

# COOPERATIVE LEARNING PRINCIPLES ENHANCE ONLINE INTERACTION<sup>1</sup>

George Jacobs<sup>a</sup>

James Cook University, Singapore

Peter Seow

Nanyang Technological University

**ABSTRACT:** *Research suggests that cooperative interactions are associated with enhanced cognitive and affective outcomes. This paper describes eight principles that can be used to promote such interactions among students working in online environments. The principles derive from a well-established approach to education, known variously as cooperative learning and collaborative learning. Each principle is explained as to what it means, why it is important and how it can be deployed. The eight principles are heterogeneous grouping, teaching collaborative skills, group autonomy, maximum peer interactions, equal opportunity to participate, individual accountability, positive interdependence and cooperation as a value.*

**KEYWORDS:** *collaborative learning, cooperative learning, computer supported collaborative learning, computers in education, Social Interdependence Theory*

## Principles to Enhance Online Interaction

When many people think about computers, tablets, smartphones and other Informational Technology (IT) devices, they picture individuals alone seemingly fixed to the screens and keyboards of their devices. Similarly, when people think of students using those devices for learning, they imagine the students alone, perhaps at desks or tables in their homes, far from their classmates. However, such images of individualised involvement with electronic learning tools often fail to look below the surface. In reality, students are often using their devices to interact with others, and frequently those others are their fellow students.

The purpose of this paper is to share ideas for facilitating and enhancing those student-student online interactions. These ideas flow from a learning technology known variously as cooperative learning (Johnson & Johnson, 2013) or collaborative learning (Bruffee, 1993). In this paper, the neutral abbreviation 'CL' will be used. The paper begins with background information on CL, including supporting learning theories and research, as well as a definition. The main section of the paper explains eight CL principles, including what each principle means, why it is important and how it can be applied in IT environments.

## Background on Cooperative and Collaborative Learning (CL)

### *Theoretical Support for CL*

CL dates back to at least the 1970s and finds support in many theories of learning, including Sociocultural Theory (Vygotsky, 1978), Social Interdependence Theory (Johnson & Johnson, 2006), Humanist Psychology (Maslow, 1968), Social Constructivism (Palincsar, 1998) and Multiple Intelligences Theory (Gardner, 1993). In the next paragraphs, each of these theories is briefly explained and ways are proposed as to how CL might operationalise the theories.

---

<sup>a</sup> Correspondence can be directed to: [george.jacobs@gmail.com](mailto:george.jacobs@gmail.com)

One theory operationalised by CL is Sociocultural Theory (Vygotsky, 1978; Jacobs, McCafferty, & Iddings, 2006). Three key ideas in Sociocultural Theory are the importance of language in cognitive development, the role of scaffolding – assistance provided by others, such as teachers and peers, and the Zone of Proximal Development (ZPD), the idea that students learn best when learning tasks are neither too easy or too difficult. CL helps with all three of these ideas: when peers discuss, elaborate, debate and explain to each other, they are using language to scaffold for each other, and this scaffolding can bring into students' ZPDs tasks that might otherwise have been too difficult, as well as providing a challenge to high achieving students for whom the tasks might otherwise have been too easy. This scaffolding can take place in person or online.

Another theory the tenets of which fit well with CL is Social Interdependence Theory (Deutsch, 1962). Social Interdependence Theory attempts to understand why people strive to help some people (i.e., they feel positively interdependent with these others), seem uninterested in the outcomes of others (i.e., they feel no interdependence with these other people), and actively seek the misfortune of yet other people (i.e., they feel negatively interdependent with these people). Based on this emerging understanding, educators have developed ways to encourage students to feel that they will benefit from the good fortune of others. This feeling has been labelled positive interdependence and will be discussed again later in this article. CL attempts to promote positive interdependence in a wide variety of ways, including each group member having different resources, e.g., information found online, group members performing different roles and group members reflecting on how they can enhance their group's effectiveness.

Concepts from Humanistic Psychology also come alive when CL is employed. Perhaps the most famous image from Humanistic Psychology is of a pyramid depicting Maslow's (1968) Hierarchy of Needs. Of the five main needs identified in the hierarchy, two needs that CL most clearly addresses are the need for belonging and the need for esteem. CL offers students a group to which to belong, a group whose members feel positively interdependent with each other. One means of promoting that feeling of belonging is for groups to develop common goals towards which they agree to strive. Furthermore, support from group mates encourages students to provide each other with positive reinforcement, which may go part of the way towards satisfying students' esteem needs. For example, when group members feel positively interdependent, they are more likely to praise group mates for putting forth effort to achieve the group's goal. Furthermore, CL strives to generate feelings of belonging and esteem not only within a small group but also throughout the class and beyond.

Social Constructivism is another learning theory that provides support and direction for the implementation of CL. The term Social Constructivism derives from the belief that students construct their own knowledge rather than that knowledge being transmitted to students by teachers and course materials. The word 'social' was added to 'constructivism' to highlight the belief that social interaction can greatly facilitate students' knowledge construction. Kuhn (2015) argued that collaborative cognition moves students' thinking to a higher level. For example, Hythecker, Dansereau, and Rocklin (1988) explained how group activities can encourage students to elaborate on their understanding of what they are reading.

The theory of Multiple Intelligences was developed by Gardner who also helped to popularise constructivism (Gardner, 1985). Multiple Intelligences posits that students are smart in a variety of ways and can become smarter in all those ways. Many teaching ideas have been developed in concord with Multiple Intelligences Theory (Armstrong, 2009). One intelligence identified by Gardner is interpersonal intelligence, which includes the abilities to understand and collaborate with others and to be a leader, as well as a preference for spending time with others, e.g., in CL activities. Yet another intelligence is intrapersonal intelligence, which involves the abilities to understand one's own strengths and weaknesses and to reflect on one's experiences, as well as a preference for sometimes working alone. While CL normally involves group interaction, the goal of the groups is the learning of each individual group member (Johnson & Johnson, 2013). Furthermore, many CL techniques, such as SUMMER (Jacobs, Power, & Loh, 2002) provide students time to work alone before interacting with group mates, and often in CL, students study together but are assessed alone.

### *Research and Practical Support for CL*

A great deal of research and methodological development has been done with CL. This research covers a wide range of learners, subjects and modes of learning, including online learning. In general, the research suggests positive effects for CL on both cognitive variables, such as test scores, and affective variables, such as self-esteem and liking for school (Slavin, 1991; Johnson, Johnson, & Stanne, 2000; Ibáñez et al., 2013). Indeed, a steady stream of research continues to investigate many areas of CL, including research on online learning (IASCE, 2014). Examples of recent scholarly work that specifically addressed peer collaboration in digital contexts include among others, Cebrian-de-la-Serna, Serrano-Angulo, & Ruiz-Torres (2014); Denner, Werner, Campe, & Ortiz (2014); Kim, Lee, & Kim (2014); Pymm & Hay (2014); Smith (2014); Yang, Kinshuk, Yu, Chen, & Huang (2014).

CL can be defined as principles and techniques for helping students collaborate with peers and others. This paper will explain eight of these CL principles. Furthermore, hundreds of CL techniques have been developed. The key point about CL is that it is so much more than asking students to push their desks together in a classroom, or to connect to each in an online environment, and then hoping that they will collaborate successfully. Instead, CL provides teachers and students with a large and growing body of ideas for taking further steps towards making it more likely that student-student interaction will realize its potential. Additionally, the hope is that the collaborative skills and attitudes that students develop in the process of interacting with their peers will serve students well throughout their lives in whatever contexts they find themselves, as most contexts in life involve social interaction.

### **Eight CL Principles**

This section of the paper explains eight CL principles, including what each principle means, why the principle is important and ideas for implementing the principle in IT groups. Readers should be aware of two points. One, different books and websites on CL espouse different principles, but a great deal of overlap exists among the various principles espoused. Second, readers should also note that a twosome or pair is considered a group. Indeed, in some ways, two members is the best size for groups, because in twosomes, students may have more opportunities to be active. Plus, students are less likely to be left out of the groups of two, and they can manage a twosome more easily than a larger group. Furthermore, after working in twos, students can pair with other twosomes to share ideas, thereby widening their resources and enjoying more interaction opportunities. The eight CL principles to be discussed in this paper are heterogeneous grouping, teaching collaborative skills, group autonomy, maximum peer interactions, equal opportunity to participate, individual accountability, positive interdependence and cooperation as a value.

### *Heterogeneous Grouping*

Heterogeneous grouping involves students forming CL groups with fellow students who are different from themselves. The many variables on which students differ include past achievement, social class, nationality, ethnicity, religion, sex, diligence and personality. Many CL experts advocate heterogeneous groups, because when students learn in groups that are heterogeneous as to past achievement, they are more likely to engage in peer tutoring, as those higher in past achievement can help those who are, at least temporarily, lower achievers. Such interactions can benefit both parties (Webb et al., 2009). Heterogeneous grouping on other social and personality variables encourages students to see different perspectives and to learn to work with people different from themselves, thereby setting the stage for building a more harmonious society (Aronson, 2014).

Often, if students choose their own group mates, the resulting groups may tend towards homogeneity, and students may, at least initially, prefer such groupings (Jacobs, Power, & Loh, 2002). The most straightforward way to encourage heterogeneous groups is for teachers to assign students to groups. In a more student centric mode, teachers can discuss with students the meaning of

heterogeneous grouping and its potential benefits. From there, students can be encouraged to form their own groups. Even if students never meet face to face, they can post data about themselves. With those data and perhaps some discussion, students working in online environments can form their own heterogeneous groups.

### *Teaching Collaborative Skills*

The CL principle of teaching collaborative skills means devoting class time for students to learn about and reflect on their use of collaborative skills. Many lists of collaborative skills exist (e.g., Underwood & Underwood, 1999). Skills important for CL include comparing understandings, asking for help, offering suggestions and feedback, responding productively to suggestions and feedback, asking for reasons, providing reasons, disagreeing politely, providing specific praise and thanks and attending to group functioning.

When students use collaborative skills, their groups are likely to function better (Soller, 2001), leading to more learning and more enjoyment of learning. Furthermore, these skills will advantage students in many areas of their present and future lives. However, not all students have these collaborative skills, and, perhaps more crucially, even if students have the skills, they may not use them routinely. As a result, instructional time devoted to learning these skills and practicing their use may be time well spent.

Johnson, Johnson and Holubec (2007) present a six step procedure for teaching collaborative skills. The procedure focuses on one skill at a time. First, students need to understand the importance of the collaborative skill and second, what the skill involves, as to verbal (the words used) and non-verbal (gestures, facial expressions, emoticons) elements. Third, students practice the skill apart from class content, that is, they work just on the skill, e.g., via a game or role play, without paying attention to the topic the class is studying. Fourth, students then combine use of the skill with learning of class content. Fifth, students discuss how well they, individually and as a group, are using the skill and how they might improve. Sixth, because time on task is often needed for students to reach the level of natural use of a collaborative skill, students persevere in practicing the skill. Teaching of collaborative skills may be especially important in online environments, such as discussion boards, email and social networks, as these environments present new challenges, requiring variations of the skills appropriate in face to face environments. For example, students can add emoticons, thumbs up symbols and other symbols or send online greetings cards to express such collaborative skills as praising and thanking others.

### *Group Autonomy*

Too often, students tend to depend too much on their teachers, overlooking their own and their peers' abilities. The CL principle of group autonomy encourages students to look first to their group mates when they need help or want feedback. For students to become lifelong learners, they need to take on some of the roles formerly seen to be the exclusive domain of teachers, such as the roles of providing assistance and feedback. Performing these roles provides students with learning opportunities and promotes peer interactions. Also, when students are helping each other within their capability to do so, teachers are able to provide help that lies beyond students' current abilities.

The CL literature offers many ideas for promoting group autonomy. For instance, groups can utilize the slogan, 'Team Then Teacher', when students ask their group mates before asking their teachers. When student groups are acting autonomously, teachers are still there to help, but not as first options. Group autonomy can be especially important in IT environments, even more so than in classrooms, as teachers are less likely to be immediately available to provide assistance. In online environments, when students face difficulties, instead of giving up or waiting several hours or more for assistance from teachers, students can turn to their peers.

### *Maximum Peer Interactions*

The CL principle, Maximum Peer Interactions, encourages more student-student interactions and fewer teacher-student interactions, as students may be more active during student-student interactions. The word 'maximum' in Maximum Peer Interactions refers to maximising two aspects of peer interactions. First, the *quantity* of peer interactions increases when group activities are used, particularly when the number of members in each group is kept small and when groups sometimes report to other groups instead of or in addition to the entire class. Second, the *quality* of peer interactions increases when students use higher order thinking skills (Chiang, et al., 2013). Indeed, the 'magic' of CL lies in the quality of peer interactions (Webb, et al., 2009). These thinking interactions promote more learning, greater depth of processing and greater engagement (Nussbaum, 2008; Järvelä, Hurme, & Järvenoja, 2011). Thus, the greater the quantity of these quality peer interactions, the better.

IT provides many new and engaging tools for peer interactions such as Google Docs and online discussion boards. Unfortunately, too often, the use of IT in education merely results in teacher fronted instruction being delivered electronically, for instance, via videos of lectures, rather than face to face. This situation can easily be changed. When students listen to online lectures or read texts provided online, time and tasks for interactions should be included, and these tasks should include thinking tasks. Care, however, must be taken so that these thinking tasks are within students' current ability levels, i.e., within their ZPDs (Vygotsky, 1978). Here, teachers have a vital role in providing the support students need so that these interactive thinking tasks are doable. This support might, for example, include annotated model responses being posted online. Furthermore, when groups are heterogeneous as to past achievement, lower achieving students can ask their group mates for help, rather than going astray or giving up when faced with tasks that are too challenging.

### *Equal Opportunity to Participate*

Sometimes one or more group members attempt to dominate the group, denying others the chance to interact with the task and with group mates. Equal Opportunity to Participate is the CL principle that specifically addresses such situations. When some students are excluded from the group interactions, those students may learn less and enjoy less. At the same time, the rest of the group members lose the benefits of interacting with the excluded person(s). For instance, if excluded group members are less proficient at the task the group is undertaking, the other group members miss out on peer tutoring opportunities they would have if everyone is included.

CL techniques, along with various software, offer tools for providing all group members equal opportunity to participate. For example, in contrast to face to face discussions in which some group members may have difficulty being heard, asynchronous online communication allows students to share their ideas without having to compete for a spot in the conversation. Other ideas promoting Equal Opportunity to Participate include colour coding to show each person's contribution to a graphic, table or text, and group members being chosen at random to share their group's ideas. Additionally, some software allows students and teachers to monitor the distribution and quality of turns in their groups.

### *Individual Accountability*

While Equal Opportunity to Participate is the CL principle which seeks to offer all group members chances to play important roles in their groups, the principle of Individual Accountability puts pressure on members to do their fair share in the groups. Thus, Individual Accountability can be seen as the flip side of Equal Opportunity to Participate. Students need to use the opportunities provided to contribute what they can to their groups. Unless students feel individually accountable, if instead some students act as freeloaders, group morale may suffer, and students may lose faith in the use

of groups for learning due to the presence of these freeloaders. Furthermore, freeloading makes assessment more difficult, as teachers may not be able to judge the members' contributions to their groups (Johnson & Johnson, 2003).

Fortunately, the CL literature and IT tools offer ideas for promoting individual accountability. For example, groups can roster who needs to do what and when, and monitor if it is done. Additionally, the same software that promotes Equal Opportunity to Participate by monitoring each group member's participation can also let group mates and teachers know who is not pulling their weight in the group. Two ways to address the difficulties that freeloaders pose for assessment are to involve peers in assessment, as peers are better placed to monitor each member's input, and for students to study together but be assessed alone, as when after students work together to solve a set of online mathematics problems, they do another set of similar problems on their own.

### *Positive Interdependence*

Positive Interdependence is the CL principle which most prominently encourages sharing among students. When students feel positively interdependent with their group mates, the group feels that their outcomes are positively correlated. Whereas Individual Accountability puts pressure on group members to contribute to the group, Positive Interdependence provides support; if students are having difficulties, their group mates are there to help them. Positive Interdependence can also promote motivation to learn, because students are learning not just for themselves but also for the benefit of their groups.

Many ideas have been developed to encourage students to feel positively interdependent with their group mates. For instance, students are more likely to feel that all group members' outcomes are positively correlated if they have group goals. These goals are not about the group, but about the strengthening of each individual member. An example in a writing class of such a group goal would be for all group members to do better on the second writing task of the term (except in the case of group members with perfect scores on the term's initial writing task). To help group mates improve, students could use the Track Changes and Comments functions in MS Word to offer each other feedback on their drafts. If everyone in the group succeeds in improving on the second writing task, a celebration or other rewards could recognise this accomplishment. Yet another means of promoting Positive Interdependence is for each student to have different resources. For example, each group member could go online to research a different subtopic of the larger group topic and then share what they learned with their group mates (Aronson, 2014).

### *Cooperation as a Value*

An eighth CL principle, Cooperation as a Value, builds on Positive Interdependence and seeks to spread the feeling of "One for all; all for one". While students need to know how to compete and how to work alone, the hope embodied in the principle of Cooperation as a Value is that students will come to view cooperation as their preferred option. A look at the news headlines on almost any day finds many areas in which the world needs more of this cooperation, yet many factors in society foster competition and individualism.

Many means exist for promoting Cooperation as a Value. For example, in service learning projects (Kinsley & McPherson, 1995), students work together to provide a service while at the same time engaging in learning linked to their curriculum, e.g., IT students might develop websites and other online tools for non-profit organisations. Another means of promoting Cooperation as a Value would be for students to appreciate the many benefits of cooperation, e.g., they can learn about IT inventions, IT companies and IT networks that required large scale cooperation to bring to fruition and to grow. Students can also reflect on how their own cooperation in small groups (2-4 people) lays a foundation for their later participation in larger scale cooperation.

## Implementing the Principles in IT Environments

To sum up this section on CL principles, teachers have varied interpretations of CL, and some teachers tend to interpret CL as just group work, i.e., a furniture arrangement of desks pushed together or an electronic arrangement of linked devices. The implementation of group work without awareness of CL principles is less likely to lead to meaningful collaboration in the classroom or online. For example, Individual Accountability may be lacking, and, thus, a group's work may rest on one or two students instead of involving every student in the group, or Maximum Peer Interactions may be lacking as to the quality of peer interactions, with students merely exchanging information rather than discussing ideas (Gillies, 2007). Furthermore, teachers may design collaboration to focus on the outcome of groups' products rather than the processes or quality student interactions that would lead to more learning in the groups. Teachers' reluctance to implement CL may be due to their negative experiences with group activities implemented without guidance from CL principles, due, in turn, to teachers' lack of knowledge of the principles and how to implement them.

Teachers' reluctance to use CL may also spring from other reasons. Some teachers are concerned over student behaviour in groups, resulting in the loss of control and off-task behaviour during CL activities (Kohn, 1992). This concern may be exacerbated in online environments where teacher monitoring may be more difficult than in typical classroom settings. Additionally, teachers may hold the belief that CL is time consuming. Again, online environments may heighten this fear, as students may need time to master online collaboration tools, thus, taking yet more time away from content learning. To make matters worse, internet connections, as well as hardware and software, may be unreliable. A further objection to the use of groups in IT and other learning environments flows from teachers' worries about assessment of students in groups (Gress et al., 2010), for example, how can teachers monitor each student's contribution to their group?

The above problems and concerns faced by teachers in the use of CL suggest the need for teachers to experience CL, to develop their own collaborative skills, to understand the value of collaboration, and to design and enact collaborative lessons in the classroom (Cohen, Brody, & Sapon-Shevin, 2004). Lesson Study (Lawrence & Chong, 2010) and other forms of peer learning among teachers offer ways for teachers to experience CL principles in action and develop their skill in implementing these principles. Though teachers may attend workshops on designing lessons for CL, they also need the on-going support of their peers to sustain and improve their practices in the classroom. Thus, for teachers to sustain the implementation of CL in the school, there is a need to develop a culture of collaboration in the school among teachers. The principle of Cooperation as a Value can contribute to this by helping schools develop this culture of collaboration, not just for learning but in all school activities including extra-curricular and co-curricular activities.

In addition to understanding CL principles, teachers need time to develop familiarity with collaborative Web 2.0 and 1:1 mobile technologies, such as tablets for recording and sharing text, images or videos has led teachers to explore the possibility of using these tools for the classroom (Hertz, 2011). Exploring various IT tools is time consuming for teachers. However, if teachers do not have sufficient opportunities or resources to try these tools for themselves, teachers may not come to recognise the features of the various software and how these features can be integrated into CL activities so as to enhance peer interactions.

## Examples of Some of the CL Principles at Work with Technology

### *Google Docs*

The availability of Web 2.0 and cloud-based tools, such as Google Docs, Popplet and Prezi, allows multiple users to create, write, edit, annotate and comment on shared documents, thereby providing a platform for individuals to collaborate (Kamel Boulos & Wheeler, 2007). This section of the paper illustrates the application of the eight CL principles described earlier. Square brackets are used to

make explicit the presence of each principle. In this lesson students use Google Docs as an online tool to collectively write a research report.

Students begin by forming groups that are heterogeneous on such variables as language proficiency, content knowledge, ethnicity and knowledge of ICT tools (heterogeneous grouping). The class might decide to work on a collaborative skill, such as praising others (teaching collaborative skills). Students' use of praising can be facilitated by discussion of why the skill is important, explanation of the words and non-verbal language that go with praising, practice in praising, monitoring of students' use of praising and continued focus on the skill.

The groups discuss among themselves what they will research and who will be responsible for which parts of their report (group autonomy). Group members divide up the work, with each person responsible for a designated part (equal opportunity to participate) and deadlines for when their work is due (individual accountability). After they finish their individual research, students contribute their draft to the shared Google Doc. Online and in-person, group mates give each other feedback and debate what should go in the final report (maximum peer interactions). This give and take occurs in a cooperative atmosphere of mutual support (positive interdependence). Those group members who are relatively better in certain skills will help their group mates.

Through the process of collective writing, students will recognise the benefits of cooperation (cooperation as a value), being aware that the quality and success of their report is dependent on the contributions and feedback of individual students. Technology allows the collaboration to happen in real time where students' feedback and comments can be instantly viewed. Moreover, with the cloud computing, collaboration between students takes place seamlessly across different devices, such as tablets, smartphones and computers, and students can collaborate wherever they are and just-in-time.

### *Collaborative Mind Mapping*

Here is another example of the application of CL principles to a lesson using ICT tools. Popplet is a Web 2.0 tool which provides a collaborative platform for students to share and jointly create concept maps. The students can engage in collaboration activities through a common collaboration space by exchanging their collected artefacts, e.g., pictures, assembling mind maps and free-hand drawing on top of the space. This collaboration allows for both structured and emergent group consolidation and can serve as a constantly available repository of group created artefacts ready to be examined anytime anywhere in a variety of spontaneous or teacher-initiated collaborative activities. It will be used to stimulate students to give positive, constructive feedback to their peers, present their ideas or negotiate to resolve conflicting perspectives.

CL principles could facilitate this lesson in a wide variety of ways. For instance, the principle of cooperation as a value could encourage students to consider how their concept maps might be used to educate others on important topics, such as the negative impact of animal based foods, such as meat and dairy, on the environment. By encouraging people to move towards more plant based diet, the concept map would provide a community service. Another CL principle that could be usefully applied in this lesson is maximum peer interactions, as discussions in small groups promote a high quantity of peer interactions, and emphasising the collaborative skill of providing elaborated responses, e.g., reasons and examples, raises the quality of peer interactions.

The CL principles of equal opportunity to participate and individual accountability could be promoted in several ways. Firstly, each student could use a different colour for their input in their group's concept map, and a legend in the map could show which group member had which colour. The goal would be to achieve a fairly even distribution of colours in the map. Secondly, groups could display their maps for other groups to see and comment on. Each group member would be responsible for responding to some of the comments left by other groups and for making comments on the other maps. This commenting and responding could be done online or on hard copies. Thirdly, each student could work alone to write a reflection piece on their experience in creating the map



in their group, with reflections on what content was learned, as well as what was learned about working in groups.

## Conclusion

The goal of this paper has been to offer principles and other ideas to heighten the value of student interactions conducted via electronic devices. The foundation of the ideas in this paper lies in a learning technology which some call cooperative learning and others call collaborative learning, both of which can be abbreviated as CL. David and Roger Johnson of the Cooperative Learning Institute (<http://www.co-operation.org>) are two of the pioneers in CL who have done extensive work in theory, research and dissemination. Interestingly, in a recent opinion piece (Johnson & Johnson, 2014), they argued that online peer interaction is less effective than face-to-face peer interaction. Reasons for the relative ineffectiveness include: (1) distractions from other affordances, (2) hardware, software and connectivity that may not be available, affordable and reliable, (3) students' lack of skill in the use of education affordances and (4) students' unfamiliarity with academic interaction without the presence of teachers (Kreijns, Kirschner, & Jochems, 2003).

Nonetheless, Johnson and Johnson (2014) expressed optimism about the potential of online interaction. They stated that technology could "revolutionise" the way CL is done. Indeed, technology offers new and more sophisticated ways for students to interact. Also, whereas previously what was said in a group vanished as soon as the words were spoken, technology now provides tools for teachers to more effectively and comprehensively monitor student-student interaction. An example of how new technology enhances interaction can be found in flipped classroom settings (Phillips, & Trainor, 2014), where technology enables students to not only prepare for peer interaction in the classroom by reading and viewing online before class but also to begin interacting with peers before class, to interact during class and to continue interacting after class.

Ministries of Education around the world realise that in this Information Age, computer literacy constitutes an essential 21<sup>st</sup> century competency. However, as the human population of the Earth moves towards nine billion people, other competencies must accompany computer literacy. As people deal with increasingly complex, interdependent issues, socially oriented competencies are needed for successful global interactions. These social competencies must go hand-in-hand with computer literacy. CL facilitates students' development of these competencies.

For countries to develop their students' competency in online interaction, perhaps the key idea to take away from this paper is that pedagogy needs to drive technology, not vice-versa (Baker, 2012). The initial steps of students forming groups and having access to technology tools are only very initial steps. Much more needs to be done to increase the chances that the group members will feel positively interdependent and therefore strive to foster each other's learning. Thus, CL pedagogy must be included in pre-service and in-service teacher development programmes. In conclusion, the theory and research cited earlier in this paper speak of the great potential of student-student interaction, and the eight principles described in this paper help students take many more steps towards successful groups not just among themselves as students but also in the wider world generally.

## Notes

<sup>1</sup> Paper presented at the 2014 Global Conference for Teaching and Learning with Technology, 9-10 July 2014, Singapore.

## References

Armstrong, T. (2009). *Multiple intelligences in the classroom* (3<sup>rd</sup> ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

- Aronson, E. (2014). *The jigsaw classroom*. Available at <http://www.jigsaw.org>. [Accessed on 1 February 2015].
- Baker, J. (2012). Shaping new pedagogies. *Idiom*, 48(3), 26-27.
- Bruffee, K. A. (1993). *Collaborative learning: Higher education, interdependence and the authority of knowledge*. Baltimore, MD: Johns Hopkins University Press.
- Cebrian-de-la-Serna, M., Serrano-Angulo, J., & Ruiz-Torres, M. (2014). eRubrics in cooperative assessment of learning at University. *Comunicar*, 22(43), 153-160.
- Chiang, V. C. L., Leung, S. S. K., Chui, C. Y. Y., Leung, A. Y. M., & Mak, Y. W. (2013). Building life-long learning capacity in undergraduate nursing freshmen within an integrative and small group learning context. *Nurse Education Today*, 33(10), 1184-1191. DOI: 10.1016/j.nedt.2012.05.009.
- Cohen, E. G., Brody, C. M., & Sapon-Shevin, M. (Eds.). (2004). *Teaching cooperative learning: The challenge for teacher education*. Albany, NY: State University of New York Press.
- Denner, J., Werner, L., Campe, S., & Ortiz, E. (2014). Pair programming: Under what conditions is it advantageous for middle school students? *Journal of Research on Technology in Education*, 46(3), 277-296.
- Deutsch, M. (1962). Cooperation and trust: Some theoretical notes. In M. R. Jones (Ed.), *Nebraska symposium on motivation* Lincoln, NE: University of Nebraska Press, pp. 275-319.
- Gardner, H. (1985). *The mind's new science: A history of the cognitive revolution*. New York: Basic Books.
- Gardner, H. (1993). *Multiple intelligences: The theory and practice*. New York: Basic Books.
- Gillies, R. M. (2007). *Cooperative learning: Integrating theory and practice*. Thousand Oaks, CA: Sage Publications.
- Gress, C. L., Fior, M., Hadwin, A. F., & Winne, P. H. (2010). Measurement and assessment in computer-supported collaborative learning. *Computers in Human Behavior*, 26(5), 806-814.
- Hertz, M. B. (2011). *What Tech Tools Should Be Required Knowledge for Teachers?* Available at <http://www.edutopia.org/blog/technology-skills-required-knowledge-mary-beth-hertz>. [Accessed on 1 February 2015].
- Hythecker, V. I., Dansereau, D. F., & Rocklin, T. R. (1988). An analysis of the process influencing the structured dyadic learning environment. *Educational Psychologist*, 23, 23-37.
- IASCE (2014). *IASCE newsletter*. Available at <http://www.iasce.net/home/newsletters>. [Accessed on 1 February 2015]
- Ibáñez, M. B., García Rueda, J. J., Maroto, D., & Kloos, C. D. (2013). Collaborative learning in multi-user virtual environments. *Journal of Network and Computer Applications*, 36(6), 1566-1576.
- Jacobs, G. M., McCafferty, S. G., & Iddings, C. (2006). Roots of cooperative learning in general education. In S. G. McCafferty, G. M. Jacobs, & Iddings, C. (Eds.), *Cooperative learning and second language teaching*. New York: Cambridge University Press, pp. 9-17.
- Jacobs, G. M., Power, M. A., & Loh, W. I. (2002). *The teacher's sourcebook for cooperative learning: Practical techniques, basic principles, and frequently asked questions*. Thousand Oaks, CA: Corwin Press.
- Järvelä, S., Hurme, T. R., & Järvenoja, H. (2011). Self-regulation and motivation in computer supported collaborative learning environments. *Learning across sites: New tools, infrastructures and practices*. London: Routledge.
- Johnson, D. W., & Johnson, R. T. (2003). *Assessing students in groups: Promoting group responsibility and individual accountability*. Thousand Oaks, CA: Corwin Press.
- Johnson, D. W., & Johnson, R. T. (2006). New developments in social interdependence theory. *Genetic, Social, and General Psychology Monographs*, 131(4), 285-358.
- Johnson, D. W., & Johnson, F. (2013). *Joining together: Group theory and group skills* (11th ed.). Boston, MA: Allyn & Bacon.
- Johnson, D. W., & Johnson, R. T. (2014). *Using technology to revolutionize cooperative learning: An opinion*. *Frontiers in Psychology*, 5. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4195269>. [Accessed on 1 February 2015]

- Johnson, D. W., Johnson, R. T., & Holubec, E. J. (2007). *Nuts & bolts of cooperative learning* (2<sup>nd</sup> ed.). Edina, MN: Interaction Book Company.
- Johnson, D. W., Johnson, R. T., & Stanne, M. B. (2000). *Cooperative learning methods: A meta-analysis*. Minneapolis, MN: University of Minnesota.
- Kamel Boulos, M. N., & Wheeler, S. (2007). The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education. *Health Information & Libraries Journal*, 24(1), 2-23.
- Kim, H., Lee, M., & Kim, M. (2014). Effects of mobile instant messaging on collaborative learning processes and outcomes: The case of South Korea. *Journal of Educational Technology & Society*, 17(2), 31-42.
- Kinsley, C. W., & McPherson, K. (Eds.). (1995). *Enriching the curriculum through service learning*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Kohn, A. (1992). Resistance to cooperative learning: Making sense of its deletion and dilution. *Journal of Education*, 174(2), 38-56.
- Kreijns, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: a review of the research. *Computers in Human Behavior*, 19(3), 335-353.
- Kuhn, D. (2015). Thinking together and alone. *Educational Researcher*, 44, 46-53. DOI:10.3102/0013189X15569530.
- Lawrence, C. A., & Chong, W. H. (2010). Teacher collaborative learning through the lesson study: identifying pathways for instructional success in a Singapore high school. *Asia Pacific Education Review*, 11(4), 565-572.
- Maslow, A. H. (1968). *Toward a psychology of being* (2<sup>nd</sup> ed.) New York: Van Nostrand.
- Nussbaum, M. E. (2008). Collaborative discourse, argumentation, and learning: Preface and literature review. *Contemporary Educational Psychology*, 33(3), 345-359.
- Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology*, 49, 345-375.
- Phillips, C. R., & Trainor, J. E. (2014). Millennial students and the flipped classroom. *Journal of Business and Educational Leadership*, 5(1), 102-111.
- Pymm, B., & Hay, L. (2014). Using etherpads as platforms for collaborative learning in a distance education LIS course. *Journal of Education for Library and Information Science*, 55(2), 133-149.
- Slavin, R. (1991). Synthesis of research on cooperative learning. *Educational Leadership*, 45(5), 91-82.
- Smith, K. A. (2014). Health care interprofessional education: Encouraging technology, teamwork, and team performance. *The Journal of Continuing Education in Nursing*, 45(4), 181-187. DOI: <http://dx.doi.org/10.3928/00220124-20140327-01>.
- Soller, A. (2001). Supporting social interaction in an intelligent collaborative learning system. *International Journal of Artificial Intelligence in Education*, 12, 40-62.
- Underwood, J., & Underwood, G. (1999). Task effects on co-operative and collaborative learning with computers. In K. Littleton & P. Light (Eds.), *Learning with computers: Analysing productive interaction*. Florence, KY: Psychology Press, pp. 10-23.
- Vygotsky, L. S. (1978). *Mind in society*. Ed. by M. Cole, V. John-Steiner, S. Scribner, & E. Souberman. Cambridge, MA: Harvard University Press.
- Webb, N. M., Franke, M. L., De, T., Chan, A. G., Freund, D., Shein, P., & Melkonian, D. K. (2009). 'Explain to your partner': Teachers' instructional practices and students' dialogue in small groups. *Cambridge Journal of Education*, 39(1), 49-70.
- Yang, J., Kinshuk, Yu, H., Chen, S., & Huang, R. (2014). Strategies for smooth and effective cross-cultural online collaborative learning. *Journal of Educational Technology & Society*, 17(3), 208-221.