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HOW COMMUNITIES OF INQUIRY DRIVE TEACHING AND LEARNING IN THE DIGITAL AGE

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The development of communities of inquiry, highly engaged in the co-creation, discovery and development of knowledge, capabilities and skills, is enabled by learning management systems, collaborative platforms and social-constructivist teaching activities (Garrison, Anderson & Archer, 2000, 2001a, 2001b; Garrison & Anderson, 2003). This paper explores the current state of communities of inquiry (COI) in teaching and learning in the digital age, including the technology to support learner presence (Shea & Bidjerano, 2010) and personal learning environments. It also argues for the communities of inquiry model to evolve into a learning model, that recognizes the importance of motivation, self-efficacy and personal skills in effective communities of inquiry.

The paper addresses five key questions examined through the lens of the Community of Inquiry Model:

- What skills and abilities need to be developed for teachers and learners to fully leverage the power of communities of inquiry? What are the prerequisites for effective learning?
- What are we learning from the growth of peer-to-peer learning and peer assessment which supports the power of communities of inquiry?
- What can emerging technology approaches to adaptive learning and adaptive assessment bring to the practice of communities of inquiry?
- What are the known best practices and emergent next practices for communities of inquiry?
- What are examples of communities of inquiry in action from a variety of settings around the world?

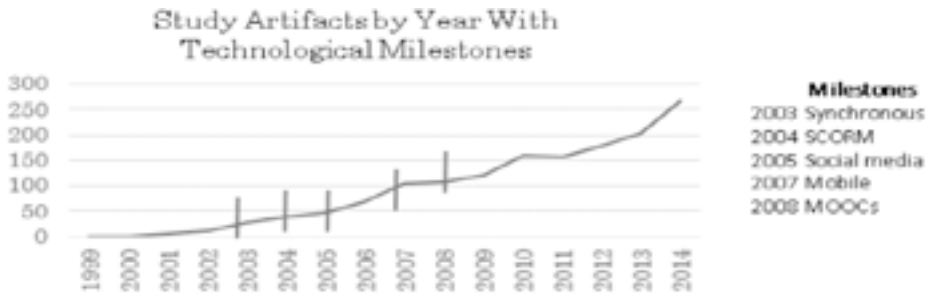
THE EVOLUTION OF THE COMMUNITY OF INQUIRY MODEL

The Community of Inquiry (COI) has emerged in the past two decades as the most widely cited model for both course development and teaching research in online education (Bozkurt et al., 2015). The set of articles in which we introduced the model, the three presences (social, teaching, and cognitive), and our research methods were written by Randy Garrison, Walter Archer and myself (with invaluable assistance from graduate student Liam Rourke) from 1999-2001. These articles in total have been cited over 10,000 times by other researchers (Google Scholar, May 2017). In addition, the COI model has been used to develop many online courses and programs and has been used as the conceptual model for hundreds of thesis and research studies (Kineshanko, 2016). I use the coming 20th anniversary of this work to reflect on the key insights from the model and speculate on its future developments.

Integrating the New Technologies: The COI model has shown itself to be popular as a model to support research and course development not only within the online conferencing context in which it evolved, but also with new technologies as they have emerged. Figure 1 illustrates the increasing number of references to the COI overall and also shows that the model is robust enough to be useful when applied to a variety of intercultural contexts and technologies used to support distributed learning. These

include blogs (Angelaina & Jimoyiannis, 2012), immersive reality systems (McKerlich & Anderson, 2007), synchronous technologies (Fayram, 2017), wikis (Lambert & Fisher, 2009) and MOOCs (Frau-Meigs & Bossu, 2017; Holstein & Cohen, 2016). More importantly, these references also show results of model implementation in practice and usually detail associated challenges, including technological issues, lack of familiarity, less than enthusiastic adoption and how the absence of one of the presences (notably effective teaching presence) can decrease the efficacy of the learning. As COI is essentially a social-constructivist model, it is also somewhat surprising to see its applicability to even the so called xMOOCs, which are based largely on cognitive-behaviourist pedagogies (Anderson & Dron, 2012). Holstein and Cohen (2016) analyzed large numbers of student perceptions of successful Coursera MOOCs and found that "constructing a successful MOOC can be accomplished by including all of the presence elements" - including social presence.

Figure 1. COI citations with technology timelines from Kineshanko (2016)



Threaded Discussions: Quite surprisingly, there has been very little innovation used in the threaded conference systems since our very early work in the 1990's. I should note that experimental systems that support "like buttons" (Makos, Oztok, Zingaro, & Hewitt, 2013) or that force students to classify or add descriptive metadata or tags to their response (for example, disagreement, further example, types of thinking, Schellens, Van Keer, De Wever, & Valcke (2009)) have been shown to induce increases in at least social presence and commonly all three presences. There has also been work using machine algorithms to classify or highlight student messages requiring instructor feedback but none of these have resulted in widespread implementation in existing LMS systems. It seems that the now venerable threaded discussion continues to dominate online education, as it is as familiar to both students and teachers today as the systems we originally used to develop and validate the model. Perhaps the simple threaded discussion, like email, meets the needs of most teachers and thus there is little demand for systemic improvements. It is interesting to speculate whether mobile apps, with their more immediate response messaging that dominate both social and commercial communications, will dethrone the asynchronous threaded discussion in the near or distant future.

Improving Student Postings: Despite the lack of technical innovation, teachers using COI pedagogical models have incorporated a variety of

protocols and best practices to enhance the value of student postings. Most often these include providing assessment rubrics (Makos et al., 2013; Pelz, 2010), providing model student answers or defining response protocols (Chen, Zydney, & Patton, 2017) and sharing exemplar contributions from past courses. Many teachers also advocate making student posting compulsory to receive passing course credits, offer "bonus marks" for participation or, as I do, require students to provide a final summary post, describing and reflecting upon their contributions to the COI.

Technology: New and Old: As noted earlier, the COI model can be applied to courses based on a variety of technologies. Given the speed of change of pedagogical and communications technologies that we have witnessed since the COI model was developed twenty years ago, it is tempting to say that things will likely slow down now and allow us and our institutions to catch up! Unfortunately, this is likely a delusional belief in that technologically induced change continues and the need for educators and administrators to be both open to learning themselves and experimenting with their students in new learning communities is critically important. In earlier work, we showed that educational technologies largely do not disappear (Dron & Anderson, 2016). For example, blackboards, television, printed books and many other technologies are still used – despite the adoption of newer technologies. Thus, the palette of delivery and communications options grows larger and the successful teacher learns not only to effectively use what they are most familiar and proficient with, but also to experiment and adopt new tools that may increase the efficacy of students' educational experience.

Learning Activities: The selection or design and facilitation of learning activities are key components of teaching presences and critical to the emergence of all three of the presences (Morueta, López, Gómez, & Harris, 2016). As is often remarked 'it ain't what you've got, but what you do with it that counts.' Key to the development of cognitive presence is the development (both planned and spontaneous as opportunities arise) of effective questions. Richardson, Sadaf, & Ertmer (2012) found making certain that questions were perceived as authentic and grounded in at least the possible personal experiences of learners induced the development of cognitive presence. McLoughlin and Mynard, (2009) examine effective practices that need to be used with any technology. They concluded that "with appropriate tasks, careful wording of instructor prompts, clear guidelines, and examples for participants, an imposed time limit and, possibly, the assignment of grades, the medium can provide students with opportunities for developing higher-order thinking."

Integration of Social Media: With the predominance of social media available and used today, participants (both teachers and students) have a great many tools that can be used to enhance their social presence beyond the institutional learning management system. Even without conscious effort, many of us are creating a net presence that is found by search engines constantly combing social and educational web sites. Rather than leave this to chance, I have argued (Anderson, 2016) for the

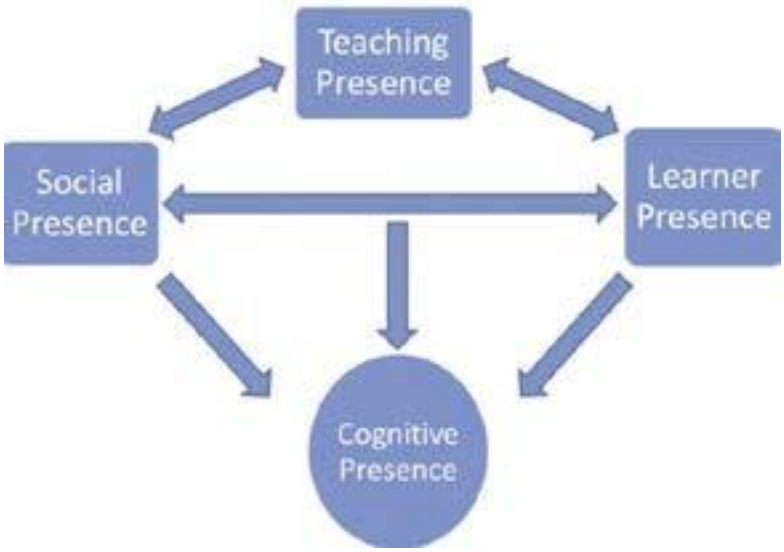
need to actively build and manage presence on social networks and to develop personal learning environments so as to maximize the effect and authenticity of our net presence. Moving outside the protective walls of the institutional LMS, however, gives rise to potential for privacy invasion and commercial and political exploitation by the owners of these networks. Thus, Jon Dron and I (Dron & Anderson, 2014) have been working for over six years to develop an institutionally owned social network that not only allows better control of privacy and removes exploitation, but also permits students and teachers to open the windows on our "walled garden" to allow others to discover our net presence and our contributions to both courses and other academic pursuits.

NEED FOR ADDITIONAL PRESENCES TO DEFINE A COMMUNITY OF INQUIRY

The march of progress over the past two decades has also seen the call for additional "presences" with a goal of more completely describing the educational experience. These include vicarious presence (Sutton, 2001), emotional presence (Cleveland-Innes & Campbell, 2012) and autonomy presence (Lam, 2015). There have been efforts to expand the social presence category in the COI model (especially for application in blended contexts) to include affective association, emotional presence, community cohesion, instructor involvement, interaction intensity, and knowledge and experience (Whiteside, 2015). I would argue that each of these already exists in the original model, but further definition helps focus on particular salient components of social presence.

None of these proposed additions has received wide adoption and there is certainly something to be said for the parsimonious advantage of only three presences. However, my biggest concern with the existing COI model is that while it helps construct and define an effective teaching model, we all know that the effectiveness of teaching is equally dependent on the learners. Thus, I am supportive of the addition of a "learner presence" described and measured by Shea and Bidjerano (2010). They illustrate learner presence as in Figure 2 and note its components of effort, self-efficacy, and other forms of student self-regulation. This addition also brings the model more in line with notions of self-directed learning that predominate in connectivist (Siemens, 2005) and heutagogical (Blaschke, 2012) based learning designs. Finally, the notion of measurement and support of learner presence allows the COI to evolve beyond a teaching model to a 'teaching and learning' model and thus moves it beyond formal schooling and educational contexts. It is no longer enough for teachers to ask what types of presence(s) do I need to develop in my teaching, but rather how do I match my teaching model and behaviour with the learning capacities of the learners.

Figure 2. Suggestions for a revised COI Model from Shea and Bidjerano (2010)



In the next section, I detail a variety of best practices associated with each of the three presences that have emerged during the past 20 years.

BEST PRACTICES IN SOCIAL, TEACHING, AND COGNITIVE PRESENCES

Social Presence: The COI stresses that social presence opens the door to and makes possible cognitive presence and successful accomplishment of educational outcomes. Analysis of the simple threaded text messages that first led us to embrace and develop this model showed quite clearly that both cognitive and teaching presence can be created and sustained using this medium while taking advantage of the inherent reflection and time shifting capacity of asynchronous communications. However, my personal attempts, as well as a number of studies (Tekiner Tolu, 2010) at building confidence and mutual awareness, have shown that synchronous communications can be especially useful in quickly establishing, building and modeling social presence. Other researchers have shown that many of claims associated with blended classrooms that combine face-to-face and online interactions (Chandler, Park, Levin, & Morse, 2013) can also be achieved with synchronous online interaction (Power, 2008; Szeto & Cheng, 2016).

There are a variety of techniques to enhance social presence, many of which evolved in classrooms. These include ice-breaker activities including self or pair based introductions, opportunities to talk about personal contexts, session check-ins and digital story-telling. LMS systems (like most social media) provide spaces for learners to complete their own student profiles. Although tedious for students to complete and maintain these profiles on every new system (underscoring the need for standards and better linking of profiles across platforms) completing profiles helps both teachers and peer members of the COI to familiarize themselves with other community members.

Finally, studies have shown that use of social networking tools extend

learning to “informal spaces” further enriching social presence (Yang, Crook, & O’Malley, 2014). In addition, many community members are developing their “net presence” using a variety of net tools and platforms. Much value can be accrued by both students and teachers linking their current formal courses to their emergent “net presence” thereby increasing social presence by sharing a more complete picture of themselves within the community of inquiry.

Teaching Presence: One of the key components of teaching presence is the setting and managing of both individual and collaborative learning activities. Here the COI builds upon its constructivist and adult education roots by suggesting activities that elicit reference to learners’ personal experiences and provides opportunities to negotiate meaning and the diverse understandings of other members of the community. Effective learning activities provide a focal point and tasks for meaningful student interactions and encourage the students to be active learners, not mere receptacles of learning content. Quality COI activities challenge students with tasks that are authentically based and assessed and which have potential for enriching not only the somewhat artificial context of formal education but the students’ real world contexts as well (Lock & Redmond, 2015).

For each of the presences, but perhaps especially for teaching presence, it is critical that the teacher models effective problem solving, provides constructive feedback, offers probing questions and otherwise actively facilitates tasks so that students can witness scholarly and ethical thinking in action. We long argued that the term for this component of the COI is ‘teaching’ and not ‘teacher’ presence. This provides room for, and encourages, students to take a positive and visible role in the learning of their peers. The notion of ‘direct instruction’ within teaching presence has caused some controversy in the research (see for example van Oostveen, DiGiuseppe, Barber, Blayone, & Childs, (2016)). Diehard constructivists decry any amount of teacher telling, while direct instruction advocates argue for the efficiency of students being directly instructed in the “correct knowledge”. We concluded that a formal COI is not a social club or debating society, but rather can and does benefit from appropriate amounts of interjections through direct instruction, so as to maximize development of cognitive presence without reducing opportunities for knowledge construction by students.

Cognitive Presence: We developed the notion of cognitive presence and the variety of indicators for it from a generalized model of critical thinking (Garrison, 1991). In an era of “alternate truths”, filter bubbles and media saturation, it is of upmost importance that students learn to critically explore and evaluate information they encounter and knowledge that they are constructing. Equally as important, students need opportunities and incentives to test and apply this knowledge beyond the sheltered context of formal education. Perhaps of greatest impact in this area of the COI in the past two decades has been the capacity to find, filter and retrieve information from the Internet. No longer can any single text or recommendation from a teacher be sufficient to support a complete

community of inquiry. The intercultural, multi-level and diverse sorts of information on the Net can and should be used not only to confirm, but also to challenge, solutions that evolve within the closed COI. I also strongly support the public annotation, archiving and active curation of artifacts (papers, reports, student projects, annotated list of resources, slideshows etc.) that are produced within the COI so as to provide resources for other and subsequent COIs located around the globe (Tibbo, 2015; Ungerer, 2016).

We were perhaps the first, but certainly not the last researchers, to note how few of the interactions observed within the COI routinely demonstrate higher levels of cognitive presence, specifically the resolution and application of problems. We have provided a rationale for this noted absence – much of which is related to the artificial context of formal education itself (Garrison, Anderson, & Archer, 2010). But we also note the critical role of teaching presence in designing meaningful learning activities, triggering questions, effective assessment and pushing students to go beyond observing and sharing to actually resolving and testing solutions. Without this active teaching presence, the higher levels of cognitive presence are rarely developed.

One of the challenges we first encountered when trying to both extract and then codify the characteristics of each of the 'presences' from text based transcripts, was the often excessive time requirements for and the inability of teachers to measure the presences as they evolve (and thus adapt interventions in real time to meet any deficiencies). We also had hoped that this analysis could be done rapidly and continuously by machines to provide formative feedback to teachers while the course was in progress. The most challenging of the presences (and arguably the most critical in formal education) is the identification and measurement of cognitive presence. From early work by McKlin, Harmon, Evans, & Jones (2001), rapid development of learning analytics has led to very promising developments in this area for use in online courses (Kovanović, Gašević, Hatala, & Siemens, 2017) and even for use with MOOCs (Kovanović, Joksimović, et al., 2017). Despite the progress, we still await this functionality to be built in teaching and learning systems.

THE GROWTH OF PEER-TO-PEER LEARNING AND PEER ASSESSMENT AND COMMUNITIES OF INQUIRY

Perhaps the strongest motivation for our development of the COI was to propel distance education beyond the social and technical limitations and the cognitive-behaviorist pedagogical designs of earlier correspondence-based distance education. We wanted to create what Garrison and Shale described as "not distance education, but education at a distance" (Garrison & Shale, 1990). The primary pedagogical affordance of network-based technologies is the capacity for peer-to-peer interaction. Collaborative and cooperative learning, peer teaching, study groups and other activities had long been used and validated through extensive research in classroom based learning (see for example Johnson and Johnson (1994) or the meta-analysis by Springer, Stanne et al

(1999)). These types of social learning activities and associated positive results were absent from individualized models of distance education. Telecommunications technology made possible and practical a variety of collaborative and cooperative learning activities. We soon discovered that one can engage in all types of collaborative and cooperative learning at a distance even using asynchronous technologies - however it usually takes longer to accomplish. The time factor was a result of challenges of coordination over distance and time zones, of inefficiencies of document sharing and collaborative editing, and other challenges associated with project management. The development of collaborative authoring, sharing and scheduling tools such as wikis and Google docs, coupled with very low cost and ubiquitous real and asynchronous communications tools have largely eliminated these concerns about the quality or efficiency of distributed education. This is not to suggest that face-to-face teaching and learning have no advantages (as has been illustrated by many studies of blended learning); however, the flourishing of distributed groups, teams and classes shows that working effectively together does not strictly depend on physical co-presence. Thus, I anticipate further gains in the value of the model as network based collaboration and project management tools are further integrated into formal learning contexts.

LEARNING ANALYTICS, PERSONALIZED LEARNING AND ADAPTIVE ASSESSMENT

One of the educational ideas currently riding highest on the "hype cycle" is that personalized learning, propelled by learning analytics, will revolutionize or least drastically change and improve formal education by moving us away from one size fits all teaching models. I am less confident of these changes than some of their most passionate evangelists, but I do believe that adding machine intelligence to discovery and alteration of learning paths and assessments can bring positive change. Moreover, I don't underestimate the value (nor the challenges) that can be extracted from administrative data that is gathered over multiple years and in varying contexts to provide a larger focus on formal education effectiveness. A report by Figlio, Karbownik & Salvanes (2017), argues that "administrative data open up new questions that could not previously have been studied, allow us to re-evaluate existing questions with new and more compelling empirical approaches and identification strategies, and permit analysis of questions of specific interest to particular localities".

Personalization for pedagogical purposes includes customization of not only the difficulty level of the content, but also of pace, space, technology and pedagogy used. Most work in this area has been focused on more cognitive-behaviorist online learning models and includes things such as creating individualized quizzes and tests that are responsive to students' previous answers or altering the sequencing or the amount and type automated feedback to students based upon learners conscientiousness (Dennis, Masthoff, & Mellish, 2012). However, this type of increased personalization implies or at least benefits most from self-paced models that allow learners to start, pace and complete their learning based on

decisions from their individual constraints and unique contexts (stored as their learning model). As noted earlier the COI is a social constructivist model and thus it is not readily compatible with the completely individualized nature of such technologies.

However, we can expect the power of analytics to also be used for supporting groups and social processes (Ferguson & Shum, 2012). Creation of groups by teachers and by group members promises to be improved and better managed through analytics. Creating groups of students with similar profiles in terms of geographic location, similar vocational or academic interest may facilitate more efficient group communications, while adding measured amounts of diversity can also enrich learning communities. Complete personalized adaptation is impossible in a COI model, but there are many ways in which the obscurity and potential loneliness associated with social online learning can be reduced – including learning analytics. One of the relatively few papers looking at analytic support for group and discussion based models is the work of Gaudioso and Boticario (2003). Their "fundamental objective is therefore to enhance user access to the services offered (forums, information sources,...) as well as facilitating collaboration between members in the same group." The activities they suggest assign students to groups based upon their past activity levels, and classify forum postings based on users' interests. Providing summaries and statistics of student reactions or ratings could also be of value, as would appropriate scaffolding to encourage student reflection upon their learning process. In short, learning analytics and personalization have been applied to pedagogical designs and activities from which data are more easily gathered and more immediately responsive to measurable student activity. I remain hopeful that COI models will, in the future, benefit more in allowing both personal and personalized support to enhancing community awareness, activities and learning.

At its most basic level, adaptive learning allows students to apply their knowledge to mental constructs and physical environments with which they are familiar – thereby grounding the learning in direct experience. Thus, student assignments, triggering questions and application examples all are designed to support personalization. The torrent of open education resources currently available – including full MOOC courses, allows individuals or teachers to enhance and personalize their learning by using a variety of different content and learning activities.

We know, however, that learning at a distance can be a lonely experience for some students and thus technological tools that allow us to select and read individual profiles, blogs and tweets of both students and teachers can help personalize our contributions to the community. In addition, new students are often shy and unclear on the norms and expectations of the community and the course. Thus, we have experienced positive results (Anderson, Upton, Dron, Malone, & Poelhuner, 2015; Berry, 2016) from leaving the archives of conversations, contributions and projects from past communities online and alive, so that students can see the work of past cohorts and personalize their own contributions in line with community

expectations. In addition, the continuing improvement of personal learning environments (PLEs) developed by student and teacher selection of learning tools and skills that they have mastered, allows individual students within the community to customize their interactions based upon their own learning needs.

Finally and most commonly, analytics are used to allow the teacher to easily monitor the progress, contributions and activities of the student members of the community. This can result in interventions from the teacher that personalize the teaching presence through customized feedback, direct instruction or encouragement. We have also shown that giving students themselves access to the traces of activity left by other students in the community can improve performance (Miyazoe, Anderson, & Sato, 2013) and help them to grow a sense of self-direction in their learning.

At its heart, the COI is a social model that depends upon regular and timely communications amongst its members. Thus some individualization is sacrificed for social negotiation, ratification, collaboration and growth. These are also critical capacities needed in work, family and other formal and informal communities – thus the social constraints are justified. However, I have come to believe that a complete education includes opportunity and challenge to learn effectively alone, in a group, and in a network – with a teacher and without one.

Stephen Downes (2016) makes a useful distinction between this type of personalized learning in which the pre-established menu is altered slightly depending on individual tastes and personal learning where the content (or menu) itself can be changed by the learner - thus creating personal learning. There are also concerns with personalized learning models that take student control from pacing and sequencing and replace it with machine or teacher control – thus potentially removing the important self direction necessary for lifelong learning to develop. The COI model can be useful for both personalized and personal learning – as long as the instructor presence does not totally dominate content or methods selection and thus I expect continuous development in both personal and personalized learning.

THE FUTURE OF COMMUNITIES OF INQUIRY AND EMERGING TECHNOLOGIES

One of the challenges of all social-constructivist learning models – including the COI - is scaling up to meet demand and so increase access by large numbers of learners. Traditionally, distance education institutions have done this by breaking large courses into smaller tutorial groups and supporting these groups with tutors in face-to-face or online groups. I have very rarely seen this model increased beyond 40 or 50 students and 20-30 students is the norm. This limitation prevents large scaling of COI modeled learning as costs tend to increase directly with the number of students (Bates, 2005). Industrial and post-industrial models attempt to address this limitation by increasing student-student interaction or by, for example, increasing teaching presence through use of recorded

video, automated and pre-set responses and pre-programmed teaching tools such as computer assisted learning, simulations and games. Most recently, MOOC models are evolving that focus not on the learning group like the COI model, but on a network of learners working on a course of studies (Dron & Anderson, 2014). Networks are less formally structured than groups, more flexible in the entrance and exit of members and tend to expand beyond a single structured course similar to the so-called groups (actually networks) that are created or emerge on Facebook, LinkedIn and other social networking systems. The informal nature of communication has evolved outside of formal education.

Some of the COI constructs cross easily to network models, but others suffer from the need for time synchronization, and the often overwhelming presence of teacher assessment that can inhibit opportunity for networks to fully develop. Jon Dron and I have also explored and developed tools for learning in 'sets' – the aggregation of all those with interest in a topic but who have no interest in developing a closer and more time dependent network or a group. The classic example is the set of individuals who work creating Wikipedia articles and the larger set of those who garner information on a particular topic from them. Learning in sets allows, but does not demand, contributions, recommendations or assessments and thus reduces demands for structured time and personal interaction (Dron & Anderson, 2014).

Humans evolved in groups (mostly families and larger kin and tribal groups) and these have evolved to create the social glue that facilitates learning and enhances motivation in the COI model. The continuing popularity of the model, through different technologies, shows that group based learning is still highly valued and the most common way in which at least young people engage in both formal and informal learning. However, we expect the future to see increasing opportunities to develop and benefit from network and set models that are based upon ubiquitous and increasingly powerful and flexible digital networks. The value of new models will be most important in providing lifelong learning opportunities for personal, community and career development.

MOVING FORWARD WITH THE COMMUNITY OF INQUIRY MODEL

With the inclusion of the attributes and effort of the learner – the Learner Presence added (see above) – the COI provides a model for lifelong learning, as well as for formal education. As Garrison and others have constantly argued, the COI is about the process of inquiry – teaching, demonstrating and reflecting on how we engage with teachers, other students and content as we learn things. The generalized scientific model found in the cognitive presence of beginning with what we know, searching for, testing, and applying this knowledge in recursive cycles of inquiry has been an effective learning strategy in the past and continues to be useful today.

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