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ORIGINAL ARTICLE

# Emerging approaches for supporting easy, engaged and effective collaborative learning

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**Abstract** Collaborative learning is one of the key instructional strategies and is adopted world widely. In the past three to five decades, cooperative learning in a traditional classroom has been popular in the west countries and has been adopted gradually in east countries; collaborative knowledge building through online community attracted much attention in the last 10 years. With the development of social networking and the expansion of Web 2.0/x.0, the query of collaborative learning effectiveness appeared in both classrooms and online environments, which are a concern to educators, researchers and policy makers. Based on the analysis of new generation of students, in the present article, we first analyzed the issues in both F2F and online collaborative learning, and the differences of collaborative learning between the west and the east from the perspective of culture. After that, we proposed three new approaches for future CSCL studies: orchestrating diverse activities with resources, embedding assessment into learner experience, and infusing smart environment with group activities.



## 1. Introduction

Collaborative learning has gained an increasing role in educational research and practices in recent years. Computer-supported collaborative learning (CSCL) is a pedagogical approach wherein learning takes place via social interaction using a computer or through the Internet. Therefore, in the field of computer-supported collaborative learning, the group interactions are often mediated by various kinds of technologies. Nowadays, many new technologies emerged, such as ubiquitous learning technologies, gesture-based computing, augmented reality technology, learning analytics etc. Students who have been growing up in the technology environment are keen to using new devices, apps and various kinds of new technologies. However, in the field of computer-supported collaborative learning there are still some issues and challenges need to be addressed, when considering how to utilize emerging technologies to support collaborative learning.

Collaborative learning aims to promote students' individual cognition, group cognition and community cognition. The learners' characteristics are key pedagogical aspects for designing collaborative learning activities, while it is claimed that new generation of students has significant different learning characteristics from the previous generation. So we first analyzed the characteristics of the new generation students. Then

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we identified issues from the dimensions of knowledge building, interaction analysis methodology and assessment. Finally, we proposed the three approaches to support easy, engaged and effective collaborative learning.

## 2. Diverse needs of the new generation students

When we consider new generation of students, there are three similar concepts of Millennial, digital natives, and net generations. Howe and Strauss first coined the term 'Millennial Generation' (defined as being born between 1982 and 2000), as successor to, but not wanting to be associated with the 'Generation X' (born between 1961 and 1981) (Howe and Strauss, 1992). They claimed that special, sheltered, confident, team-oriented, achieving, pressured, and conventional were the basic characteristics of Millennials. 'Digital Natives' was introduced to describe this generation by Prensky (2012), because he found them to be 'native speakers' of the digital language of computers and the Internet. Digital natives was accustomed to the twitch-speed, multitasking, random-access, graphics-first, active, connected, fun, fantasy, quick-payoff world of their video games, MTV, and Internet. 'Net Generation' was proposed by Tapscott (2005), and he argued that the generation of children who grew up with the new medium was defined by their relationship with digital technology. Then, Brown (2005) identified the 10 learning characteristics of Net Generation: group activity, goal and achievement orientation, multitasking, trial and error, heavy reliance on network access, pragmatic and inductive, ethnically diverse, visual, and interactive. Based on the previous research, Berk (2009) identified the 20 characteristics of 'N-Geners': technology savvy, relies on search engines for information, interested in multi-media, creates internet content, operates at a fast speed, learns by inductive discovery, learns by trial and error, multi-tasks on everything, shorten attention span, communicates visually, craves social face-to-face interaction, emotionally open, embraces diversity and multiculturalism, prefer teamwork and collaboration, strives for lifestyle fit, feel pressure to succeed, constantly seek feedback, thrives on instant gratification, response quickly and expect quick responses in return, and prefer typing to handwriting.

From the analysis of different terms associated with new generation of students, we can see that new generation of students is experiential learners, interactive and social learners, multi-taskers, structured and relevant learners, and technology immersed learners. However, researchers argue that while digital technologies are associated with significant changes in the lives of young people, there is no evidence of a serious break between young people and the rest of society (Bennett et al., 2008; Selwyn, 2009). Jones and Hosein (2010) argued that there was not a single Net Generation with common characteristics, and age only seemed to be one of several interrelated factors, rather than the sole factor. Jones (2013) pointed out that the claim that there was a new generation of learners characterized by a new mentality had to be carefully assessed in the light of recent empirical evidence. Whether the students who had grown up with technology could stand for a new generation, was the debate between the two parties/groups of researchers on the new generation students. So students may have very diverse needs in the process of collaborative learning, even though they have something in common. Collaborative learning design should consider new generation students' learning preference and at the same time consider the diversity of learners.

## 3. The query on effectiveness of computer-supported collaborative learning

The CSCL is characterized by the sharing and construction of knowledge among participants using technology as their primary means of communication or as a common resource (Stahl et al., 2006). The CSCL can be implemented in online and classroom learning environments, which can take place synchronously or asynchronously. The appropriate processes assessment and interaction analysis methods can provide insight into effectiveness of collaborative learning in face-to-face and online context.

### *3.1. The lack of processes assessment in classroom collaborative learning*

In classroom environment, the effectiveness of collaborative learning is almost measured by assessing the outcomes, which are produced by both individual and group. Assessment can be seen as the engine that drives learners to participate in collaborative learning activities and contribute more. Assessment data serve as a vehicle for helping teachers to monitor collaborative learning progresses and adjust instruction. Assessment in F2F context consists of observing, capturing video, and summarizing complex individual and group behaviors, engagement questionnaire, pre-test and post-test, from which researchers make reasonable inferences about learning processes and products.

Because the processes assessment is often neglected, the assessment always fails to measure the knowledge level, skills, attitudes, and emotions of collaborative learning in time. In addition, there are still other issues when assessing collaborative learning processes. For example, how can a teacher know learners' contributions during completing ongoing task? How can a teacher effectively monitor the collaborative learning process and assess group performance in time? How to use just-in-time assessments to support ongoing learning activities? How can a teacher identify if an idea is a promising one or not, and if it is improved by other group members?

To solve these problems, we can adopt different assessment methods from a different perspective. There are three types of assessment in collaborative learning: self-assessment, peer assessment, and whole-group assessment. Self-assessment can be valuable both for providing an insight into the group progress and for individual learning (Lee et al., 2006). Peer-assessment is also an important method to improve students' understanding of subject matter and metacognitive skills. The whole-group assessment can measure the quantity and quality of students' learning as a team and facilitate learners' reflections on the collaborative learning processes. Meanwhile, various emerging technologies can also be used for recording the processes of collaborative learning and help teachers to understand how the intersubjective meaning making is achieved.

### *3.2. The query of interaction analysis methods in online context*

Currently, online collaborative learning tends to focus on the cognitive process by emphasizing task-oriented communica-

tion, while assuming that the social dimension will occur automatically via communicative technologies (Kreijns et al., 2003). So the effectiveness of collaborative learning heavily relies on the quality of interaction. Therefore, analyzing the processes of interaction is very vital for evaluating the effectiveness of collaborative learning. Many qualitative and quantitative methods are used to analyze interactions, including discourse analysis, content analysis, social network analysis, sequential analysis, multilevel models, visual representations of data, etc. At present, the most often used method is content analysis (Strijbos and Stahl, 2007). When researchers adopted content analysis method to analyze the interaction process, the first step is to select the analysis unit. Both individual and group can be taken as the unit of analysis. For example, Arvaja et al. (2008) adopted an individual level of analysis to reveal the individual role and recourses used in tasks. While VMT Project selected the group as the unit of analysis and analyzed interaction process at the group level (Stahl, 2009). Another dimension of analysis unit includes a message, paragraph, thematic unit, sentence and illocution (Rourke et al., 2001). However, the definition of analysis unit is often ambiguous and it is very difficult to distinguish between them. For example, Veldhuis-Diermanse (2002) adopted the thematic unit to represent an idea, while Muukkonen et al. (2001) used proposition to denote a single idea. This will affect the replication of coding schemes and the accuracy of results to a large extent.

The grain size of the unit of analysis is another issue that researchers are confronted with and need to consider thoroughly. If the grain size of data was small, there will be refined analysis result but contextual information may be lost. On the contrary, the large analysis unit can generate abundant context information but there will be little details of interactions.

Segmenting of data is also a big challenge of interaction analysis. Segment rules should be made in advance and the boundaries of a segment should be included in the segment rules. Then researchers should train the coders on how to segment the discourse until they understand all of rules. In addition, at least two coders independently segment and code the same discussion transcripts. Finally, the segment reliability needs to be computed according to the percentage of agreement or Cohen's kappa or other inter-reliability coefficients.

Therefore, unit of analysis, grain size of data, segmenting of data are very important issues of analyzing interactions in CSCL. The interaction analysis at both the individual and the group level is necessary (Stahl et al., 2006). So Chavajay and Rogoff (2002) suggested that unit of analysis and grain size of data need to be determined according to research questions and objectives for analysis.

## 4. Orchestrating diverse activities with resources for engaged collaborative learning

Engagement, defined as ''student-faculty interaction, peer-to-peer collaboration and active learning'' (Chen et al., 2008), has been positively related to the quality of the learning experience. An engaged learning is the process in which students actively participate in their learning. Engaged learning indicators were developed by Jones et al. (1995), which revealed that engaged collaborative learning could be achieved by some strategies. With emerging technology, engaged learning could be nurtured by orchestrating diverse activities and resources.

From a cognitive perspective, knowledge resides in people's minds, while in the socio-cultural approach the concept of collective knowledge is central. The internal-individual and external collaborative processes that take place when people work are the two directions for analyzing collaborative learning. Specifically, individual learning, small-group cognition and community knowledge building are the three units of analysis that CSCL research typically investigates. However, CSCL analyses generally focus on only one of these units, even in multi-method approaches (Stahl and Öner, 2013). The three levels of individual learning, group cognition and community knowledge building could be connected by the theory of the connection of these levels proposed by Stahl. In fact interactional learning resources could support multiple learning activities occurring at multiple social levels. All references brought into discourse are resources which are identifiable units of the physical or linguistic world that are involved in meaning-making practices—spanning the classical mind/body divide (Stahl and Öner, 2013). Diverse collaborative activities may require different resources. In order to promote collaborative activities and the connection of different levels of cognition, the integration of diverse activities and resources is important and urgent.

The term ''orchestration'' has been used to describe runtime adjustments in complex socio-technical designs that include multiple social planes in different contexts mediated by multiple devices (Dillenbourg and Jermann, 2010). Classroom orchestration has been a rising topic in the CSCL community in the last few years (Dillenbourg et al., 2009). Orchestration typically covers the whole lifecycle of the CSCL activity implementation, from its design and preparation to the actual enactment in the classroom (Prieto et al., 2011).

Orchestrating activities with resources to increase the quality of learning experience by connecting different levels of cognition not only happens in classroom, but also in online environment. For example, MTDashboard is an orchestration tool displayed at a handheld device, giving the teacher control over classroom activities and providing 'real-time' indicators of participation and task progress of each group (Clegg et al., 2013). While meaning making and knowledge creation by group interactions are the nature of collaborative learning. As a new approach, tracking evolving resources can help to understand how intersubjective meaning making is achieved and orchestrate collaborative learning activities. When design orchestration, we should consider the integration of interactional resources for connecting different levels of cognition into diverse activities.

It has been identified that science education teachers could benefit from their participation in communities of best science teaching practices by sharing, not only digital educational resources, but learning designs that reflect their pedagogical practice (Sampson et al., 2011b). The learning designs always reflected in activities, and students may have different learning resources when they have different activities. Sampson et al. (2011a) proposed learning design repositories to orchestrate different activities and resources. Clegg et al. (2013) used social media technologies to support more collaborative interactions through highlighting the importance of providing support for facilitating scientific communication and underscoring the

importance of factoring the learning context into the design and implementation of CSCL technology.

To sum up, orchestrating activities with resources are an effective method to support students' engaged learning. For sharing teaching experience, orchestrating activities and resources are an important idea for designing online teaching communities.

## 5. Embedding assessment into learner experiences for effective collaborative learning

Effective learning focuses on learning happens with or beyond the expectations. Effective learning activity was defined as "the process of finishing the learning task, and achieving the learning objective in the expected time for learners" (Huang et al., 2010). Huang et al. (2013a,b) proposed five conditions of effective learning activities: starting with authentic problems, motivating with learning interests or willingness, taking the experience of learning activities as the explicit behaviors, taking critical thinking as the implicit behaviors and providing tutoring and feedback as external support. It is obvious that the learners' good experiences will help to improve willingness of participations, experience of individual and group activities, and awareness of feedback from systems and tutors. In addition, the five elements for effective cooperative groups identified by the work of Johnson et al. (1984) are positive interdependence, individual accountability, promotive interaction, social skills, and group processing. Definitely, three of the five elements, i.e. just-in-time interactions, the skills of social networking and group processing in completing a task, are also related to learners' experiences.

Learner experience was derived from the user experience, which involves a person's emotions about using a particular product, system or service, which highlights the experiential, affective, meaningful and valuable aspects of human–computer interaction and product ownership (Bevan, 2009). Assessment plays a crucial role in helping learners to improve learning performance (Brown, 2004). Adaptive assessment in collaborative learning will help to understand and promote the learner experience, which includes all of learner' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after the collaborative learning process and using learning tools or platforms.

Just-in-time and friendly feedback are a key element for adaptive assessment, which can improve learner experience to facilitate collaborative learning. Adaptive assessment can be the most difficult activity to conduct online, especially for a massive open online course (MOOC), which is an online course aimed at large-scale interactive participation and open access via the web, proposed from the foundation of ALISON (Booker, 2013). With the emergence of several well-financed MOOCs providers, such as Coursera, edX, and Udacity, the MOOCs became the hottest topics in education, especially higher education. One of the important reasons why MOOCs became popular is that it embedded assessment into learner experiences for making learning more effective than ever before. As we know, in addition to traditional course materials such as videos, readings, and problem sets, MOOCs provide interactive user forums that help to build a community for the learners, professors, and teaching assistants. The participants will get the help from all over the world. Above all, the two most common methods of MOOC assessment are machine-graded multiple-choice quizzes or tests and peer-reviewed written assignments (Rivard, 2013). Machine–grades multiple-choice quizzes refer to getting the assignment graded by an auto-grader. Participants over the world are still working on the process of getting an open ended subjective question evaluated correctly by the system. The participants will get just-in-time feedback, and check whether they have learned or not, which will bring a friendly experience for learners. Peer assessment is also an important form of collaboration that is used for quality control. It can improve students' performance. Peer review will often be based upon sample answers or rubrics, which guide the grader to award different answers. These rubrics cannot be as complex for peer grading as they can be for grading by teaching assistants, but students are expected to learn both by being the grader as well as by having their work graded. Machine grading of written assignment is also being developed. Special techniques such as adaptive testing may be used, where the test tailors itself give the student's previous answers or presenting questions based upon the number of correct answers given. Therefore, it will be more effective if embedding assessment infuses into learners' experiences.

## 6. Infusing smart environment with group activities for easy collaborative learning

Easy learning concerns how to make learning easy, which refers to accessing to technologies, learning activities, resources etc.; providing opportunities when learners want to learn no matter where they are; scaffolding with real-time feedback when learners need help. So easy collaborative learning mainly concerns how to make collaborative learning easy by providing easily accessing, more opportunity and scaffolding on demand, both in the formal and informal collaborative learning scenarios. Formal collaborative learning consists of students studying together to achieve shared learning objectives and complete jointly specific tasks and assignments, while informal collaborative learning consists of having students work together to achieve a joint learning goal in temporary groups that last from a few minutes to one class period (Johnson and Johnson, 2008). The formal learning and informal learning are separated from each other in most of current learning circumstances. Therefore, smart learning environment is supposed to bridge the gap between formal and informal learning. Smart learning environment refers to the learning place or an activity space that can sense learning scenarios, identify the characteristics of learners, provide appropriate learning resources and convenient interactive tools, automatically record the learning process and evaluate learning outcomes in order to promote the effective learning (Huang et al., 2013a,b). The main function of smart learning environment is to facilitate easy accessing, provide more opportunity and scaffold cognition by tracking learning process, recognizing learning scenario, and connecting learning communities.

In smart learning environment, collaborative learning activities can be tightly coupled and learners work in a joint problem space. In addition, group activities in formal scenario and informal scenario can be connected seamlessly in smart learning environment. Seamless learning was conceptualized as a learning model where a student can learn whenever they are

curious in a variety of scenarios and in which they can switch from one scenario or context (Chan et al., 2006). Seamless learning environment put more emphasis on seamless learning flows across contexts (Wong and Looi, 2011). And also, in smart learning environment, students can obtain the real-life experience which is necessary for future life. Smart learning environment can provide the continuity between formal and informal learning contexts by mobile technologies. To sum up, easy collaborative learning will be realized by infusing smart environment with group activities distributed in anyplace and anytime.

## 7. Conclusions

Based on the literature review on the characteristics of new generation of students, we analyzed the key issues concerning effectiveness of computer-supported collaborative learning, which includes the lack of processes assessment in classroom collaborative learning and the query of interaction analysis methods in online context. In order to meet the needs of new generation students, we proposed three new approaches of CSCL research: orchestrating diverse activates with resources, embedding assessment into learners' experience, and infusing smart environment with group activities. At the same time, we believe that easy, engaged and effective collaborative learning is preferred by the new generation students in the technology enriched environments.

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