogy in distance education (Ke and Carr-Chellman 2006). In this approach, learning is conceptualized as a collective and participatory social process in which a series of multi-stranded interpersonal transactions mediate the exchange of knowledge (Cole and Engeström 1993). This conception of learning has been well integrated into the notion of the online learning community—"a learning atmosphere, a context providing a supportive system from which sustainable learning processes are gained through a dialogue and collaborative construction of knowledge by acquiring, generating, analyzing, and structuring information" (Carlen and Jobring 2005, p. 273).

In practice, online learning communities are increasingly used for professional development of teachers, in knowledge-sharing settings (such as medical support groups or corporate helpdesks), and for students in formal schooling (Chang 2003; Pearson 1998). At their best, these communities can be effective online communities of practice (Lave and Wenger 1991) or knowledge-building communities (Scardamalia et al. 1992). At their worst, they can impede groups of users or lead to persuasive but unproductive ideas if group interactions are disrespectful or unequal (Linn and Burbules 1993).

Despite an increasing interest in designing and implementing online learning communities, there have been few attempts to identify criteria to evaluate whether certain design efforts produce an effective OLC or whether a particular online community is successful in fostering explicit learning activities. Studies vary radically in how they evaluate online learning communities, depending on the researchers' goals, the types of online learning communities, and the types of data that are available for collection in a given circumstance. Therefore, a review that summarizes the studies which have evaluated online learning communities is valuable because it will help OLC scholars better understand this divergent research base.

To provide this summary, we review recent evaluation studies of online learning communities to develop a taxonomy of how online learning communities are evaluated. Historical issues related to the definition of online learning communities are discussed to provide a context for the summary of recent evaluation studies. To create the summary, representative evaluation cases were selected and categorized by the taxonomy that organizes the evaluation approaches that emerged from the review. Finally, suggestions for future directions of OLC evaluation are presented.

Defining online learning community

The online learning community is an extension of the physical learning community to the electronic one (Russell and Ginsburg 1999). Definitions of the term *learning community* abound. Contexts in which the phrase is currently applied include any or all of the following: a site for learning's fulfillment (Tu and Corry 2002), a collection of people with a shared will to learn (Kowch and Schwier 1997), an emotional foundation for the learning process (MCMillan and Chavis 1986), an instructional design model (Romiszowsky and Mason 1996), and a naturally occurring sociological phenomenon (Johnson 2001). Hence, online learning communities may refer to virtual locations, virtual groups, weak or strong emotional ties in a virtual group, systematic models for improving e-learning, and certain phases of online learning development.

For example, Tu and Corry (2002) stated that, when learning activities and interactions occur electronically, the resulting environment is referred to as an online learning community. The online learning community is thus a virtual learning environment in which the

process of learning takes place outside the boundaries of face-to-face contact, typically online. However, some have argued that environments are not necessarily learning communities. To them, for a community to emerge, a learning environment should at least comprise "collections of autonomous, independent individuals who are engaged by influencing each other within a learning process" (Kowch and Schwier 1997, p. 3). In addition, an OLC must allow learners to cultivate *increasing levels of commitment* in the transaction of knowledge (McMillan and Chavis 1986). In other words, online learning communities evolve from simple cohorts when learners elevate their engagement with each other to an emotional 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 and Chavis 1986, p. 9).

Adding to the confusion over the definition of an online learning community are the uncertainties concerning whether a learning community is emergent in nature or created by design. Although much has been written about the ability of online communities to evolve "spontaneously" out of the Internet (e.g., Steinkuehler 2004; Hiltz and Turoff 2002), another view holds that a learning community is created by design (Johnson 2001). Some scholars (Lock 2002; Palloff and Pratt 1999; Swan 2002) have described the online learning community as "a complete system or systematic model for improving teaching and learning online," or in other terms, an instructional design model for e-learning (Romiszowsky and Mason 1996, p. 446).

Whether it is emergent or designed, the online learning community is an incremental development (rather than a static entity) that is fluid in nature and evolves through nurturing conditions (Renninger and Shumar 2002; Rheingold 2000). For example, Palloff and Pratt (1999) define four stages of virtual community development: (1) the initial phase, (2) the conflict phase, (3) the intimacy and work phase, and (4) the termination phase. A learning community emerges only in phase 3—when language, learning practices, collaboration customs, and resources in the setting develop into an ideal state (Haythornthwaite et al. 2000).

Definition of an online learning community in this review

In this review, we adopt a broad and readily accessible characterization of an online learning community as a *developed activity system* in which a group of learners, unified by a common cause and empowered by a supportive virtual environment, engage in collaborative learning within an atmosphere of trust and commitment (Engeström 1993). This conceptualization depicts 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. Because we are interested in OLCs as an educational phenomenon, we focus in this analysis on OLCs that intentionally support learning, whether on the part of the designers or on the part of the participants.

Furthermore, we adopt the definitions of prototypical OLCs proposed by Carlen and Jobring (2005), who categorized OLCs according to the role of their *participants*. For example, in an e-learning community, participants learn in formal education systems; in a virtual community of practice, participants learn within an organization based on their profession; in an interest OLC, participants learn in an informal environment while sharing a common interest.

Methods used in the review

This review involved the following phases: (1) creation of inclusion criteria and identification of relevant evaluation research, (2) critical appraisal and extraction of key measures, and (3) synthesis of the findings.

Inclusion criteria

The selection process for our literature review was guided by the following criteria:

1. Studies had to examine an OLC according to our definition (i.e., one that supported the intentionality of learning on the part of either the participants or the designers).
2. Studies had to contain data from the evaluation of an online learning community, although evaluation did not necessarily have to be the focus of the study.
3. Studies had to be original and empirical. Theoretical conceptualizations were excluded, although they were considered as background material.
4. Research studies of an online learning community aimed at demonstrating a program's effectiveness were also included as evaluations. According to Upcraft and Schuh (1996), evaluation and research are different only in the reasons they are conducted. The function of instructional research is to determine how and why certain practices have potential for promoting learning, while the purpose of educational evaluation extends that function to judge particular interventions as successful or unsuccessful.
5. Studies had sufficient detail about the criteria for evaluation.

Identification of studies

OLC evaluations reviewed in this study was drawn from English-language publications identified through a literature search on (1) computerized bibliographic databases (i.e., ERIC, PsycInfo, Educational Technology Abstracts, Dissertation Abstracts, and Cambridge Scientific Abstracts), (2) education and technology journals,[1] and (3) conference proceedings.[2] During the literature search process, the keywords used included "learning community," "knowledge building community," and "community of practice." The publications were filtered using the above inclusion criteria. A total of 42 studies met the inclusion criteria, and they are numbered at the beginnings of their citations in the reference list.

The following questions were addressed for each study that met the inclusion criteria:

1. What was the purpose of the study?
2. What evaluation approaches were used in the study?
3. What indicators or measures of online learning communities were observed in the study?
4. How did the study collect and analyze data?

[1] e.g., Educational Technology Research & Development, Journal of Educational Computing Research, British Journal of Educational Technology, Computers & Education, Instructional Science, Journal of Interactive Learning Research, Journal of Asynchronous Learning Networks, Journal of Distance Education, etc.

[2] e.g., Proceeding of Computer Support for Collaborative Learning, Association for Educational Communications and Technology International Convention, International Conference of Learning Science, etc.

Data analysis

When conducting the literature search, we developed an initial coding matrix to categorize each study's evaluation purpose, evaluation approach, measure for evaluation, data collection technique, data analysis technique, and data report technique. This coding matrix was refined as the analysis process proceeded. It was an overlapping process of coding the studies and placing them into categories. Using the constant comparative method (Strauss and Corbin 1990), the authors constantly compared the data collected/coded to revise the coding categories, reanalyzed studies, and gain new insights. The consistency and rigor of analyses and results were achieved by using multiple coders (the first author and two trained research assistants) for peer examination and inter-rater checking during the coding process (Creswell 1998). The average code-recode intra-rater reliability was 93% agreement and the inter-coder reliability (Cohen's Kappa) was 82% agreement. In case of disagreements, a single code was determined after discussion among the three coders.

Results

Our initial findings show that there are many approaches to OLC evaluation. Although the overall objective of such evaluations is to identify what may improve learning practices, some evaluations gauged the effectiveness of specific programs while others addressed operational questions of the OLCs.

Another result of this study is the development of a taxonomy for synthesizing and classifying important features of OLC evaluation studies. This taxonomy (Fig. 1) is not intended to be exhaustive, but it provides a method of positioning a particular study within the broad range of OLC evaluation studies. It also provides a way to select an appropriate evaluation approach within the context of a specific OLC. Finally it provides a means to illustrate the common themes of OLC evaluation studies. The taxonomy structure for the 42 studies is shown in Table 1, and detailed information of the 42 studies is available at: http://www.unm.edu/~fke/olceval/fullmatrixtable.pdf.

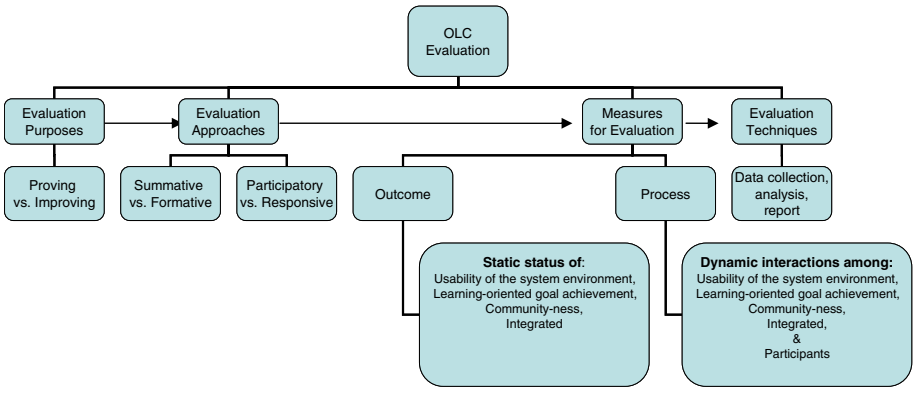


Fig. 1 A taxonomy of OLC evaluation

Table 1 Categorization structure and frequency counts

Domains	Categories				Frequency
Evaluating purpose	Proving (*No. *1, 3, 6, 7, 11, 16–18, 24, 25, 27, 28, 30, 33, 35, 36, 38, 39, 41*)				19
	Improving (No. *5, 10, 12, 13, 15, 20, 21, 26, 31, 37, 42*)				11
	Mixed (No. *2, 4, 8, 9, 14, 19, 22, 23, 29, 32, 34, 40*)				12
Evaluating approach	Summative (No. *1, 3, 6, 7, 11, 16–18, 24, 25, 27, 28, 30, 33, 35, 36, 38, 39, 41*)				19
	Formative		Illuminative (No. *15, 20, 26, 31, 42*)		5
			Integrative (No. *5, 10, 12, 13, 21, 37*)		6
	Integrated (No. *2, 4, 8, 9, 14, 19, 22, 23, 29, 32, 34, 40*)				12
	Responsive (No. *4, 5, 8–10, 12–13, 17, 24, 38*)				10
	Participatory (No. *1–3, 6–7, 11, 14–16, 18–23, 25–37, 39–42*)				32
Measures for evaluation	Outcome construct (28 studies)	Usability	Survey/interviewing (No. *11*)		1
			User testing (No. *27, 41*)		2
		Learning achievement (20 studies)	Individual gains (19 studies)	Subject-knowledge (No. *3, 7, 8, 9, 11, 14, 18, 23, 30, 33, 35, 36, 39*)	13
				Intellectual/social development (No. *6, 36*)	2
				Knowledge construction process (No. *4, 7, 16, 17, 24, 38*)	6
			Worth of the program (No. *2*)		1
		Community-ness (11 studies)	Behavioral (No. *4, 19, 39, 40*)		4
			Experiential (No. *25, 29, 32, 33, 34, 35*)		6
			Mixed (No. *1*)		1
		Integrated (No. *22, 28*)			2
	Process construct (23 studies)	Participant—community-ness (No. *12, 20, 32, 34, 40, 42*)			6
		Community-ness—learning achievement (No. *2, 9, 14, 15*)			4
		Protocols—community-ness (No. *2, 4, 5, 10, 13, 19, 21, 23, 29*)			9
		Tools—community-ness—learning achievement (10 studies)	CMC tools (6 studies)	Email (No. *8, 12*)	2
				Threaded discussion (No. *12, 22, 31, 42*)	4
				Chat-room (No. *23*)	1
			Non-CMC tools (No. *10, 26, 29, 37*)		4

Table 1 continued

Domains	Categories		Frequency
Data collection	Objective data collection (No. *4, 5, 6, 8, 12, 13, 17, 24, 38*)		9
	Qualitative data collection (No. *3, 11, 14, 18, 19, 25, 27, 28, 30, 35–37*)		12
	Mixed (No. *1, 2, 7, 9, 10, 15, 16, 20–23, 26, 29, 31–34, 39–42*)		21
	Longitudinal (No. *10, 14, 21, 23, 31*)		5
	Fixed-term (No. *1–9, 11–13, 15–20, 22, 24–30, 32–42*)		37
Data analysis	Methods	Content/discourse analysis (No. *1, 4, 6, 8, 13, 16, 17, 22, 24, 38, 40*)	11
		Social network analysis (No. *4, 12*)	2
		Thematic analysis (No. *2, 5, 7, 10, 14, 15, 19, 20, 23, 25–27, 29–33, 36, 42*)	19
		Statistical analysis only (No. *3, 9, 11, 18, 21, 28, 34, 35, 37, 39, 41*)	11
	Units of analysis	Individual (No. *1–12, 14–16, 18–37, 39–42*)	39
		Group (No. *17*)	1
		Other (No. *13, 38*)	2
Data report	Quantitative (No. *1, 3, 4, 9, 11–13, 17, 18, 21, 34, 35, 37, 38, 41*)		15
	Qualitative (No. *5, 7, 8, 10, 14, 15, 20, 24–26, 30, 31, 33, 36, 40, 42*)		16
	Mixed (No. *2, 6, 16, 19, 22, 23, 27–29, 32, 39*)		11

Please note that one study may evaluate constructs and measures that belong to different categories or sub-categories within the same domains

* The studies with its signifying number have been listed within each sub-category. For example, No. 1 means Study No. 1 in the reference list; No. 16–18 means Study No. 16, Study No. 17, and Study No. 18 in the reference list

Evaluation purposes

The starting point for categorizing OLC evaluation studies is identifying the purpose of each study. Two purposes were identified: *proving* (19 studies) and *improving* (11 studies). Studies with the "proving" purpose (e.g., Chang 2003; Meyers et al. 2002; Russell and Ginsburg 1999) recorded and described the impact of an OLC to address questions like: "Has the online program led to the emergence of a learning community that comprises knowledge construction and networking among the community members?" and "What were the *values* or *worth* of the specific online learning community for community members and the hosting organization?" In comparison, studies with the "improving" purpose (e.g., Bielaczyc 2001; Cho et al. 2007; Collins et al. 2001) focused on questions like: "How did the program create an empowering environment (e.g., effective communication tools and supportive interaction protocols) to foster learning community development?" or "What influencing variables or processes facilitated or impeded learning community development?" With these questions, OLC scholars collected information to examine either existing OLC development issues or the characteristics of successful OLC practices to guide future program development and betterment.

The other 12 evaluation studies served dual purposes: investigating the current impact of an online learning community, and exploring the ways of OLC program improvement. For example, Ardichvili et al. (2002) examined the online community of practice in Caterpillar Inc. first to assess the major organizational benefits of the community (e.g., access to best practices and lessons learned) and then to examine success factors and barriers that influenced community development (e.g., organizational culture and employees' reluctance to contribute knowledge).

Evaluation approaches

The review of the 42 studies revealed a pattern of approaches in the OLC domain that conforms to the classifications of general evaluation approaches stated by Oliver (2000) and Patton (1997)—summative, formative, participatory, and responsive. The review also indicated that evaluation purposes usually influenced the methods employed. Studies aiming to prove the value or emergence of an OLC generally adopted a summative evaluation (e.g., Alem and Kravis 2004; Auyeung 2004; Bozik and Tracey 2002). In comparison, studies aiming to improve an OLC practice usually used formative measurement to identify problems by describing and interpreting processes and events (e.g., Collins et al. 2001; Conrad 2002; Cuthell et al. 2002). Notably 12 studies adopted both summative and formative evaluations to first record the impact of an OLC and then gather information for program betterment (e.g., Ardichvili et al. 2002; Aviv et al. 2003; Brown et al. 1998).

Summative or formative evaluation

In OLCs, summative evaluation (19 out of 42 studies reviewed) could be characterized as going beyond improvement to examine evidence of a learning community, such as collaborative knowledge construction and social networking among community members. Oliver (2000) asserts that even though summative evaluations are usually carried out using quantitative experimental design, this approach in an educational setting is often impossible on pragmatic and ethical grounds. We found that almost all summative evaluations of

OLCs used qualitative techniques of survey, interviewing, observation, and analysis of online transcripts; only five of them also employed quantitative comparisons between OLC and non-OLC programs or comparisons of learning outcomes "before and after" adaptation to an OLC format. For example, Derry and DuRussel (1999) assessed knowledge construction in an OLC program for secondary teachers. They first used interviewing, survey, and discourse analysis of interaction transcripts to predict the degree to which a virtual group within the OLC program was involved in collaborative knowledge construction. Afterwards, they compared different virtual groups in terms of the degree of collaboration and group members' learning outcomes to assess whether the virtual groups that were operating as knowledge construction communities produced better learning outcomes.

According to Oliver (2000), formative evaluation occurs as illuminative or integrative evaluation. Illuminative evaluations of OLC (five in total) were primarily ethnographic and served to discover issues considered relevant by participants. Wegerif (1998), for example, conducted an ethnographic study of an e-learning community. Using online observation, in-depth interviewing, a learning experience survey, and analysis of online transcripts, he found that the success or failure of community-based learning depended upon the extent to which participants were able to cross a threshold from feeling like outsiders to feeling like insiders. Integrative evaluations of OLC (six in total), by contrast, combined the structured approach of experimental evaluations and the flexibility of ethnographic studies to evaluate the effectiveness of a program environment for cultivating OLC development. A good example was provided by Kilner and Hoadley (2005), who examined the impact of anonymity in a large online community of practice for U.S. soldiers. In addition to surveying participants on their perceptions of online interaction norms, Kilner and Hoadley coded online interaction transcripts and experimentally compared the effects of four levels of anonymity (anonymous, username only, username that indicates real name, and signed with real name) on the quality of peer discussions.

Participatory or responsive evaluation

According to Patton (1997), participatory evaluation encompasses both internal evaluation made by participants and external evaluation conducted by external evaluators, whereas responsive evaluation has only external evaluators. In reviewing the OLC studies, we found 32 participatory evaluations. The researchers who described OLC development based on participants' engagement usually took a participatory approach (e.g., Conrad 2002; Poole 2000; Rovai 2001). An ultimate expression of participatory evaluation is *action research* (Schön 1983), which allows OLC practitioners to carry out evaluations on their own, thus adding an educative element to the process of judging value. Leh's study (2002), as one of the three action-research evaluations, was longitudinal action research on learning communities emerging from hybrid courses. Leh experimented with various online discussion-moderating strategies and computer-mediated-communication (CMC) technologies in his own courses and conducted an on-going evaluation of these strategies on OLC development with transcript analysis, interviewing, and surveys. In the other 10 studies, evaluators played the role of arbiter or observer by collecting data through responsive online observation or document analysis (e.g., Bielaczyc 2001; Cho et al. 2007; Collins et al. 2001). These evaluators typically observed or archived participants' online activities and interaction scripts and conducted content analysis without interviewing or surveying participants.

Measures for evaluation

A wide variety of measures were used in the 42 studies. In order to identify and classify these measures to make findings coherent and systematic, we developed measures' charts (Figs. 2 and 3). Two major constructs measured in the studies were *outcome* and *process*. Evaluators who examined the *outcome* construct measured the value and status of OLCs by examining the established situations of multiple dimensions: *usability of system environment* (that comprises *protocols* and *tools*), *learning-oriented achievement, community-ness*, and the *integraton* of the three dimensions. Evaluators who examined the *process* construct measured dynamic development processes—interactions—among the aforementioned outcome dimensions, such as the impact of *usability of system environment* on the levels of *learning-oriented achievement* and *community-ness*, or the correlation between participants' *community-ness* development and their *learning-oriented achievement*. In the measures' charts, *outcome* constructs were illustrated in Fig. 2 as triangle tips (e.g., community-ness, protocols) while process constructs in Fig. 3 were highlighted as lines (e.g., pair 1, community-ness—participants) or triads (e.g., triad 1, community-ness—learning oriented achievement—tools) among the triangle tips. It should also be noted that *participants* (i.e., OLC members), while not a measured outcome dimension, have been counted by many OLC studies as a dynamic component that may mediate each key outcome dimension to affect the success of an OLC. Hence, participants are depicted as a

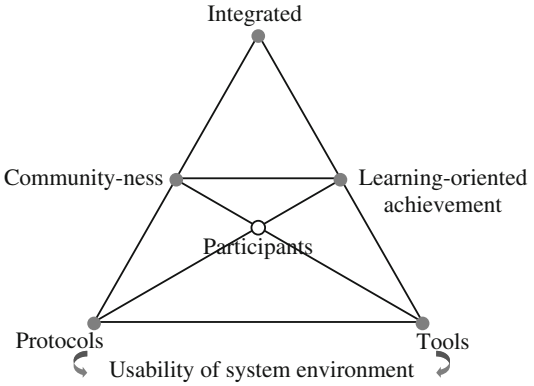


Fig. 2 Measures for the outcome construct

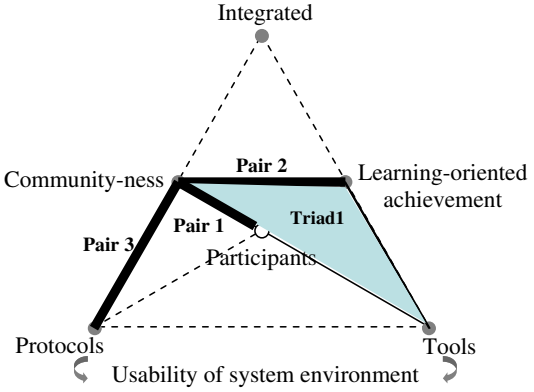


Fig. 3 Measures for the process construct

central linkage in the measures chart. The following section presents an explanation of each evaluation construct and its measures, with the support of exemplar cases.

Measures for the "outcome" construct

Usability of the system environment was the evaluation focus of three studies that aimed to develop hospitable online environments for learning-community development (i.e., Chang 2003; McPherson and Nunes 2004; Watkins 1997). These studies measured whether an OLC system was easy to use while achieving a high level of productivity. They focused on the community-supportive environment that comprises both scaffolding tools (e.g., CMC technologies) and intangible protocols (e.g., rules governing online discussion participation).

The three aforementioned studies measured usability by either eliciting participants' self-reported experiences of the OLC system or observing users' responses to the system. Chang (2003) used a 5-point Likert questionnaire survey that asked students to rate such items as contents, user interface, technological functions, frequency of use, and learning effects. In addition, he interviewed experts to help triangulate findings. In comparison, Watkins (1997) applied field observation of user testing to evaluate the usability of an online community system by noting time spent, functionalities, error rate, instructional strategy and design effectiveness, and overall satisfaction rate.

Learning-oriented goal achievement was usually interpreted as the *effectiveness* of an OLC (e.g. Auyeung 2004; Brett et al. 1999; Fusco et al. 2000). It should be noted that the *learning-oriented goal achievement* of an OLC comprises not only individual participants' gains but also the worth of the overall OLC program to its benefactor (such as a school, university, professional organization, or society as a whole). Some researchers have equated the effectiveness of an OLC with the gains of individual OLC participants. We suggest that the former encompasses different kinds of evidence than the latter.

Individual gains We found that evaluators differed on whether individual gains in OLCs included subject-knowledge achievement alone or whether they additionally involved social and intellectual growth. The review also indicated that the measurement of individual gains in an OLC could be a summative assessment of participants' achievements in subject knowledge and general social/intellectual skills or a formative evaluation of their knowledge-construction processes.

Thirteen OLC evaluations recorded participants' subject-knowledge achievement. Scardamalia et al. (1992) and Brown et al. (1998) found that students of a networked community did better on standardized tests of reading and language and demonstrated greater higher-order thinking skills in math and science. Bruckman (2004), with a portfolio-based assessment, reported that voluntary participation in an online learning community contributed to school children's achievement of creative writing and object-oriented programming. Other studies (Auyeung 2004; Brett et al. 1999; Chang 2003; Fusco et al. 2000; Leh 2002; Orey et al. 2003; Rovai 2002; Rice-Lively 1994; Russell and Ginsburg 1999; Spitzer and Wedding 1995) surveyed or interviewed participants on their general learning experiences, perceived gains, and satisfaction levels.

Two OLC studies also examined the impact of OLCs on participants' general intellectual and social development. Bozik and Tracey (2002) analyzed discussions in an electronic bulletin board to evaluate whether a WebCT learning community fostered students' intellectual development. Russell and Ginsburg (1999) interviewed SeniorNet participants and reported that the most striking effect of the community was the creation of social capital for senior citizens.

Recently, OLC evaluators argued that learning occurs as a social process in an OLC. Hence six studies examined knowledge construction as a process and product of online interaction by conducting content or discourse analysis of transcripts of online interactions. For example, Derry and DuRussel (1999) measured individuals' and groups' attention-deficit rates during interactions, the amount of information shared and captured online, the number of interaction threads, groups' negotiation and argumentation levels, and conceptual or belief changes of individuals. Similarly, Soller and Lesgold (2003) closely examined participants' knowledge-sharing conversations. They differentiated instances of effective from ineffective knowledge-sharing interaction by analyzing and assessing the numbers of new concepts shared and assimilated between *sharers* and *receivers*. Littleton and Whitelock (2005) investigated how personal meanings and understanding are created and enriched within interpersonal exchanges. Using Mercer's (1995) conceptualization of the modes of interaction (disputational, cumulative, and exploratory) when conducting sociocultural discourse analysis with online-interaction transcripts, they found that learners predominantly engaged in a cumulative social mode of thinking in which knowledge was constructed largely through accumulation and accretion. All these OLC evaluators used a pre-post experimental design together with quantitative content analysis. By contrast, De Laat and Lally (2003) used qualitative "critical event recall" interviewing in addition to quantitative content analysis to reveal the differentiated nature of peer learning in a networked learning community. First, they used content analysis to code meaningful learning events, classified these events into types of learning processes, and calculated rates of events happening for each individual at each phase of community development. They then elaborated quantitative data with participants' qualitative explanations gained through critical-event recalls and interviews.

It is important to note that this wide variety of measures for individual gains reflects both the varying goals of OLC researchers (for instance, individual vs. group goals, social skills vs. knowledge-retention goals, etc.) and the theories of action held by the researchers. Thus, even when evaluators may have agreed on a particular sort of learning outcome as important, one researcher might measure it very differently from another. For example, one might measure increased facility with certain math concepts by doing a microgenetic content analysis while another might use a traditional math test.

Worth of the program Only one OLC study undertook evaluations to assess the value or worth of an OLC as a whole in contrast to evaluations on individual gains. Ardichvili et al. (2002) conducted a qualitative case study to describe the benefits of a virtual community of practice at Caterpillar for the development of the organization's knowledge workers. With the data collected from interviewing and document analysis, they reported the top two organizational benefits of the community of practice: 1) the community helped new people to more quickly integrate themselves into their new job positions; and 2) the community provided a virtual space for better collaborative work and communication.

'Community-ness' was used as a gauge to distinguish an online learning community from a simple virtual learning cohort group, the so-called "quasi-community" (Hung and Chen 2002, p. 24). In theory, individuals within the OLC may succeed on the learning goals by means other than those afforded by the learning community. For instance, students in an online university course might succeed tremendously at learning the course content through individual study, even if the intention of the instructor was that they should learn by participating in the course as a tight-knit social group. Therefore 11 OLC studies evaluated 'community-ness' rather than learning-oriented achievement (e.g., Alem and

Kravis 2004; Johnson et al. 2002; Majdalani et al. 1999). To the extent that these studies made claims about achievement of goals, they implicitly relied on the assumption that an OLC led to the desired outcomes without explicitly testing whether the desired outcomes (e.g., individual learning) took place.

McMillan and Chavis (1986) noted that online learning communities evolve from simple cohorts when learners elevate their engagement with each other to an emotional 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" (p. 9). Accordingly, community-ness has two levels of connotation. One level is active *participation*—the community must be strongly involved (Preece 2000). The second level is good *sociability*—participants of the community should interact with each other not only academically but socially, since "a community is first and foremost a social process" (Tu and Corry 2002, p. 3).

As Preece (2000) and Renninger and Shumar (2002) claimed, determinants of participation and sociability include a long list of measures, such as membership growth, the average duration of membership, the number of active participants and lurkers, the number of messages per unit of time, participation time, the number of on-topic discussions, the number of new ideas produced, the degree of empathy in the interaction, the number of social cues within online communication, and the degree to which members of the community help other members. In an exemplar case study, Alem and Kravis (2004) made daily online observations of participation, did discursive analyses of online-interaction transcripts, and conducted surveys of community members to collect data for almost all aforesaid measures. Wang et al. (2003) examined only members' participation behaviors. They conducted content analysis of the online-interaction transcripts by coding the number and content of the messages posted and searching for presence (e.g., emoticons) of the social connection established. By contrast, Rovai (2001) developed a 20-item Likert-scaled Classroom Community Scale for online course students to self-report their emotional sense of community (i.e., sense of trust and belonging). Generally, the measure of community-ness is contingent on the theories and goals of the researchers in that it may be examined as observed behaviors and/or self-reported feelings.

Integration of the system usability, learning achievement, and community-ness Taking a holistic approach, two OLC studies tried to present as rich a picture as possible of the value and status of an online learning community by integrating the evaluations of the system usability, learning goal achievement, and community-ness. Lally and Barrett's evaluation of an e-learning community (1999) enumerated various aspects of knowledge construction (i.e., participative, social, interactive, cognitive, and metacognitive). They conducted content analysis of online-interaction transcripts, documented members' participation time, and described the socio-emotional nature of online communications. They also interviewed participants about the tools' usefulness. Meyers et al. (2002) evaluated an online community of practice for middle school teachers by administering a post-treatment survey that elicited members' estimations of their knowledge gains, participation time, and the effectiveness of technologies and course design.

Measures for the "process" construct

Recently, the online learning community has been described as the result of an incremental process (rather than as a static entity) that is fluid in nature and evolves through nurturing

conditions (Renninger and Shumar 2002). Therefore 23 OLC studies examined dynamic interactions in order to understand what facilitated or impeded OLC development. Commonly examined measures for the process construct that emerged from the review were synthesized and presented as a variety of pairs or triads of nodes outlined in Figs. 4, 5, 6, and 7.

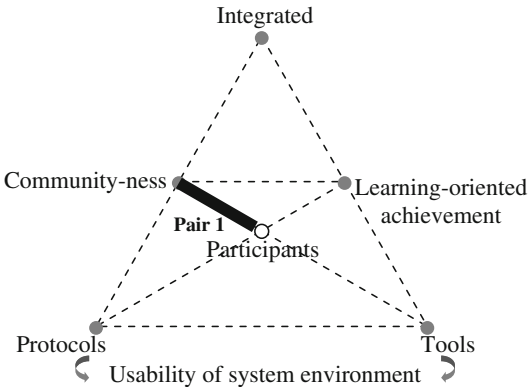


Fig. 4 Pair 1: Participants—community-ness

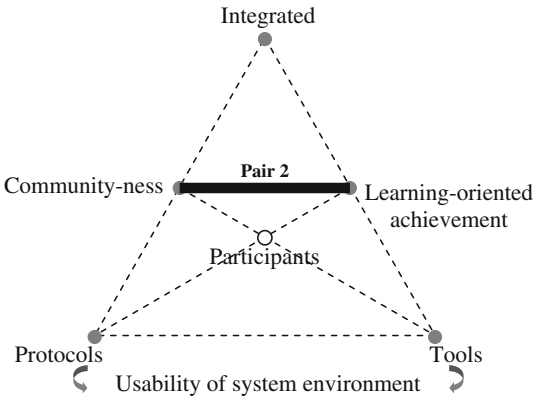


Fig. 5 Pair 2: Community-ness—learning-oriented achievement

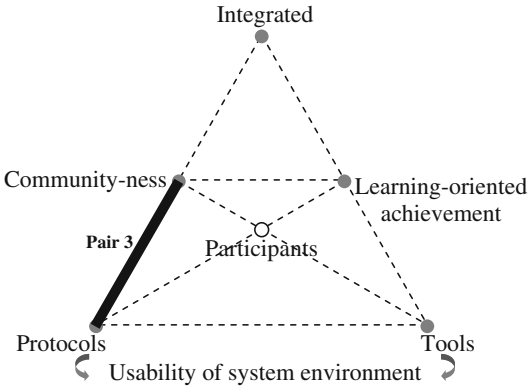


Fig. 6 Pair 3: Protocols—community-ness

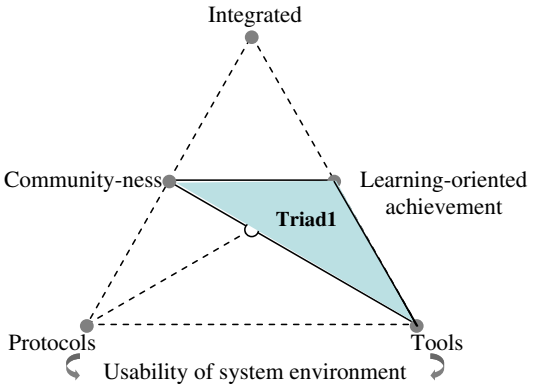


Fig. 7 Triad1: Tools—community-ness—learning-oriented achievement

Pair 1: participants—community-ness

The pair *participants—community-ness* refers to individual participants' characteristics or social and communicative roles in relation to the development of community-ness, which informs whether an OLC accommodates the diversity and equality of participants. Three OLC studies (i.e., Rovai 2001; Ke and Carr-Chellman 2006; Wang et al. 2003) examined the impact of gender and learning-style differences on participation and sense of community development. In a phenomenological inquiry, Ke and Carr-Chellman (2006) discovered that learners with a solitary learning style demonstrated unique online interaction patterns that made them disadvantaged in community development. Wang et al. (2003) conducted content analysis of online chat transcripts to compare male and female participants by the number and content of the messages posted. Their findings revealed that males were more likely to discuss information, while females were more likely to engage in social interactions; however, there was no direct impact of gender and interaction styles on levels of participation or sense of community development.

Three studies indicated that learners' selection of social and communicative roles in the online social network should be monitored and guided for the successful development of OLCs (i.e., Cho et al. 2007; Poole 2000; Wegerif 1998). Cho et al. (2007) studied "key communicators," who occupied a central position in a given social/communication network, and tested how those key actors influenced others' behaviors in the form of social navigation. Applying social network analysis to the log of discussion board threads and class listserv emails, the researchers found that the number of pageviews and unique visitors to a URL was positively associated with the centrality or prestige of a communicator who posted the URL.

Pair 2: community-ness—learning-oriented achievement

The pair *community-ness—learning-oriented achievement* refers to the correlation of community-ness (i.e., participation and sociability) with the achievement of learning goals. Four studies that were classified under this category underscored the influence of socialization and collaboration on community-based learning. Bruckman (2004) examined school children with different levels of participation (tracked by time on task) in an e-learning community and found that uneven levels of participation contributed to uneven learning achievement as measured by portfolio-based assessment. Cuthell et al. (2002), as a

result of online observation and interviewing, claimed that those who read postings but rarely became engaged in active exchanges (lurkers) had more opportunities than active community participants to develop higher-level cognition. However, those who were active within a community—in that they contributed to postings, initiated debate, and synthesized the submissions of others—increased the sum of the cognition distributed within the community. Finally, Rovai (2002) used the self-developed Classroom Community Scale to evaluate members' perceptions of learning and community-ness in an e-learning community and reported that members with stronger senses of community perceived greater cognitive learning achievement.

Pair 3: protocols—community-ness

The key element of this evaluation measure is the set of agreed-upon protocols established to govern online participation and interaction with others (Bryce-Davis 2001). Examples are using anonymity in peer discussion, commenting on a minimum number of posts in a discussion thread, following a set of rules of writing online "peer-to-peer" posts, or adopting a set of procedures for moderating a planned event. Protocols can be either created or defined by OLC developers through explicit instructional design, or they can be emergent in nature and implied by OLC participants. Hence the evaluation of protocols for community development can both reveal the possible deficits in design efforts and indicate what kind of social network has emerged in an OLC.

In spite of scholars' efforts to propose and design various protocols for OLCs, only nine evaluation studies examined the practice of protocols. Recently, Kilner and Hoadley (2005) explored the impact of anonymity on levels of participation and quality of online discussions in a large online community of practice for U.S. soldiers. They surveyed participants on the evolution of norms, reporting that eliminating anonymity produced significantly fewer antisocial comments and fewer comments overall but did not affect overall participation as measured by numbers of logins and page views.

Triad 1: tools—community-ness—learning-oriented achievement

As the only "triad" depicted in the measures chart, the *tools*-centered evaluation triad informs how tools should be selected to foster participation, sociability, and hence learner success. This evaluation triad is an integration of the dynamic interactions among the three key *outcome* measures (usability, community-ness, and learning achievement) and hence is a unique measurement in the 42 studies reviewed. According to Kuutti (1996), *tools* are "artifacts" that have a "mediating" role, such as "instruments, signs, procedures, machines, methods, laws, forms of work, and organization" (p. 26). *Tools* in this study refer not only to CMC technologies but also to *non-technological artifacts* such as linguistic conventions that aid online communication, *informational artifacts* such as readings, and *human artifacts* such as tutors or leaders who provide "mediation" for social-learning task performance.

The review identified six studies evaluating the impact of CMC tools on OLC development, with five examining only asynchronous tools (threaded discussion and email) and one also examining text-based synchronous tools (e.g., chat rooms). For example, Leh (2002) surveyed his participants in online communities within hybrid courses and reported that synchronous communication in chat-room strengthened students' sense of belonging. Cho et al. (2007) conducted social-network analysis with an online activity log file and reported that the class listserv generated more responses than the discussion board, thus

creating a more densely-connected social network. Through a blend of online observation, analysis of online communication transcripts, questionnaires, and interviewing, Pearson (1999) evaluated how threaded discussions foster academic communication and reflections of trainee teachers in an online community of practice. It should be noted that none of these studies started looking into emerging computer conferencing (e.g., Elluminate web conferencing) and Web 2.0 tools (e.g., Wiki, Ning social network platform) for co-constructing knowledge.

Four OLC studies examined non-technological tools in OLC. Among them, Collins et al. (2001) conducted linguistic analysis with communication transcripts to establish how language genres created and shared by the community activated knowledge-oriented communication. Maor (2003) and Shea et al. (2005), using participants' online postings and survey responses, illustrated how an instructor's facilitation and teaching presence positively fostered students' interaction and sense of community, thus facilitating learning community development.

Evaluation techniques: data collection, analysis, and report methods

The data collection techniques adopted by the studies were diverse and could be categorized as *objective* (9 studies), *qualitative* (12 studies), or *mixed* (21 studies). The objective data collection was usually performance-based assessment, collecting data that are valid and reliable in a contextually independent way, such as online activity records, interaction transcripts, knowledge-retention tests, performance checklists, and skill demonstrations. The qualitative data collection generally comprised judgments by participants or experts based on the interpretive and affective data from ethnographic observations, interviews, and attitude questionnaires. In five studies data collection processes were longitudinal, continuing through various development stages of an OLC (e.g., Kilner and Hoadley 2005; Leh 2002; Pearson 1998), whereas in the others (e.g., Chang 2003; Meyers et al. 2002) data collections were conducted at the completion state of an OLC (e.g., communities within fixed-term online courses).

Correspondingly, a variety of data analysis techniques were adopted for OLC evaluations. Content analysis or discourse analysis with online-interaction transcripts was used in 11 studies (e.g., Alem and Kravis 2004; De Laat and Lally 2003; Littleton and Whitelock 2005; Soller and Lesgold 2003; Wang et al. 2003). Researchers classified online interaction-transcripts into categories in terms of cognitive thinking levels, socio-emotional nature, or modes of interaction (e.g., Henri's cognitive skills framework 1992; Mercer's mode of interaction 1995). Social network analysis with online activity logs was another methodology used in two studies to examine the socio-academic nature of OLC (i.e., Aviv et al. 2003; Cho et al. 2007). Both content analysis and social network analysis could be accompanied by descriptive or correlational statistical analyses with the quantified data collected from online transcripts, activity logs, or surveys. For example, Alem and Kravis (2004) conducted a case study to evaluate the success of an online community of practice for public health researchers. Drawing on a sociability perspective, they did discourse analysis with online-discussion transcripts to collect data on the indicators of participation, such as the number of messages sent, the number of on-topic discussions, and the number of active participants. They then surveyed participants on their satisfaction with social interaction and the level of trust. With both participation and sociability data collected and quantified, Alem and Kravis ran descriptive and correlation analyses to verify the success of the community.

However, a greater number of studies (19 in total) used only qualitative thematic analysis with data collected from interviewing or online observation to document the OLC development and success (e.g., Maor 2003; Orey et al. 2003; Majdalani et al. 1999; Oren et al. 2002). Eleven studies used only statistical analysis with data collected from learners' self-report questionnaires, either to report OLC learners' self-perceived achievements (e.g., Auyeung 2004; Chang 2003; Johnson et al. 2002) or to infer the influential factors that might influence learners' self-perceived achievement levels (e.g., Kilner and Hoadley 2005).

The studies also differed in units of analysis. Most of the studies (39 out of 42) stated a social-cognitive view of learning and focused on individuals' cognitive thinking in data analysis. For example, Lally and Barrett (1999) used Henri's (1992) cognitive skill framework to classify individuals' messages into types of learning process, then calculated rates of events happening for each individual at different phases of community development. Only one study declared a socio-cultural view of community-based learning. Using the virtual group or team as the unit of analysis, Derry and DuRussel (1999) conducted discourse analysis with the online transcripts to estimate and compare the knowledge productivity of virtual groups within an online community program. Two studies adopted communication theory. Soller and Lesgold (2003) identified *productive* online knowledge-sharing instances in OLC by analyzing *knowledge-sharing episode*s (or instances) in which one episode involved multiple individuals or one individual learned across multiple episodes. Collins et al. (2001) adopted the concept of *genre*—a communicative act or entity—to detect patterns in the electronic interaction within an OLC. In their evaluations, a *genre* comprised a group of online posts or discussion threads that shared a similar topic or pattern.

In summary, 15 studies (e.g., Chang 2003; Cho et al. 2007; Leh 2002) quantified the findings, 16 studies (e.g. Conrad 2002; Rice-Lively 1994; Russell and Ginsburg 1999) used thick descriptions with qualitative interpretation, and 11 studies (e.g., De Laat and Lally 2003; Johnson et al. 2002; Oren et al. 2002) complemented numeric data with qualitative elaborations in their reports.

Conclusion and discussion

The review of the 42 OLC evaluation studies indicates that the choices of evaluation approach, measures, and techniques are linked not only to the particular goals of the OLC and/or researchers but also to the researchers' theoretical assumptions. Hence the idea of creating a monolithic, one-size-fits-all "good learning community indicator" evaluation model may not work. However, there is great interest in generalizing lessons learned from one OLC to others. Blending results is difficult but may be essential to effective implementation of OLCs (Hoadley 2002).

Our study presents a general taxonomy that synthesizes a wide variety of OLC evaluation dimensions. Clearly, it is unlikely that any one study can look at an OLC and evaluate that it is a "good" or "successful" learning community based on every combination of the dimensions in the taxonomy. By presenting a taxonomy of approaches, measures, and techniques, we hope that OLC-study authors can be more precise about *what* they are measuring, *why* they believe their measures map onto either product or process goals for the intervention, and how they hope their results will be used. In the following section, we further discuss the limitations of current OLC evaluation research and propose a potential approach for future OLC evaluation practice.

Limitations of current OLC evaluation research

According to Watkins (1997), an evaluation seeks to assess the value or merit of a program or practice when compared with pre-established criteria. This traditional conceptualization of evaluation is not appropriate for OLCs. First, OLCs are defined differently by different scholars, so evaluators do not have clear goals against which to judge value. Second, the review of the studies indicates that even if evaluators were clear on the goals, they might disagree on the assessment criteria that would be satisfactory for those goals. Therefore, OLC evaluators may need to adopt a goal-free evaluation approach (Scriven 1991) by gathering data on a broad array of actual outcomes and then comparing the observed outcomes with the actual needs of program participants. However, the review of the studies reveals that only three OLC studies examined an integration of different outcome constructs. Besides, few studies have explicitly reported that they conducted needs analyses with participants or demonstrated efforts to compare outcomes with participants' needs.

This review indicates case analysis as the major reporting style of the 42 studies. This finding supports the conclusion of Ricketts et al. (2000) on the lack of experimental design in studies of online learning. More importantly, some OLC studies lack a detailed description of the OLC contexts and evaluation procedures, thus making it difficult for consumers of the evaluation literature to make sense of what an evaluation does and does not address. Therefore, OLC studies' findings usually cannot be generalized or transferred. More work is needed to see if the use of the general evaluation taxonomy developed in this study can help us identify dimensions of variability of contexts and hence try to generalize some of the findings uncovered through detailed case analysis.

Another critical shortcoming of many research projects in online communities is that the data collected are limited to *online* activities. In many cases, interactions take place in a variety of *offline* ways. In addition to offline events, much online community research is restricted to *public* online events. The analysis of archives of public conversation misses the important *private* conversations that take place among community members, whether by email, chat, or even audio. There is often sketchy evidence of private conversations in the public discourse.

Finally, very few studies are longitudinal and address the natural evolution of different kinds of OLC over time. Since language, practices, customs, and resources in an OLC develop over time (Squire and Johnson 2000), it may be especially important to conduct a longitudinal, time-series analysis when evaluating an online learning community. However, as Hugo (2002) stated, the historical evidence of learning in community is disparate. Few studies have examined OLCs longitudinally, especially at different temporal stages of the virtual community development—such as the *initial* phase, the *conflict* phase, the *intimacy and work* phase, and the *termination* phase (Palloff and Pratt 1999).

The dimensions or measures to be examined in future OLC evaluation studies

As shown in Fig. 3, quite a few dimensions of the *process* construct have not been examined (demonstrated as dotted lines or empty triads), but can be important measures to inform OLC development. First, a critical measure may be the interaction between *protocols* and *learning achievement*. There are conceptual discussions on how the designing factors of interaction/participation protocols (e.g., group structure of cohorts, moderation strategies for meaningful discourses, etc.) may influence the magnitude and types of knowledge created and shared (Aviv et al. 2003). But little OLC empirical research is available to back up those discussions. The correlation between *protocols* and *tools* should

also be an important evaluation measure to inform whether an online environment is hospitable for the learning-community development. For example, future research may examine how CMC technologies imply appropriate communication rules and hence how we can design adaptive participation protocols for different online communication tools (e.g., text-based threaded-discussion versus audio-based web conferencing). Finally, although some OLC studies have examined the interactions between tools and learning-oriented achievement, more empirical studies are needed to examine the mediating effect of the emerging CMC tools (e.g., web 2.0 tools for co-constructing knowledge) in comparison with the traditional threaded discussion forums in mediating a *conversational mode of learning* in an online learning community (Thomas 2002).

A comprehensive syndromes diagnostic approach for OLC evaluation

According to Moore et al. (2002), not every intervention lends itself to an experimental evaluation. This statement is especially true in the case of the online learning community—a multifaceted, living system comprising diverse hallmarks, processes, and outcomes. Instead of adopting experiments that are one-shot, decontextualized, and potentially confounded by unmeasured interacting variables related to the phenomenon, we suggest a comprehensive diagnostic approach to identifying and measuring multiple variables or *syndromes* to evaluate the success of OLCs (Miller 1994). This approach has its roots in the methodology of psychiatric diagnosis, in which psychiatrists identify, split, clump, and otherwise deal with symptoms to make decisions on medical treatment for illness.

According to Miller (1994), psychiatric diagnosis is a complex procedure involving more than producing a disease label for a set of patient descriptors; efficient and ethical diagnostic evaluation requires a broad knowledge of people and a variety of disease states or syndromes. In addition, psychiatric diagnosis is an evolving process. Diagnosticians form diagnostic hypotheses early in case evaluation, based on recognition of key or *pivotal* findings, then refine their initial hypotheses as more information becomes available. The disease labels used in diagnosis reflect only current levels of scientific understanding for making a diagnosis (Miller 1994).

Similar to psychiatric diagnosis, a comprehensive and valid approach to OLC evaluation will be to make explicit and measure multiple components or variables of a particular OLC—such as the outcome and process measures outlined in our taxonomy and measures chart—to aid with a synthesis of data from multiple sources. With OLCs, it is important not to assume any single, positive outcome is part of the "syndrome" of success because "relationships among observations and diagnoses can be expressed on a continuum from full independence to full causal dependency" (Miller 1994, p. 16). In other terms, it is necessary to examine the causal relation assumed by the evaluators between what is measured and the success of OLC as an imputed outcome. Most importantly, we must work diligently to search for repetitions of patterns across OLCs. Even when a detailed model is unknown, the development and application of clusters of indicators are important both as solutions to problems of practice and as ways to identify deeper truths about underlying mechanisms.

Because there is no clear understanding of what makes OLCs successful, criteria for evaluation should be subjected to ongoing revision, just as diagnostic criteria in psychiatric diagnosis are continually refined. A critical area relevant to generalizations about OLCs is ongoing validation, evaluation, and quality assurance of indicators through a series of replicated in-field studies that vary in both particulars of the context and theoretical stances on learning.

In addition, potential consumers of an OLC evaluation taxonomy, who possess both a detailed knowledge of an individual OLC case and a common sense of general OLC evaluation approaches, should be included as an integral part in the maintenance of an evolving, valid knowledge base related to OLC evaluation. Particularly, these taxonomy-users can conduct so-called *sensitivity analyses* (Miller 1994) to determine which measures or variables involved in an OLC evaluation are more critical and alter the preferred evaluation strategies accordingly.

Finally, the rigidity imposed by a single formalism is often not suited to a flexible and multifaceted analysis of a complex system like an online learning community. Like psychiatric diagnosticians, OLC evaluators should be clear on the strategies they employ and theories of action upon which they rely, not just the instruments and measures they use.

In summary, we have provided a multifaceted view of how OLCs are being and may be evaluated. By categorizing these evaluations, we hope to advance the field of OLCs, in both theory and practice. We urge evaluators to be explicit about the choices and assumptions they make in analyzing communities. Our taxonomy may be helpful in this regard. Furthermore, and perhaps most importantly, we urge the field as a whole to attend to patterns of indicators more broadly than those available through any one case study. Taxonomies such as ours may inspire OLC proponents to consider a wider range of indicators to examine or to locate prior work that might interpret similar indicators. Only by identifying common patterns and the strengths (and weaknesses) of relationships among the various process and outcome indicators *across* OLCs can we hope to make cumulative progress in understanding the deceptively simple question, "Is this OLC working (or not) and why?"

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