# Advancing Collaborative Learning with ICT:

## Conception, Cases and Design

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# Preface

This monograph is written with the intent to advance collaborative learning (CoL) with information and communication technologies (ICT) in Singapore schools. As group work becomes a common approach to learn in today's classrooms, this monograph aims to seed ideas on how group work can be characterised as collaboration. This goal is underpinned by our belief that collaborative learning is instrumental towards developing our young in this 21st century. We also hope that the contents of this book would serve as a catalyst to more productive conversations on supporting collaborative learning with ICT within the teaching fraternity.

# CONTENTS

# LIST of TABLES

# LIST of FIGURES

# Introduction

The emergence of the Knowledge-based Economy or the Knowledge Age since the turn of last century has prompted many educators to reconsider the attitudes, skills and knowledge that the 21st century learners need. Successful workers of the 21st century are knowledge workers who add value and transform current state of knowledge to useful cognitive and/or physical artefacts (Bereiter, 2002). To assume the role of knowledge workers, 21st century learners are active and life-long learners with a serious yet playful attitude towards ideas. They have to possess a wealth of well-grounded knowledge. More importantly, they need the soft skills pertaining to group-based problem solving and knowledge creation (Bereiter & Scardamalia, 2006; Partnership for 21st century Skills). Collaborative learning has been identified as one of the key strategies to cultivate the needed knowledge skills (Hong & Sullivan, 2009). The role of Information and Communication Technology (ICT) in support of the knowledge creation processes has also been well recognised by educators (Jonassen, Howland, Marra, & Crismond, 2008). In this monograph, we will define what collaborative learning is and articulate the rationale of employing collaborative learning. Next we explicate the affordances of ICT in support of collaborative learning. This will be followed by a section that will illustrate collaborative learning with ICT using local school examples. Finally we suggest design principles to facilitate collaborative learning among students and provide some guidelines on ways to analyse student learning with respect to collaboration.

# 1 The Concept of Collaborative Learning

When students interact for the purpose of achieving better understanding about a concept, a problem or a phenomenon, or to create a novel piece of knowledge or solution that they do not previously know, they are engaged in collaborative learning. Collaborative learning can be simply defined as social interactions that are targeted towards deeper knowing (Chai & Tan, 2010). Beside knowledge outcomes, students who are engaged in collaborative learning would also acquire soft skills such as ways of seeing from their peers' perspectives, internalised group and communication skills, and awareness of their personal strengths and weaknesses as collaborative learners if and when teachers guide them in reflection.

Ideally, collaborative learning encompasses the following process. First, students encounter a phenomenon or are presented a problem or task. We refer to it as the triggering event. To resolve the questions that they encounter in the triggering event, they discuss and agree on the theme of inquiry or the identified problems. This initial discussion helps to cultivate a sense of ownership to the problem among the group of students, and it is commonly referred to as the establishment of joint activity (Stahl, Koshmann, & Suthers, 2006). With activity jointly established, students would then proceed towards further discussion that may lead to idea improvement and argumentative knowledge construction. They articulate what they perceive with regards to the subject matter or the phenomenon. Once students' ideas and conceptions are articulated, a pool of ideas is made public within the groups and these ideas are naturally and

necessarily different from each other. The diverse ideas then provide a basis for negotiations among students and such negotiations can be directed towards building a community-based collective understanding (Scardamalia, 2002). The social negotiation of ideas may also trigger further actions of knowing such as experimentation, collecting empirical data, review of literature, consultation with experts etc. Students also need to evaluate ideas and knowledge claims based on evidence and to resolve conflicting views (Bereiter, 2002; Scardamalia, 2002). After extended interactions, learners usually achieve deeper understanding about the subject matter or create a better solution for the problem (Mercer, 2008a).

While the preceding paragraph describes an ideal collaborative learning situation, the collaborative learning that we observe in the classrooms is at times not as perfect. Students may be engaged in off-task small talks during group work, group members may decline to offer good ideas, and students may encounter conflicts which they do not know how to resolve. As such, fostering collaborative learning among students requires skilful facilitation from teachers who are knowledgeable about the many aspects of collaborative learning. In the next section, we will first clarify the concept of cooperative learning and collaborative learning.

## Collaborative Learning vs. Cooperative Learning

The concept and process of collaborative learning may at times overlap with the concept of cooperative learning. Many practitioners and researchers do not make a distinction between the two. However, literature pertaining to cooperative learning usually advocates that teachers should adhere to a set of guidelines and assume the responsibility in planning and monitoring the group processes (Johnson & Johnson, 2009). Johnson and Johnson have also provided many good suggestions on how to foster productive group work. We argue that collaborative learning could subsume cooperative learning. For example, Summer et al. (2005)

view cooperative learning as a form of structured collaborative learning. In that light, cooperative learning can be a good scaffold towards collaborative learning. This is especially so in cases where students need to acquire some group process skills through the more structured form of cooperative learning.

Although cooperative learning can be seen as a stepping stone towards collaboration, there are discernible differences between the two. To date, it is widely accepted among educators that cooperative learning focuses on how individuals learn within group settings whereas collaborative learning examines group learning or group cognition (Koschman 2002; Zhang et al, 2009; Hong, 2010). Collaborative learning is also closely related with the use of ICT, as evidenced with the emergence of the field of computer-supported collaborative learning. In this monograph, we make a distinction between these two concepts. Specifically, drawing on Dillenbough (1999) and Summer et al. (2005), we propose that cooperative learning be viewed as the beginning of collaborative learning. Such beginnings of collaborative learning can be characterised as highly structured in terms of group formation, interaction procedure and outcomes of activity. As students mature in their practice of engaging in group negotiation of meanings, structures (in terms of group formation, interaction procedure and activity outcomes) can gradually be removed for students to assume a greater sense of ownership.

We argue that when students are able to work productively in groups, it is necessary for teachers to loosen the structure to encourage students to assume a higher level of agency. Students should be provided with more choices on what, how and whom they want to work with and manage the group process themselves. Arguably, this will offer students opportunities to experience the more dynamic form of interaction and collaboration that characterises knowledge creating communities. Zhang, Scardamalia, Reeve and Messina (2009) reported a three-year study of collaborative learning that started first with fixed

small groups, followed by interacting small groups and lastly opportunistic collaboration where the groups are formed based on emerging issues and dissolved once the issues are resolved. The less structured groups achieved highest level of knowledge advancement. In this study, findings indicated that a less structured approach, both in terms of grouping and the theme of inquiry, may be more desirable for deep negotiation of meanings to happen within and among groups.

In the following paragraphs, we draw on the literature and focus on describing what cooperative and collaborative learning look like. Further in the monograph, we give suggestions on how transitions from cooperative to collaborative learning can be facilitated. In cooperative learning, teachers set learning goals, form groups, assign roles to group members for specific learning tasks, and make use of strategies to foster positive interdependence among students. Given a structure, students are more likely to accomplish their assigned duties in the form of re-assembling parts into whole. While negotiation of meaning may occur, students are likely to be inclined towards task completion via division of labour or sometimes known as the divide-and-conquer strategy (Janssen, Kirschner, Erkens, Kirschner, & Pass, 2010). In fact, exemplified in the following quotes, this form of cooperative learning is quite commonly reported by Singaporean students (See Tan et al., 2010 for a full explication of student responses):

> *We are separated into groups, then we try to answer as many questions as we can to get these points in this point system. So we are really enthusiastic. So we also have a lot of project works like recently we have something that got to do with newsmaker, where we are supposed to do a mock version of a broadcast, yeah news broadcast… for newsmaker we were given around a month to do it. It was a really big project and… using our web cams, we could do a news broadcasting (Sec 3 student, July 2009).*

Generally, Singaporean students perceive group learning positively. Many of them report social and cognitive benefits. For example, they cite group learning help them to learn better, foster social bonding, gain more ideas and complement each others' strengths.

> *We can learn how to work with each other better… in future when… we have to work and we will have the experience of working with… many different people. So we can… work with different people better (Pri 4 student, July 2009).*

Once students are accustomed to working in a group, structures that are set up to support cooperative learning could be faded to allow students to assume greater ownership in collaboration. The case of opportunistic collaboration, as reported by Zhang et al. (2009), serves as a good example of what a highly collaborative learning situation looks like. In this case, the students were studying the topic of Optics. The teacher started by providing the students with the high-level goal of understanding Optics and the students elaborated by defining sub-goals. These sub-goals included Light, How Light Travels, Colours, Shadows, etc. The teacher did not assign students to work on specific sub-goals. Instead students were given the responsibility for the collective growth of understanding as a class. Small groups were formed, dispersed, and regrouped, and whole class discussions were held based on students' perceived needs to advance their understanding. The students posted online notes of their emerging understanding about Optics, and replied to other students' online posts. They contributed by providing explanation of questions asked; asked questions based on what others have reported, conducted experiments, reviewed materials from the library and the Internet, reviewed class progression and discussed ideas in face-to-face settings.

In short, myriad activities were carried out by the students to advance each others' understanding about the topic. In this setting, the students have multiple opportunities to shape and reshape the emerging collective understanding about

the topic. Their personal understanding or ideas about Optic is also being shaped and reshaped when they are engaged in discussion. This in essence is the negotiation of meaning within the individual (intramental) and between individuals (interpersonal). It has been argued that it is a close resemblance to what knowledge workers in the knowledge creation companies do and therefore is a good goal to aim for when one embarks on collaborative learning (Bereiter & Scardamalia, 2006).

## *Collaborative Learning Indicators in mp3*

So far, our discussion of the concept of collaborative learning has largely been descriptive in that (a) we first clarified the concept by differentiating it with cooperative learning, and (b) we illustrated what collaborative learning can look like drawing on Zhang et al.'s case example of opportunistic collaboration. Another approach collaborative learning can be understood is from a "construct" perspective as mooted by the Ministry of Education in the recently released Third Masterplan for ICT in education (mp3)[1]. From such a perspective, collaborative learning can be viewed in terms of the Group Processes construct and the Accountability of Learning construct.

As mooted in mp3, the Group Processes construct explicates the roles and responsibilities of individual members as well as the group as a whole when learning in group settings. These roles and responsibilities are largely premised on interaction patterns such as "sharing of ideas" and "listening to others" students could display when learning with peers. Additionally, suggestions of how ICT can be employed to support interactions are also included.

With respect to the Accountability of Learning construct, roles and responsibilities are explicated in terms of task achievement. Again, suggestions of

[1] URL: http://ictconnection.edumall.sg/cos/o.x?c=/ictconnection/pagetree&func=view&rid=665

how ICT can be employed to support the process towards task completion are given. Here, we replicate the collaborative learning constructs found in *The ICT Connection* portal along with the indicators for easy reference[2].

*Construct 1: Effective Group Processes*

1. When a student works in a group,

- he/she listens carefully to ideas from his/her group members;
- he/she asks questions to better understand his/her group members' ideas;
- he/she shares ideas with his/her group members;
- everyone agrees on what everyone must do;
- everyone discusses how they will do the group work;
- he/she completes the work that he/she needs to do;
- he/she uses computing tools (e.g. discussion forums, MSN Messenger, wikis) to discuss with his/her group members on what needs to be done for their project;
- he/she uses computing tools (e.g. discussion forums, MSN Messenger, wikis) to work with his/her group members to complete a project;
- he/she uses computing tools (e.g. discussion forums, MSN Messenger, wikis) to gather information for their project from people outside his/her school; and/or
- he/she uses computing tools (e.g. discussion forums, MSN Messenger, wikis) to share his/her thoughts with his/her group members on how they can work better together.

[2] URL: http://ictconnection.edumall.sg/cos/o.x?c=/ictconnection/pagetree&func=view&rid=738#col

*Construct 2: Individual and Group Accountability of Learning*

2. When a student works in a group,

- he/she tries to help his/her group members to complete the group's work; and/or
- he/she uses computing tools (e.g. discussion forums, MSN Messenger, wikis) to check if his/her group members have completed their work.

3. At the end of a project, the group discusses how well they have worked together and how they could have worked better together.

## Rationale of Employing Collaborative Learning

In the explication of the conception of collaborative learning, we highlighted some key ideas about learning in collaborative settings and alluded briefly to the rationale for collaborative learning. Here, we discuss in greater detail the rationale for engaging students in collaborative learning from a sociocultural perspective of learning.

Vygotsky's (1978) socio-cultural theory of learning has been one of the theories that provided much impetus to drive collaborative learning. Vygotsky's research reveals that children's higher mental functions are developed through interacting with others who are more capable than them cognitively. What this means is exemplified in the following example. When a child interacts with developmentally more advanced people, for example the more capable peers/siblings, the teacher or his/her parents, the child hears how these people see some problems and how they solve the problems. It is through interactions that the thoughts of others are revealed to the child. Through such interaction, the child has opportunities to observe others thinking and internalise the pattern of thinking. In this way, he develops new ways of thinking. Vygotsky described this process of mental development as one that happens first interpersonally (during interaction), then intra-mentally (during internalisation). He believed

that this is the main way human higher mental function develops. However, he explains that for such development to occur, one key condition is that the interaction needs to be within the Zone of Proximal Development (ZPD). A ZPD is "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). One problem that teachers have is they are cognitively far more advanced than the children they teach and at times they may operate beyond the ZPD of the children. Collaborative learning could provide an antidote to this situation by creating multiple ZPD (Oshima, 1998). Given that every student has a different ZPD, when they are put in group for collaborative learning, their ZPDs overlap one another's. While the teacher's teaching may be accessible to some more advanced students, the less advanced students are able to connect with the more advanced students. The overlapping ZPD of each student when put in groups form the multiple ZPDs which are theoretically more accessible to all the members. In short, collaborative learning is a conducive teaching and learning approach that could cater to diverse learners.

One recent empirical study that illustrates the functioning of Vygotsky's theory is provided by Hasan (2002). His study indicates that the different patterns of interpersonal interaction between mother and child influence the child's pattern of thinking. Some mothers encourage their children to ask questions and provide ample feedback for their children when they ask questions. Others are not so encouraging and forthcoming in responding to the children's questions. The long term effects may be that the children from the less encouraging mothers become less inquisitive, consequently less knowledgeable and perhaps having a smaller repertoire of thinking skills.

It has also been reported that the types of classroom discourse/talk shapes the thinking and the identity of students (Mercer, 2008a). The pattern of talks that

occur in classrooms has been described as either monologic or dialogic (Wells, 2007). Monologic talks are one-way transmission of knowledge from the teacher to the students, demanding that the students to be passive recipients of knowledge. Research has documented that teacher controlled talk or recitation is prevalent in the classroom (Mehan, 1979). Some Singaporean teachers are strong advocates for such an approach as it seems clear to them that it is efficient (Chai, 2006). We are not arguing that this is necessarily a bad teaching strategy. Rather, teachers may want to consider the possible undesirable effects of too much teacher talk and encourage more a dialogic mode of communication to encourage students to be more inquisitive and more active in educating themselves. The possession of knowledge, which seemingly is more efficiently achieved through monologic talk, may not be enough for learners today. The ability to create knowledge, arguably more effectively achieved through dialogic talk, is the other wing that our learners need. Research conducted by Brown and Palinscar (1989) on reciprocal teaching, Anderson, Chinn, Waggoner and Nguyen (1998) on collaborative reasoning, and Mercer (2008a) on thinking together, have all indicated that collaborative talks are positively associated with better learning performances.

Building upon Vygotsky's theory, other noticeable sociocultural theories of learning include the notion of distributed cognition (Pea, 1993) and that of Community of Practice (CoP) (Lave & Wenger, 1999). The notion of distributed cognition highlights the importance of sharing cognitive load when one is engaged in solving complex problems. Many important jobs in human society cannot be accomplished alone. An example would be flying an aeroplane. There are many readings that the pilot needs to monitor, and part of the cognitive load has been distributed to the various apparatus to monitor, alerting the pilot only when actions are needed. To design a new aeroplane, on the other hand, would be too big a task for an individual to undertake efficiently. This is usually carried out in modern times by people with different expertise to undertake as a team.

Similarly, collaborative learning avoids cognitive overload for individuals. In collaborative learning, learners share the cognitive load of authentic and complex learning tasks (Roth, 1999).

In essence, to achieve the many cognitively demanding tasks of today's workplace, workers are required to collaborate with one another. The abilities to share cognitive and other forms of responsibilities, to work with others, to communicate effectively are complex in nature and educators cannot assume that every learner possesses these abilities. Regular collaborative learning in school would provide ample opportunities for learners to acquire the complex skills involved. However, recent research has also indicated that while performing collaborative learning, learners have to devote certain amounts of attention to discuss and monitor the collaboration processes, which could distract their attention away from the learning activities. Given that, if the collaborative task is by nature relatively simple and does not necessitate collaboration, it would not benefit the learners to perform collaborative learning (Janssen et al., 2010).

The notion of CoP, on the other hand, emphasises the importance of the community in giving meaning to the talks and activities that occur within the community (Lave & Wenger, 1999). CoP was derived from anthropological research on how people learn and move from being an apprentice to being an expert within a community of certain trades. To understand how to be a master tailor, for example, one has to be provided with opportunities to see and learn what existing masters do, how they talk and think. Such opportunities are provided when one becomes an apprentice. As one is in the trade, or in situ, the meanings of talks and activities are easily understandable as the environment provides rich context for one to take reference from. The research of CoP reveals the importance of being in the authentic situation to appropriate the means of the trade. School, however, is not quite the same as CoP. School subjects are

taught not as how those subjects are being practiced. There is therefore a need to create knowledge building communities (Bereiter & Scardamalia, 2006) in schools, in which students work directly with the subject matter as knowledge producers in practice do. In other words, to teach Science, it is desirable for the students to form communities that resemble the ways scientists operate. To teach Social Studies, students ought to struggle through the issues like a community of sociologists. Allowing the learners to use the tools (both physical and conceptual) to solve authentic problems in which the subject matter experts deal with, in the social context where such problems are solved, is the approach advocated by the notion of CoP. The benefits would be deep understanding of not just the knowledge or even the process of creating the knowledge, but also the ability and identity of being a knowledge creator.

As Johnson and Johnson (2009) correctly pointed out "humans are small-group beings…… As the effectiveness of our groups goes, so goes the quality of our life" (p. 555). Learning to collaborate is therefore a worthwhile goal for anyone who wants to live a social life.

Another rationale of engaging students in collaborative learning would thus be its potential of being a fertile ground to cultivate social emotional learning (SEL). This idea of connecting collaborative learning and SEL was suggested by one of the Heads of Department we interviewed for the evaluation of mp3 (Christopher Hoe, July 2010, personal communication). Collaborative learning inevitably involves relationships among learners. Local research indicates that students, especially those who are good and competitive, are quite perceptive about the many problems involved in collaborative work (Tan et al., 2010). Below are some quotes that students have reported.

> *I don't like group work because sometimes we may quarrel with each other (sic), and sometimes the group members don't do their work and the whole group gets punished (Sec 3 student, July 2009).*

> *I do not like group work. I think it is better to depend on yourself. It is unjust when freeloaders get credit for work they did not do. We were also assigned the Social Studies project, and at our meeting the leader did not turn up, resulting in the work being done by only a few members. The members were chosen by ourselves, but we did not know that some of them were so irresponsible. I told my teacher about the situation, and she told me to give the freeloaders something to do so as to justify giving them some marks. However they still did not do anything but got the marks in the end (Sec 3 student, August 2009).*

Järvenoja and Järvelä (2009) point out that students face higher socio-emotional challenges when they are engaged in collaborative knowledge construction. Many factors could contribute to potential conflicts. Students are likely to have different interest levels, expertise, goals and communication styles. Given these differences, coupled with external problems such as insufficient materials, clash and conflict, could easily develop, causing negative emotion to run high (Järvelä, Volet, & Järvenoja, 2010). Regulation of personal and group's emotion is necessary for students to be successful in collaborative learning. It follows that students need to be aware of their personal and the group emotional states and consciously apply strategies to help themselves and the group to move forward. Collaborative learning thus becomes a fruitful ground for students to acquire the interpersonal skills and regulation strategies. Research in this area is however, just beginning.

In essence, drawing on the above discussed, there are many good reasons for the use of collaborative learning strategies in our teaching and learning. Broadly, from a curricula perspective, in collaborative learning students have opportunities to externalise what they know in interaction. Knowledge gets fine-tuned as students negotiate and understanding is sharpened. From a 21st century learning perspective, students acquire apt social skills that could serve

them well both in learning and future work situations. From a social emotional learning perspective, collaborative learning provides ample opportunities for them to be acquainted with the skills of managing their personal emotions and the group's emotions. Before we move on to discuss the role of ICT in collaborative learning, we summarise our rationalisation for collaborative learning in the following points:

(a) Interaction with peers promotes progression in students' ZPD

(b) Dialogism promotes active construction of knowledge

(c) Cognitive load gets shared out

(d) Interaction with content knowledge as practitioners in the field

(e) Cultivate social emotional learning and social emotional skills

# 2 Affordances of ICT and the Support for Collaborative Learning

Collaborative learning activities can take many forms. They range from having students solve practical or designed problems, to the development of novel products that can change the quality of our lives. ICT can play a role in whichever form collaborative learning takes. While ICT enable many-to-many interactions concurrently, which is essential in breaking the dominance of initiation-respond-evaluation (IRE) classroom-based discourse structure, the role played by ICT in the process of collaboration, however, is not always supportive of learning. ICT can be at times just a communication channel that is neutral to learning. Here in this monograph, we provide a heuristic for thinking about ICT affordances by way of contrasting ICT as communication channel with ICT for collaborative meaning making. Through this, we aim to differentiate the many ways ICT is used in teaching and learning, and thereby highlight that not all utility supports collaborative learning.

To start off, by affordance, we mean the possible actions people can perform by using certain features of tools (Gibson, 1977; McLoughlin & Lee, 2007). For instance, the affordance of blogs in its reverse chronological feature of having the most recent post at top of a page promotes diary writing. When accessing a blog, readers would read the most recent entry first and receive the updated development of the blogger's publications with ease. This affordance encourages readers to continually follow blogs for updates and correspondingly for bloggers to continue publishing.

Drawing on Suther's (2006) discussion of ICT affordance for intersubjective meaning making to make our discussion here, we highlight the distinction between ICT as communication channel and ICT for collaborative meaning making. With respect to ICT as communication, we refer to the use of ICT mainly for enabling communication. There are learning situations where ICT is used as a communication channel for members within a group to interact with one another. Such communication can take place either in class to complement face-to-face interaction, or outside class as an extension or replacement of face-to-face interaction (with the latter being more predominant). In such situations, the focus really is to enable talk among students and sometimes with the teacher, and less emphasis is placed on whether the talk leads to learning (See Olson & Olson 2000 for argument against replicating face-to-face interaction online).

Likewise, ICT for collaborative meaning making can occur within class or outside class. However, the similarity ends there. Rather than be concerned with how ICT enables talk among students, what matters is how features of ICT tools influence the course of collaboration. In other words, how students use ICT in group settings. Thus, taken in this light, students can be using ICT even in a face-to-face setting so long as the interaction works towards collaborative meaning making. In fact, Suthers (2006) argued that collaborative learning systems should be fundamentally social technologies that mediate and encourage actions by collaborators to achieve learning (see section below for Web 2.0 as social technologies). In the table below, we suggest a non-exhaustive list of ICT affordances and describe the role of technology to support collaborative learning.

Table 1: List of ICT affordances and corresponding roles to support collaborative learning

| ICT Affordances | Explanation & Example | Roles to Support Collaborative Learning |
|---|---|---|
| 1. Possibilities for Actions | Refers to the potential for action by students working together. For example, in wikis and blogs, the representation of inscriptions in a synchronised workspace enables one student to share and subsequently others to react to the sharing, thereby facilitating co-construction across time and space. | Facilitate co-construction for clarification or depth of subject-matter. Also facilitate consensus within group. |
| 2. Referential Capabilities | Refers to referential potential of externalised thinking in the form of inscriptions for reflection on prior activity or subsequent interactions. For example, an online concept map is an inscription of externalised thinking which can be elaborated or corrected by another peer in a group. | Repository or trail of ideas for subsequent actions (which can be reflection, correction, elaboration, extension or negotiations etc.) |
| 3. Mobility of Digital Inscriptions | Refers to the ease of manipulation of digital inscriptions. For example, ideas in a discussion forum can easily be "copied" onto a Google Document for subsequent action and meaning making. Alternatively, the digital inscriptions could be copied onto an email for recruitment of collaborators. | Externalised knowledge as inscriptions can easily be transferred, aggregated and modified within and across different ICT platforms thereby cutting across time and space thereby ensuring continuity of collaboration. |
| 4. Promotes patterns of Participation | Refers to the flexibility of ICT tools to allow for different trajectories of participation. For example in a social networking site, students can participate in different role positions at | Flexible participation patterns promote agency and ownership to the overall task at hand. Additionally encourages take up of different role positions in the joint meaning-making |

| | | |
|---|---|---|
| | different “places” within the site. | process. |

## Web 2.0 as Social Technologies

Social technologies or social software can broadly be defined as “software that supports group interaction” (Shirky 2003, para 2). The idea of supporting group interaction is more than just facilitating person-to-person interaction. It encompasses the notion of having users of Web 2.0 in the centre of activity where their practices (i.e. the way they use the technology) are more important than the technology itself. In fact, McLoughlin and Lee (2007) argued that Web 2.0 enables “collaborative remixability” (p. 665), a transformative process in which digital media can be recombined or recreated to become new forms in tangible (e.g. new products) and intangible ways (e.g. ideas and services).

To further flesh out the social aspects of Web 2.0, here we reiterate aspects of Web 2.0 as espoused in Lim, So and Tan (2010). We do this along three dimensions, namely technological, social and epistemological. First, on the technological dimension, Web 2.0 tools lean heavily on promoting social networking in easy and simple ways. Often it is a matter of accessing URLs in order to participate in the interactions. Second, on the social dimension, Web 2.0 tools put people in the context of other people. This contrasts with Web 1.0 that emphasised on independent self-paced learning. Finally, on the epistemological dimension, the notion of knowledge creation in a Web 2.0 environment emphasises on participation where knowing becomes public, and contradictions within get worked through.

Such social, flexible and connective character embodied in Web 2.0 lends itself well to collaborative learning (Anderson, 2004). Students collaborating in a Web

2.0 environment worry less about technological barriers, and therefore are able to focus on the task and the processes of collaboration. Contributions from peers become the foci on which interaction and meaning making can be built upon. More importantly, learning in a Web 2.0 environment is necessarily student-centred in that students would be doing the learning — searching, writing, sharing, modifying, elaborating, and so on. The learning process is participative and active with students engaged in the process. On the other hand, ideas, information and knowledge get fine-tuned and sharpened over time, arguably leading to deeper learning.

# 3 Local Case Examples of Collaborative Learning with ICT

In this section, we contextualise the descriptions of collaborative learning given above in a few local case examples. These case examples illustrate situations of collaborative learning across various social settings. The first case example crosses between formal learning in the classroom and informal learning at home while the second case example is about mobile learning in a field trip. Our objectives in the description of these case examples are twofold: First, we unpack the learning activities and processes in the lessons and highlight some key tenets about learning in collaborative settings. Second, in highlighting key tenets about learning in collaborative settings, we reinforce the rationale of employing collaborative learning in teaching and learning.

## Learning Community: Youth Olympic Games Project (Nan Chiau Primary School)

### *Context of the Lesson*

The goal of this lesson is to raise awareness of the Youth Olympic Games (YOG) in students. At the same time leveraging 1:1 technology access[3] as well as a social networking platform (Elgg) to learn across formal and informal settings, this lesson aims to inculcate in students 21st century skills, in particular self-directed learning and collaborative learning skills. For the purposes of this monograph, we will illustrate mainly the collaborative learning aspects. This lesson was

[3] 1: 1 technology access in education refers to each student or teacher having a computing device, internet access anytime, anywhere.

implemented in a Primary Five class and consisted of three activities which spanned over a week long. The specific objectives for this lesson include: (1) learn what the Youth Olympic Games represents, (2) conduct research in their specific roles and of Indonesia, (3) be effective communicators and critique peers' responses, and (4) be self-directed in their learning and collaborate with peers.

The use of the social networking platform (e.g., Elgg) in a 1:1 technology access setting is not new in the school. In fact, observations from earlier lesson implementation using Elgg and 1:1 found the design principle of giving students role positions in a social networking platform to be effective in developing collaboration skills in them (Lau et al., 2010). Therefore, this lesson can be viewed as the scaling of good practices to students of other levels in the school (see Figure 1 for the Elgg homepage for the Primary 5 class).

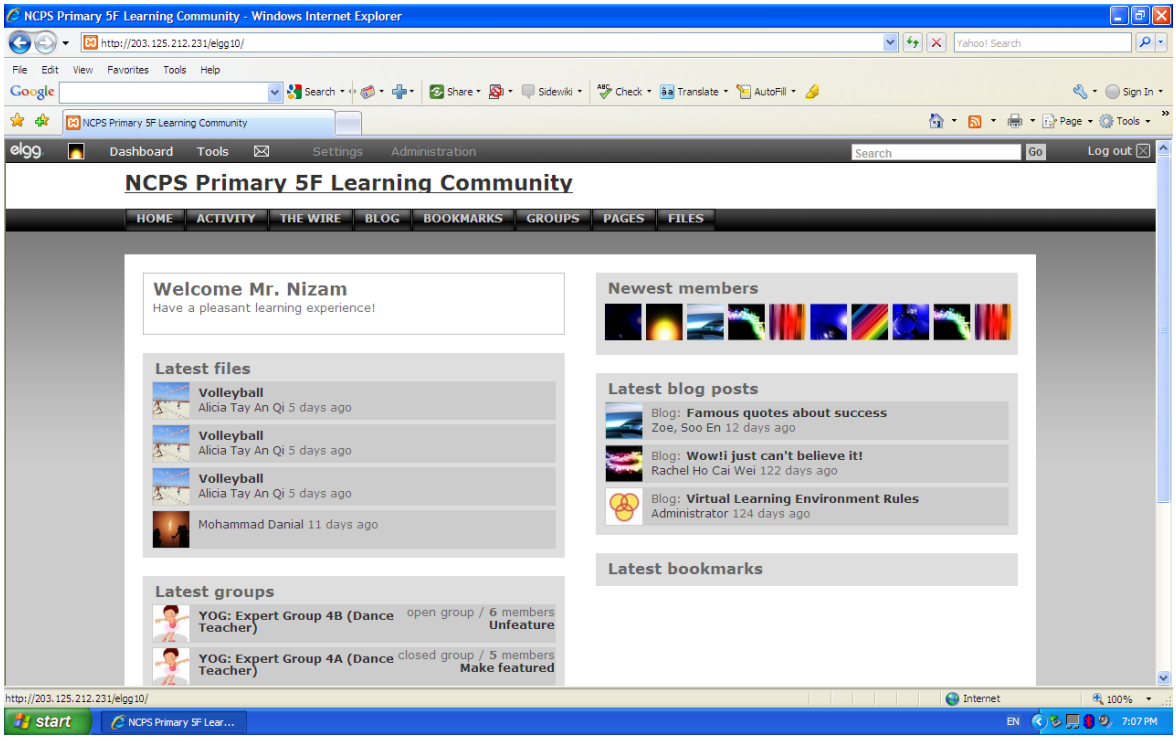


*Figure 1*: Elgg[4] homepage for Primary 5F

[4] Screenshots used with permissions of Curverider Limited (For more information, see www.elgg.org)

### *Lesson Activities*

There are three activities in this lesson, and Activities One and Two were conducted using a cooperative learning strategy known as the jigsaw method (Slavin, 1980). For Activity One, students were grouped according to expert groups, that is, as a Physical Education teacher, a Music teacher; an Art teacher and a Dance teacher. For each role position allocated, students were to research and find out the developmental trajectory for the role position. Additionally, they were also required to learn more about Indonesia, a country paired with the school for YOG specifically in areas of sports, music, art and dance culture. Given specific role positions to play, each group member inquired into the area related to the role position and shared with the other expert group members on Elgg (See Figures 2 and 3 for the expert group task description and the collection of students' research respectively). Throughout the research process, the teacher played the role of a facilitator probing into students' research and asking them to clarify what they found (See Figures 4 and 5 for what students have found and how the teacher probed for further clarification respectively). After students had researched and learnt more about their roles and of Indonesia's rich culture, they carried on to Activity Two.

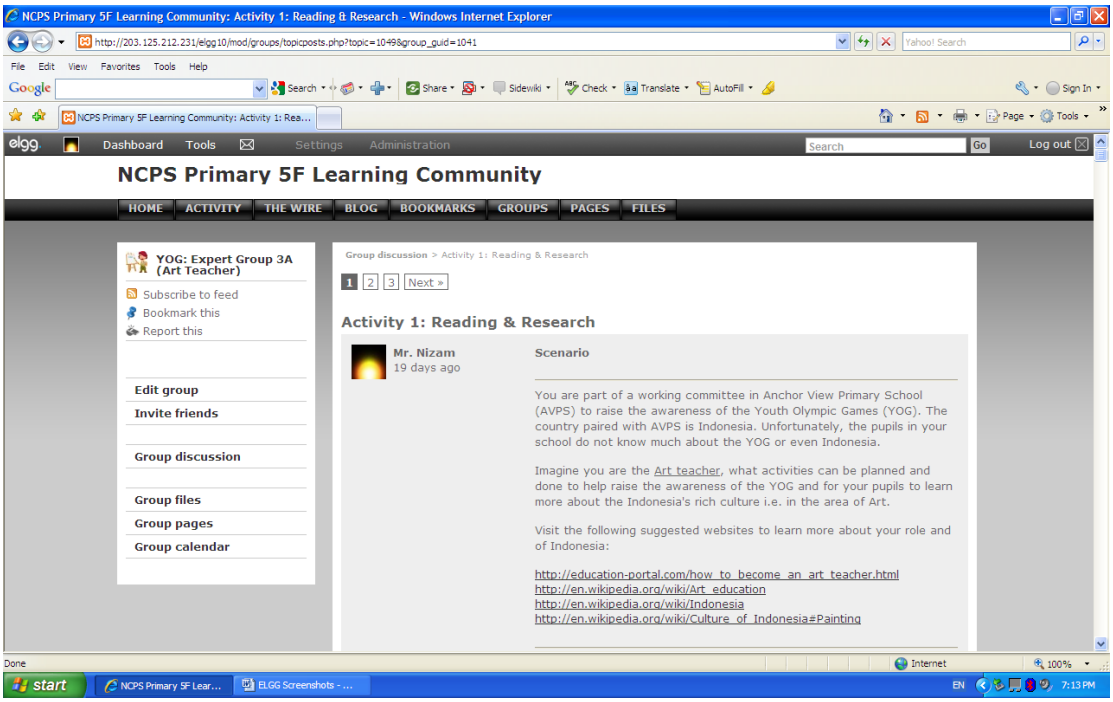


*Figure 2*: Task description for Activity One

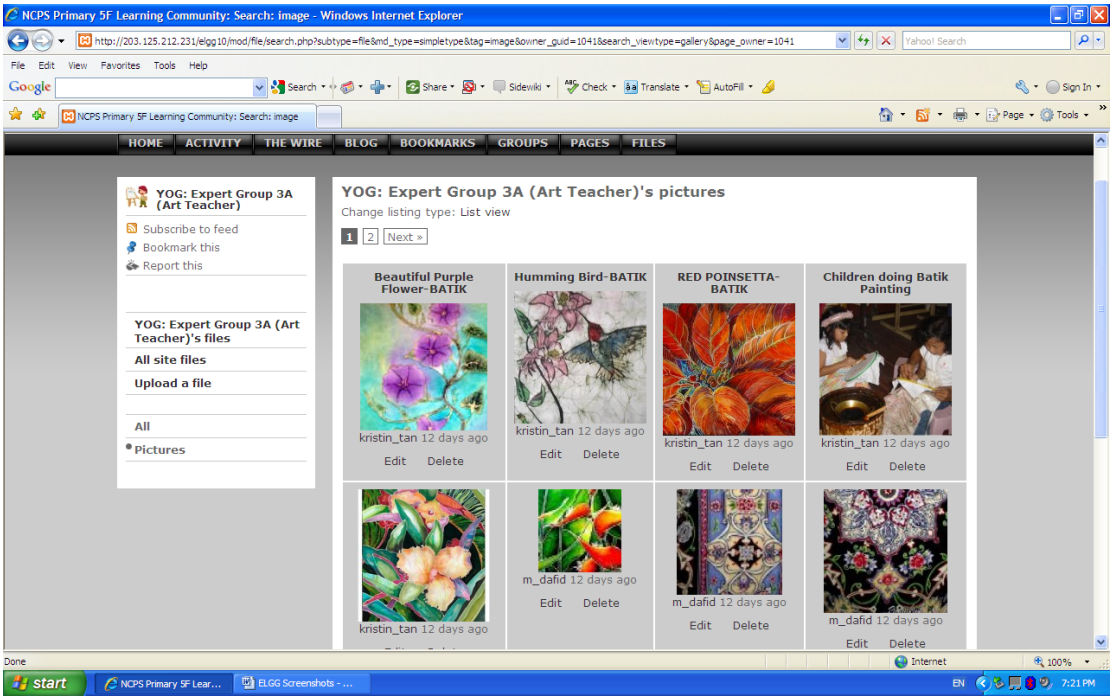


*Figure 3*: A collection of pictures from an expert group research.


*Figure 4*: A student sharing his research with other expert group members

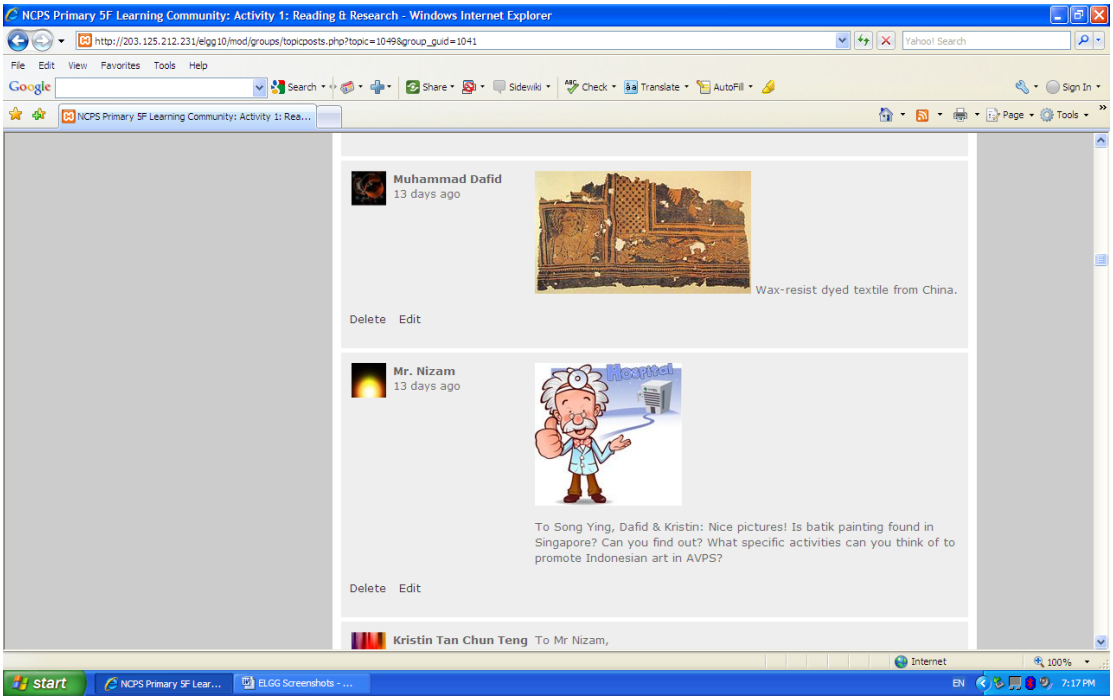


*Figure 5*: Teacher probing and directing research

For Activity Two, students returned to their home groups (i.e. Green, Yellow, Pink and Red) to discuss and share with their home group members what they had learnt (See Figure 6 for student sharing their research). Students were encouraged to ask questions and to give comments to one another so that they were clear on what they were learning from their peers. In the process, students developed their descriptive writing skills and learnt to be critical of one another as they constructed learning together.

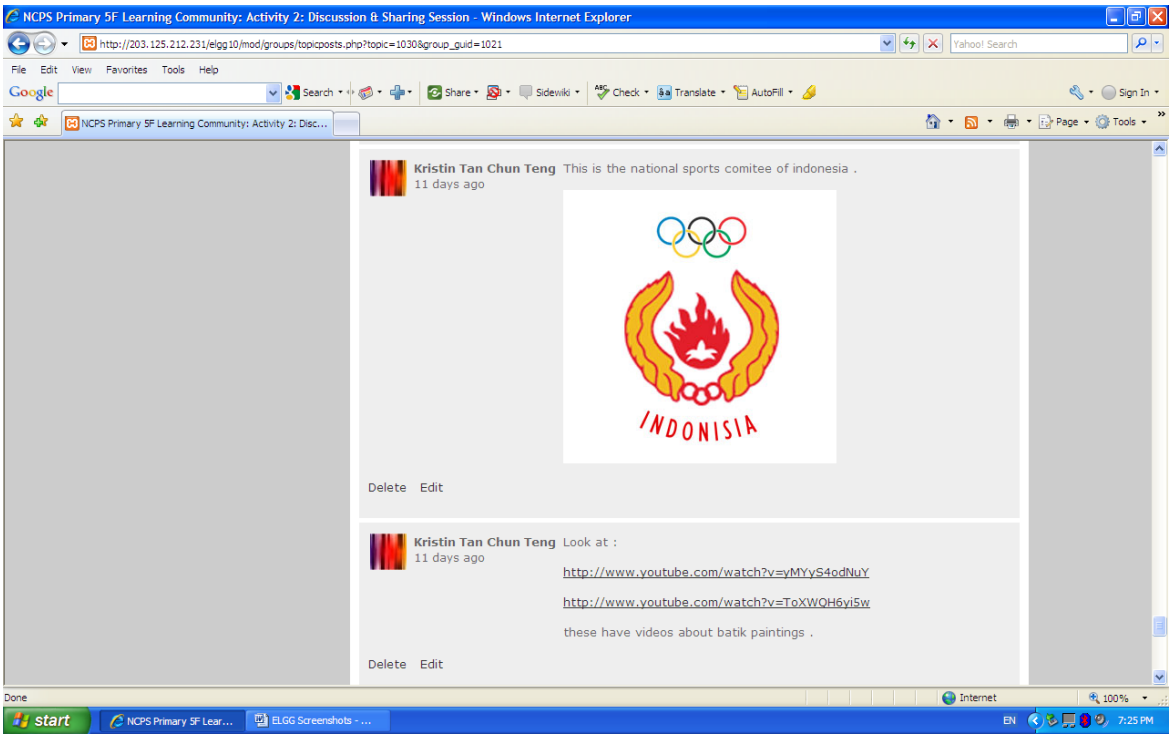


*Figure 6*: Sharing of research to home group members

Finally, in the Activity Three, students created a written piece of work. They wrote a letter to a pseudo school principal informing him of the committee's plans in organising a YOG carnival. In the letter, the pupils included the following information: (1) A proposed venue for the carnival in the school and a reason for choosing it, (2) 1 sports activity related to Indonesia's sporting culture; (3) 1 musical activity related to Indonesia's musical culture; (4) 1 art activity related to Indonesia's art culture, and (5) 1 dance activity related to Indonesia's dance culture. To perform this activity, students had to explore options considering and reflecting on various role positions, to critique and discuss their peers'

responses, and to reflect and re-evaluate their positions before making a collective decision as solutions to the learning scenario.

### *Some Tenets about Learning in Collaborative Settings*

In the Youth Olympic Games Project lesson, student-to-student interactions took centre stage. In the expert grouping, students depended on each other to build and expand on a repertoire of resources that could be shared with the home group. Back in their home groups, they had to make decisions on what resources to share and how to present the sharing/research. On the other hand, any member in a home group was simultaneously an expert in one area and a learner in another area. Hence, besides having to think through what and how to craft the sharing, students could probe and question their peers in areas they were less familiar with. Such a dialogic process of learning not only promotes active construction of knowledge. It makes the process of learning knowledge observable, and the teacher could then interject to steer and facilitate where necessary.

The design of this lesson transited from cooperative learning using the jigsaw method to a more collaborative stance where students had to negotiate from their various role positions on the choice of venue in the final written task in Activity Three. In tandem with such a choice of pedagogy, it can be seen from this lesson that the cognitive load of learning about YOG and Indonesia (with respect to sports, art and music scene) was shared among the students. Students need not learn what they needed to know solely from their own research alone but they could extend, build on or even reconstruct what they know based on peers' input.

Finally, the third salient tenet about learning in a collaborative setting in this lesson pertains to the development of social skills in students. As students presented their research and questioned one another to probe deeper into the

learning, under the guidance of the teacher they also acquired important social skills. These skills worked in complementary ways to maintain productive conversations (See Figures 7 and 8 that showed students probing into the research in socially apt ways) and thereby facilitated the quest to probe into one another's research for clarification.

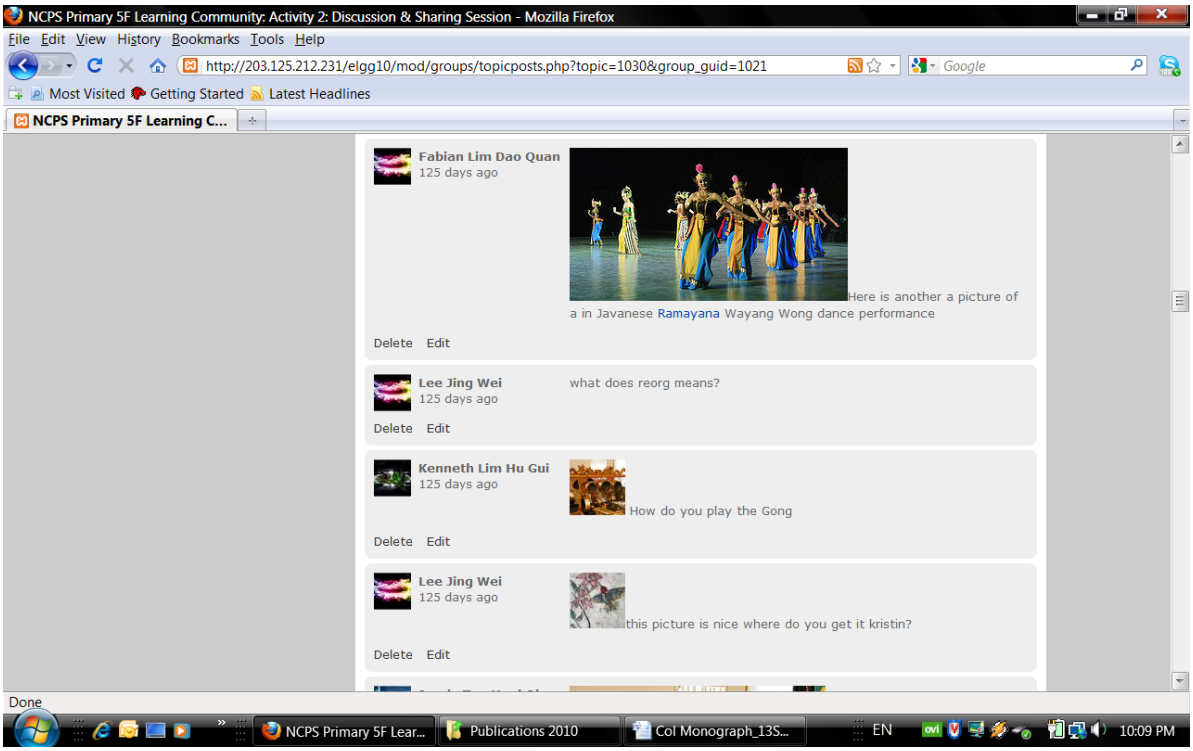


*Figure 7*: Students probe deeper into learning by questioning what they learn

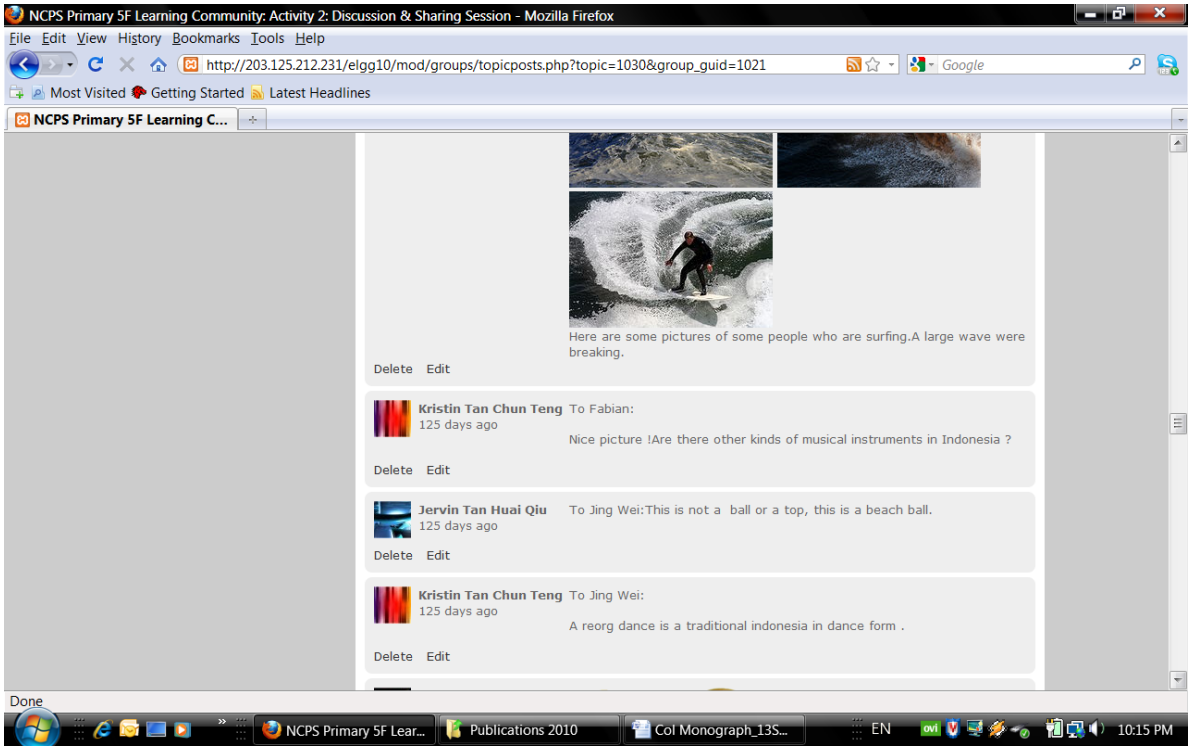


*Figure 8*: Students displayed socially apt skills as they participate in collaborative learning

## *Sentosa Mobile Learning Trail (School of Science and Technology Singapore)*

### *Context of the Lesson*

The goals of this mobile learning trail are twofold: First, to allow students to contextualise what they learn in Geography lessons into the "real world" settings. Second, to foster small group collaboration in students so as to cultivate a culture of collaborative knowledge building in the school. This mobile lesson took place in Sentosa which was chosen for the many physical and social geographic features it has for students to explore. As students embarked on the trail, they first had to make use of the given navigational coordinates in tandem with Google maps to navigate their way around Sentosa. Upon arrival at designated stations, they performed various activities involving measuring of gradient, identification

of physical features associated with erosion and disposition, and the conduct of interviews. All in all, the trail lasted for about two and a half hours.

About 200 Secondary one students participated in the Sentosa mobile learning trail. They were placed in groups of four of which 24 groups were scheduled for the morning and 30 groups in the afternoon. Each group of students shared a MacBook laptop as their ICT tool and together with the wireless technology they were able to use the Internet and Google Applications in the course of the activities (see Figure 9). The use of ICT was not new to the students. Prior to the trail, they had prior experiences in using ICT for learning across different subjects as part of their school curriculum.

### *Lesson Activities*

There were three stations in the Sentosa Mobile Learning Trail, namely, Yellow, Green and Red. At each station, students participated in a variety of activities as what Geographers would do in real life. There were two tasks students had to do at Station Yellow. In the first task, students calculated the gradient of slopes for three different sections on a beach. Equipment such as bamboo poles, raffia string and torpedo level were provided for the set-up. Using rulers and calculators or other improvisations, students had to estimate the rise and run of slopes with the goal of observing the interrelationship between the steepness of a beach and the intensity of erosion. The second task required students to interview one or two tourists. They were to find out why tourists chose Sentosa as a tour destination and what they liked about the place. In so doing, they learnt how to collect primary resources for analysis and evaluation purposes.


*Figure 9: Web platform giving students instructions as well as facilitating student inscription of field responses*

At Station Red, students collected photographic data (& made annotations), calculated height of a tower using Trigonometry and clinometers, and performed observations from the Twin Observation Tower. Through these activities, they learnt three different types of skills akin to what Geographers have. First, they learnt how to collect accurate information from the field. Second they learnt how to estimate the height of physical and human features to determine their relief in relation to the representation on topographical maps. Third, they learnt to hone their observational skills by recording descriptive data of what they saw. In addition, they also picked up the skill of identifying physical features such as ridge, sea, island and beach.

Finally, at Station Green, students participated in "design-thinking", a process that had them analyse, synthesise and evaluate real-life situations in a systematic manner. The "design-thinking" process required students to (1) brainstorm for ideas, (2) share with peers, (3) categorise ideas and (4) suggest solutions to problems. In so doing, students learnt how to scale their findings from small-scale projects to larger environmental issues such as global warming.

*Some Tenets about Learning in Collaborative Settings*

The Sentosa Mobile Learning Trail lesson was an example of "learning by doing" in a real-world context. The activities students engaged in were akin to what Geographers do in real life. Not only was the process of data collection, analyses and evaluation authentic, students experienced different types of tools and apparatus that were used by practitioners of the field. It can be argued that textbook knowledge was contextualised and made meaningful to the students. Furthermore, they immersed in a process of "learning to be", in this case, as Geographers.

The design learning activities at each station were complex, drawing on both conceptual and procedural knowledge. Such task design would appear daunting if students do not collaborate among themselves in the execution of the activities. Specifically, they had to listen to one another's ideas especially when the task contained ambiguity with no straight forward solutions. Other times, they had to rely on one another's knowledge, share and discuss in order to derive the learning points. As reported by the research team involved in this lesson, students were imbued the idea of the collective where they discovered they could achieve more as a group. Here we replicate a student's quote in So, Tan and Tay (2010) that indicated student learning about collaboration, "The thing is everyone needs to accept everyone else and it has to be focused...accept one another and come to a consensus after everybody else has contributed."

Finally, the third tenet of collaborative learning that can be gleaned from this lesson was the pedagogical function of the mobile devices (i.e. MacBook) in supporting students' performance of the activities. The use of ICT was integral to students' meaning making throughout the trail. They relied on it for navigation, data collection (i.e. photo taking and annotation), analyses and interpretations (i.e. calculation of height of tower & gradient of slopes) and record keeping (i.e. record ideas during "design-thinking" and observations from Twin Observation Tower). Indeed, ICT provided both the means and resources for students to construct knowledge which otherwise could be challenging in a pen and paper setting.

In summary, as illustrated in the two case examples, collaborative learning takes on the direction of externalisation to internalisation. As students make sense of the subject-matter at hand in interaction, learning becomes internalised (Scardamalia & Bereiter, 2006; Vygotsky, 1930/1978). In other words, where as an individual learner participates and makes sense of what is going on in the social situation, construction of knowledge occurs. Additionally, students picked up social skills and learnt to interact with the world as practitioners do in real-life. With this, we allude to the following section which articulates rationales for collaborative learning.

# 4 Designing for Collaborative Learning Using ICT

While collaborative learning is supported by strong theoretical and empirical foundations, in the classroom, the forms of dialogue that play out depend on a teacher's instructional and pedagogical skills in structuring the environment, activity and students' interactions. From students' perspective, learning in group settings is also not without problems. These problems can be classified as motivational difficulties, interaction difficulties and logistical problems. Problems such as encountering free-riding or domineering members in the group could reduce motivation of other members to contribute. Interpersonal conflicts, whether in the form of personality clash or differences in values or problem representations, require skilful conflict management strategies for resolution. Group size, composition and the sharing of resources and equipments constitute the logistical problems (Pauli, Mohiyeddini, Bray, Michie, & Street, 2008) that could be encountered.

In this section, we describe some strategies that could be employed for productive collaborative learning as well as to prevent or manage the above described issues that could occur. We do this at two levels – macro design principles that list broadly the key tenets collaborative activities should encompass and micro instructional strategies that address specific dimensions in the design of collaborative learning. Ideas in the two levels are not meant to be mutually exclusive. They serve as lenses for designers of collaborative learning to use when planning for collaboration. In our view, collaborative learning can be greatly enhanced with knowledge building pedagogy (Scardamalia & Bereiter,

2006). The knowledge building pedagogy emphasises on engaging students to identify problems of understanding and resolving the identified problems through students' collaborative effort supported by the Knowledge Forum™. Figure 10 below shows a posting of our local student in Knowledge Forum™.


*Figure 10*: The interface of Knowledge Forum [5]

We draw on Scardamalia's (2002) 12 knowledge building principles for the discussion on macro design strategies. We then look at specific dimensions such as Teacher's role, Interaction and so on in the discussion on micro instructional strategies.

[5] Screenshot used with permissions of Institute of Knowledge Innovation and Technology and Learning in Motion (For more information, see www.knowledgeforum.com)

### *Macro Design Principles*

We draw on Scardamalia's (2002) work in Knowledge Building and Knowledge Forum to outline the macro design principles (see http://ikit.org/mvt/kb_principles.htm). This is not to say we are advocating only the use of Knowledge Forum as means of ICT integration. Rather we hope to bring across the emphasis that the essence of collaboration is in knowledge building.

Instead of procedural guidelines, this section presents macro-level design principles that teachers can consider to create environments conducive to collaborative knowledge building. Initially, these principles may appear too abstract to implement, or some teachers may prefer to follow procedural recommendation about how-to-dos. However, we believe that each class operates in a different ecology, and linear procedural guidelines or best practices approaches may not be suitable for addressing emergent and diverse needs of each class, individual students, and teachers.

It is important to note that presenting 12 principles does not mean that teachers need to address and implement all principles. Some principles may appear more important to certain contexts of teaching and learning, the profiles of students, and the nature of subject areas. The emphasis here is that these principles should function as macro-level guidelines that both teachers and students can use to evaluate and reflect on the implementation path of creating collaborative learning environments from more holistic perspectives. Further, we support this principle-based approach where multiple aspects of a knowledge building pedagogy are made explicit to both teachers and students, as Scardamalia and Bereiter (2006) emphasise in the following:

> *For decades educators have promoted constructivist ideas among themselves whereas their students have been expected to carry out constructivist activities* ***without access to the constructivist idea lying behind them.*** *This is an internal contradiction that a principled approach to knowledge building should overcome (p.106, emphasis added).*

Hence, we recommend that teachers communicate these principles with students. For instance, teachers may want to discuss with students about the meaning of each principle and co-construct statements of knowledge building principles that can be easily understood by them. Through this type of student-centred exercises, the responsibility and success of knowledge building are shared by both the students and teachers instead of being borne by the teacher alone.

1. Real Ideas, Authentic Problems

The first step towards creating a collaborating community of learners is to enculturate students into collaborative learning practices. That is, developing a safe culture and environment where students can enjoy working and playing with ideas. One of the strategies to create such enjoyable environments for collaboration is to use real ideas and authentic problems as big questions or trigger questions. In fact, knowledge problems by experts often arise from their critical examination of the real world. Instead of simply progressing through a series of activities, teachers can expose students to authentic ideas and issues in problematic situations. In the course of working with real ideas and problems, it would become clear to students that applying facts, rules, and ideas in authentic situations is not straightforward, and collective effort to come up with plausible solutions is necessary.

2. Improvable Ideas

As a teacher, it is important to emphasise to the class that there is no correct or wrong answer; instead, all ideas are important and improvable. In knowledge building classrooms, ideas are improved by creating epistemic artefacts such as conceptual ideas, principles, or theories, and making them public for a community. Students are encouraged to express, articulate and put forth their ideas in a public space, which can be in the form of Knowledge Forums, online discussion forums, wikis, or other open platforms. In such public spaces, students are engaged in viewing and organising ideas, with the belief that knowledge is advanced through proposing and refining ideas collectively.

3. Idea Diversity

Idea diversity is essential for knowledge creation and innovation. Knowledge workers in organisations do not merely accumulate knowledge, but propose new problems and solutions for better understanding. Similarly, all learners are empowered to generate diverse ideas in knowledge building classrooms. Scardamalia and Bereiter (2006) explain the power of idea diversity as a "feedforward effect, in which new knowledge gives rise to and speeds the development of yet newer knowledge" (p.99). When diverse ideas are generated and respected, students are not only learning what curriculum or teachers decide on, but also what their interests drive as a new object of discussion, which may be beyond prescribed curricula.

4. Rise Above

So far, the first three principles emphasise helping students generate and improve ideas. In knowledge building classrooms, we want students to move beyond sharing simple knowledge toward more inclusive and higher-order levels of knowledge creation. For example, a community of learners can identify

emerging patterns of ideas, work together to group diverse ideas into one common theme, and explain an overarching theory. This ability to synthesise and rise above is an important cognitive skill, especially in contexts where ideas are diverse, complex, and contradictory. Further, being able to rise above means that students do not arrive at simplifications and over-generalisation, rather they formulate epistemic artefacts that encompass ideas at more complex and inclusive levels.

5. Epistemic Agency

Epistemic agency means that students assume responsibility for the overall progress of the class's knowledge advancement as well as for the advancement of individual understanding. Often in classrooms, higher-order thinking exercises are done by the teacher alone by taking responsibility of asking questions, designing tasks and activities, and finding resources for students. Epistemic agency in knowledge building classrooms means turning those responsibilities of higher cognitive activities over to students. Also, it should be noted that by "epistemic" the emphasis is on deep understanding, not on merely completing tasks.

6. Community Knowledge, Collective Responsibility

While some people may equate collaboration as a group work or project work, collaborative learning can take place beyond small group levels. In knowledge building, a class of students is considered a community, and the core task of the community is to advance community knowledge. In such community contexts, knowledge is created through the co-construction of ideas across groups as well as within groups. This is to promote inter-group collaboration, and to reduce the feeling of unnecessary competition among students. Another important idea underlying community knowledge is collective "cognitive" responsibility (Scardamalia, 2002) which emphasises the responsibility of understanding and

knowing beyond the completion of tasks, and distributed across all the team members rather than being concentrated on selected members.

7. Democratising Knowledge

Some teachers may question whether knowledge building activities requiring higher agency for learning are suitable for all students. Teachers with certain views about student abilities may use higher-order tasks for high-achieving students more often than for low-achieving students, hence low-achieving students are deprived of opportunities to develop higher-order thinking skills. However, an increasing body of research on collaborative knowledge building these days reports that when appropriate scaffolding is provided, even academically low-achieving students can manage complex problems and achieve equal learning outcomes as their counterpart do (e.g., Chan & Lee, 2007; So, Seah, & Toh-Heng, 2008; Zohar & Dori, 2003). In knowledge building classrooms, all students are empowered to be knowledge creators; thus, the diversity of abilities and differences becomes strength rather than a barrier for creating innovative ideas.

8. Symmetric Knowledge Advance

What is the role of teachers in creating pervasive knowledge building culture? Teachers may question how they can deal with the diversity of ideas. What should I do when my students are discussing wrong concepts? These are all valid questions. Creating a knowledge building culture necessitates changes in beliefs about how knowledge is created. The traditional conception of teachers as content experts does not hold successfully in knowledge building classrooms. Being a teacher in a knowledge building classroom means accepting a view that expertise is distributed within the community, and teachers are equal participants as students in the community. It is important to note that this is not to say that teacher roles are not important in knowledge building classrooms.

Instead, this is to emphasise the changed roles of teachers as facilitators, partners, and participants of learning process. Through this symmetric structure, teachers can advance their state of knowledge as students do.

9. Pervasive Knowledge Building

Students are spending significant time out of schools. One study indicated that students spend only 14 percent of their time in school (Bransford, Brown, & Cocking, 2000). Hence, if the focus of learning is solely on the hours that students spend in school contexts, we may overlook the significant opportunities of learning in other contexts. The same principle applies to knowledge building classrooms. Students are building knowledge across physical contexts and time scales, implying that teachers need to scaffold students to be engaged in pervasive knowledge building practices. Here, the use of web technologies and mobile devices/application affords ways to link knowledge building beyond the boundaries of classrooms (So, Seow, & Looi, 2009).

10. Constructive Uses of Authoritative Sources

In essence, the premise of a knowledge building pedagogy is that authentic creative knowledge work can take place in school settings. However, it may be unrealistic to expect students to create novel ideas unknown in the society like what scientists, engineers, and designers do. Students as knowledge creators can be understood students becoming more aware of what they know and what needs to be known, and seeking new information and authoritative resources such as books, websites, or experiments for better understanding. The constructive use of authoritative sources does not mean that students need to accept authoritative statements. Instead, this principle emphasises fostering student abilities to judge the quality, validity, and credibility of abundant knowledge sources in the society, and even challenge authoritative statements and accepted facts when questions arise. Then, authoritative sources are not

viewed as end knowledge, but as tools to facilitate further idea generation and improvement toward better community knowledge.

## 11. Knowledge Building Discourse

Discourse is a fundamental form of learning that reveals how knowledge building is enacted and embodied by a community of learners. Knowledge building discourse can be defined by progressing mutual understanding rather than simply producing descriptive information for others to agree or disagree with (Scardamalia & Bereiter, 2006). Comparison and contrast among various terms like knowledge sharing, knowledge construction, and knowledge creation by van Aalst (2009) would be useful to understand the meaning of knowledge building discourse. He defines that knowledge sharing is transmission of information between people while knowledge construction is a cognitive process where individual students are engaged to construct understanding of ideas, concepts, principles, etc. He further differentiates knowledge construction and knowledge creation by emphasising the aspect of community discourse. That is, in knowledge construction, knowledge is residing in the mind of individuals whereas in knowledge creation, cultural artifacts shared by a community of members mediate the advancement of knowledge. To put simply, knowledge building discourse goes beyond idea sharing, argumentation, and debate at an individual level.

## 12. Embedded, Concurrent and Transformative Assessment

Assessment is a challenging issue in promoting collaborative learning practices. Often times, students are engaged in collaborative group work, but their assessment is done individually. This creates conflicts between the mode of learning and the mode of assessment. For instance, a teacher may use an online forum for collaborative discussion, but the evaluation of student understanding is performed individually. A useful distinction to conceptualise the new assessment approach in knowledge building classrooms is assessment of learning and assessment for learning (Black & William, 1998). While assessment of learning means assessing current states of understanding, the focus of assessment for learning is to scaffold students for improving understanding. Assessment can also be embedded in the day-to-day life of students instead of being captured in a summative manner.

To add value to the 12 knowledge building principles that foster the formation of a knowledge building community, we re-categorised them in tandem with affordances of technology discussed earlier in this monograph. Our goal of doing so is to explicitly establish linkages between ICT and the processes of collaborative learning. That said, we add that it does not mean the mere employment of ICT affordances would make learning collaborative knowledge building. For analysing learning as collaboration, see the section below that discusses assessment issues.

Table 2: Link between ICT affordance and 12 Knowledge Building Principles

| ICT Affordances | Knowledge Building Principles | Rationale |
|---|---|---|
| 1. Possibilities for Actions | • Improvable Ideas<br>• Idea Diversity<br>• Pervasive Knowledge Building<br>• Democratising Knowledge | First actions mediated by digital media are externalised thoughts. Therein provides concrete artefacts for improvement and diversity. Second, in an online environment, given equity access, students are free to voice their ideas towards democratic pervasive knowledge building |

| | | |
|---|---|---|
| 2. Referential Capabilities | • Embedded, Concurrent and Transformative Assessment<br>• Rise above | ICT affords a trail of thinking across time, thereby enabling in-situ embedded assessment and rise above of ideas drawing on previously externalised thoughts. |
| 3. Mobility of digital inscriptions | • Real Ideas, Authentic Problems<br>• Knowledge Building Discourse<br>• Constructive Uses of Authoritative Sources | Ease of digital inscriptions allow for easy establishment of real issues/authentic problems as well as authoritative voices (from authoritative sources). At the same time, it facilitates inter-team, inter-textual sharing and communication. |
| 4. Promotes Patterns of Participation | • Symmetric Knowledge Advance<br>• Epistemic Agency<br>• Community Knowledge, Collective Responsibility | Students playing different role positions lend expertise to be distributed, and symmetric knowledge advancement can occur given knowledge exchange. Such knowledge exchange can occur in various epistemic role positions e.g., as a cynic in one forum and a proposer in another. |

## Micro Instructional Strategies

### *Teacher Facilitation*

At the initial stage of collaborative group learning in the classrooms, teachers have to take a more active role in fostering collaborative learning. This can be done through careful design of learning tasks, group composition and perhaps explicit teaching of group processes. In particular, we list the following areas teachers can consider when planning for learning in collaborative settings:

- Create multiple and appropriate opportunities to generate and promote collaboration among students
- Design learning experiences that require positive interdependence among students.

- Develop students' communication skills and interpersonal skills
- Provide conflict management strategies on resolving diverse or conflicting views
- Use various assessment methods to assess both individual and group learning and performance
- Provide feedback on individual and group learning, and performance

### *Explicit teaching of communication and interpersonal skills*

For collaborative learning to happen, the initiation into productive talks is essential. This would involve first establishing a safe environment for students to voice their perspectives. Also, teachers need to model socially appropriate and cognitively stimulating talks for students to emulate. Through extended period of such modelling, students would internalise the pattern of discourse and hence the ways of thinking (Vygotsky, 1978). Below is an episode of interaction between a teacher and her students that illustrates how a teacher can establish a conducive and interactive environment for meaning making (adapted from Mercer, 2008b).

Teacher: We will next move to the computer labs. Before we go, can anyone tell me what do we need to ensure before we embark on the activity? Kai Seng?

Kai Seng: We need to agree on our plan.

Teacher: Good. We need group consensus. This is one area we have agreed to help us work better in a group. What else do we need? What questions can we ask?

Hock Jia: What is your idea?

Teacher: Great. And?

Choon Hua: What is your view? Why do you think so?

Teacher: Bravo. Any other good practice we need to observe?

Kiat Ru: Everybody has a chance to share his ideas?

Teacher: Oh yes. And what do we do when we disagree?

Choon Hua: We give reasons.

Hock Jia: Provide evidence.

### *Transition from Cooperative to Collaborative Learning*

If cooperative learning is first used to structure student learning in group settings, it is important to plan at the onset how to fade structures of cooperation to promote collaboration. In the Structuring Activities Guide (See Appendix A), we suggest how this could be done along several instructional events, namely Topic Selection, Learning Processes, Identification of Resources and Outcomes of Learning. In this Guide, we also include descriptors of self-directed learning to show how aspects of self-directed learning have implications for the design of learning tasks.

This guide could be used by first identifying the level (i.e. level 1, 2 or 3) students are currently in, using General Definitions. Next, depending on the assessment, teachers could then move students towards level 3 by structuring activities that is at the subsequent level. For instance, a class could be assessed at level 1 of the Group processes and management based on the given general definition. A teacher could then draw on the scaffolding strategies of the various instructional events outlined in level 2 in a bid to promote collaboration among students. Given increased exposure to collaborative activities, students have opportunities to hone their collaboration skills and be better at it.

### *Promote Interaction*

Given that the process of learning is mediated through language, teachers should promote the externalisation of thought and interaction with others. When learners articulate their developing knowledge, they learn more effectively

(Bransford, Brown & Cocking, 2000). In other words, articulation and externalisation of thinking and learning go hand-in-hand. This is in contrast with a more traditional notion of learning where articulation of learning only proceeds after a learner has acquired knowledge.

Meaning in interaction cannot be neatly attributed to an individual learner or a single articulation. It is a joint accomplishment in collaborative settings, and the accomplishment process is a complex one. Often, it entails referencing previous interaction in the current social situation with the prospective goal the group has in mind (Sawyer, 2006). Such a process can be facilitated by ICT that keeps a repository of interaction such as discussion forum or Wikis. As students work together on a chosen digital media, the following interaction rules (Mercer, 2004, p.2) could be used to guide their talk:

- Seek contributions from all group members, ensuring that everyone has a chance to speak
- Actively listen and stay involved
- Be positive and open to new ideas
- Question others about their ideas
- Respect and value other people's opinions and feelings
- Explain your ideas concisely but clearly
- Give clear reasons for your opinions, and expect them from others
- Challenge and discuss points if you disagree
- In case of alternative proposals, decide together which is supported by the best reasons
- Keep to the subject
- Be ready to compromise and reach agreement if possible

### *Establish meaningful integration of ICT*

In terms of student-teacher-computer interaction, we need to consider how computers are used in classrooms and how students and teachers interact with each other through the computers. For example, we could provide one computer to each student, or require the students to share a computer. If a group of students are assigned to a computer, we may need to establish some rules for students to perform different role positions.

We also need to consider how to weave the face-to-face instructions with online collaboration. It might be contrived to force students to talk through computers in a face-to-face setting without good reasons for the online collaboration. On the other hand, with a good strategy in place, online collaborative during face-to-face settings could increase degree of collaboration. For example, Knowledge Forum allows students to key in a group note in class. The groups should be given time to capture the key points of their face-to-face discussion and post an online message before the lesson ends. After curriculum hours, the students could then contribute individual notes by building on the group note. It is also important that the teacher refers to the online discussion content in a face-to-face setting so that the students know that online collaboration is an integral part of the lesson rather than a nice-to-have activity.

# 5 Analysing Students' Collaborative Learning

In any form of learning, educators generally seek three forms of change to signify that learning has taken place: attitude, skills, and knowledge. In the case of collaborative learning with/without ICT, we consider students' attitude towards collaborative learning; the social skills involving meaning negotiation and the quality of thinking embedded in the talk; and the quality of the knowledge and solutions constructed through talks would be of interest to teachers for the purpose of both formative and summative assessment. However, before we suggest some possible means which teachers could employ to further understand the quality of collaborative learning among their students, a set of indicators that signify successful group practices are provided first. Our review of the collaborative learning literature shows that successful groups manifest the following indicators (Dillenbourg, 1999; Johnson & Johnson, 2009):

*Group Indicators*

- Establishment of common goals
- Negotiation and reaching consensus about group members' roles and responsibilities
- Group members accept individual responsibility towards the group's goals
- Group members rely on each other for success (Positive interdependence)
- High interactivity and negotiability
- Mature group processing

*Individual Student Indicators*

- Able to negotiate and set common goals
- Contribute own ideas clearly and consider other points of view objectively
- Ask questions to clarify and offer constructive feedback
- Take on different roles and tasks within the group to achieve group goals
- Work towards completing individual's assigned tasks as well as help group members achieve group goals
- Reflect on group and individual learning processes

The manifestation of students' indicators signifies that positive learning has taken place. Several pedagogical benefits that are related to these indicators have been reported. They include improvement of communication skills, team process skills, critical thinking skills, and possible contribution to self-directed learning skills. Collaborative group work can also foster better social integration among students and enhance retention (Summers et al., 2005). As such, analysing and assessing students' collaborative learning is an important task for teachers. Below we introduce some means that have been employed by researchers to understand students' collaborative learning. Given that action research is becoming a common way for schools to embark on bottom-up school improvement efforts, these means may be used in action research to provide some evidences about the values of the changes introduced. We also suggest that school can collaborate with researchers when conducting action research so as to acquire the competencies of collecting and interpreting scientific evidences for school improvement. Some of the means such as surveys, observation, analysis of talks, and portfolio assessment are introduced below.

*Surveying Students' Perception towards Collaborative Learning*

Surveying students' perception towards collaborative learning is a means to understand their attitude towards the learning strategies. Shell et al. (2005) constructed a survey labelled as *Student Perception of Classroom Knowledge-Building* (SPOCK) and studied the two high schools students' perceptions about strategic and collaborative learning. The results indicate that students' perceptions are associated with their academic achievements. This may be a suitable survey for the Singapore context. We have chosen 3 out 6 subscales from the SPOCK instrument. There are here labelled as the *knowledge building focus*, the *teacher directed classroom*, and the *collaborative learning*. The first subscale represents students' perception about learning for meaningful personal understanding. The second subscale measures students' perception of the degree of teacher directness in the classroom. The third subscale measures students' perception about the collaborative learning. A five-point Likert scales with 1 representing Almost Never and 5 representing Almost Always were employed. We performed a principal axis factoring of the items with 175 secondary students. After deleting items with loading lesser than 0.5, the final items are listed below.

Table 3: Principle Axis Factoring of Subscales of Knowledge Building Focus, Teacher Directed Classroom and Collaborative Learning

| Dimensions | Items | Factor | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Knowledge Building Focus (α=.86) | In this class, I try to fully explore the new information I am learning. | .740 | | |
| | In this class, I try to go beyond just what we are given in the lectures and text. | .728 | | |
| | In this class, I focus on those topics that are personally meaningful to me. | .714 | | |
| | In this class, I explore topics that interest me. | .706 | | |
| | In this class, I focus on developing my own understanding of the important ideas in what I am studying or reading. | .703 | | |

| | | | |
|---|---|---|---|
| Teacher Directed Classroom (α=.78) | In this class, the instructor tells us what the important information is. | .817 | |
| | In this class, the instructor gives us specific instructions on what we are to do. | .816 | |
| | In this class, I spend most of my time listening to the instructor. | .528 | |
| Collaborative Learning (α=.83) | In this class, my classmates and I actively work together to learn new things. | | .967 |
| | In this class, my classmates and I actively share ideas. | | .628 |
| | In this class, my classmates and I actively work together to help each other understand the material. | | .514 |

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

Rotation converged in 6 iterations.

There are a number of surveys available from research for the purpose of surveying students' collaborative learning. We are suggesting the SPOCK instrument above as a starting point, and schools may choose other instruments available. When students' aggregated scores for the collaborative learning and knowledge building dimensions are high and the scores for teacher directed classrooms dimension is low, it may indicate progress towards the formation of a collaborative learning culture.

*Observing Students' Behaviour during Group Work*

Observing how students interact to construct knowledge would be another important means for the building of comprehensive understanding about the types of collaborative learning that are occurring in schools. In this regard, the classroom observation record form created by Tan et al. (2010) could be of use. Appendix B is designed with additional space for the observer to indicate and provide details on whether and how the indicators mentioned in earlier sections are enacted.

*Analysing Students' Talk*

Collaborative learning is mediated by students' talk or discourse, be it face-to-face or in an online environment. It is therefore important to understand how students talk for the purpose of co-constructing knowledge. Mercer (2008a) identified three types of talk that could be observed when students work in group. The first type is labelled as disputational talk. The characteristics are such that the talks are constituted by short articulation in the form of assertions without much explanation of why an assertion is being put forth. The pre-intervention talk below is an example of such talk in the context of problem solving.

*Pre-intervention Talk*

Tess: It's that.
Graham: It's that, 2 *(referring to the second figure in the set).*
Tess: 2 is there.
Graham: It's 2.
Tess: 2 is there Graham.
Graham: It's 2.
Tess: 2 is there.
Graham: What number do you want then?
Tess: It's that because there ain't two of them.
Graham: It's number 2, look one, two.
Tess: I can count, are we all in agree on it?
*(Suzie rings number 2 – an incorrect choice – on the answer sheet)*
Suzie: No.
Graham: Oh, after she's circled it!

After going through training on *thinking together* (see Mercer & Littleton, 2007), the students are able to talk with reasons and explanations more

spontaneously as shown in the post-intervention talk. This leads to better performance in collaborative problem-solving task.

*Post-intervention Talk*

Suzie: D9 now, that's a bit complicated it's got to be.

Graham: A line like that, a line like that and it ain't got a line with that.

Tess: It's got to be that one.

Graham: It's going to be that don't you think? Because look all the rest have got a line like that and like that, I think it's going to be that because

Tess: I think it's number 6.

Suzie: No I think it's number 1.

Graham: Wait no, we've got number 6, wait stop, do you agree that it's number 1? Because look that one there is blank, that one there has got them, that one there has to be number 1, because that is the one like that. Yes. Do you agree?

*(Tess nods in agreement)*

Suzie: D9 number 1.

*(Suzie writes number 1, which is the correct answer)*

(Mercer, 2008a, p. 97)

As schools employ discussion forums and other Web 2.0 tools more frequently, students' online interaction recorded in the servers become another valuable source of data. Applying content analysis schemes such as the interaction analysis model (Gunawardena, Lowe, & Anderson, 1997; Chai & Tan, 2009) could help teachers to see if students are co-constructing knowledge online. Again, this

is just one of the schemes that the authors are familiar with. Comprehensive reviews of content analysis schemes are available in current literature (for example, see Tan, So & Chai, in press). To apply these schemes, substantial training is needed. We therefore suggest that professional development is necessary before schools should embark on analysing students' talk.

*Assessing Process and Products through Portfolio Assessment*

Assessing students' performance in learning is not just the prerogative of the teachers. In fact, the most important persons who need to understand their performances are the students themselves. We believe that the portfolio assessment is one possible means for students to document and assess their progress and to showcase their products. Van Aalst and Chan (2007) reported three case studies where they or the teachers designed portfolio assessment requirements which are tied to the principles of collaborative learning. For example, students are required to identify how their online posts can be considered as demonstrating the principle that they are identifying knowledge gaps and asking productive questions. Students are also required to identify their contributions towards the community growth in understanding. These processes of portfolio building engage students in reflecting about their work in relation to the community's progress. The portfolio also documents deep learning achieved through online discourse.

# Conclusion

On the whole, the use of ICT to support collaborative group learning has yet to be a common phenomenon in today's classrooms (e.g., Becta, 2007). A teacher needs to build the culture of collaborative learning, both online and offline over an extended period of time. Building a collaborative classroom culture is an ongoing process, and requires continual effort. Some strategies include: praising a group for their collaborative effort, demonstrating how different ideas can be combined to build a better idea, assessing the students based on group effort, and showing students how they have progressed as a group over time. Sustained period of professional development is also necessary for teachers to develop the competencies needed for computer-supported community-based learning (Chai & Tan, 2009).

To inculcate collaborative learning is culture shifting work. It has to be done on a long-term basis because essentially it entails changing students' dispositions in learning. Collaborative learning offers many opportunities for students to acquire important knowledge and skills. Given the context of joint problem solving, students naturally are required to engage in explaining one's thought, seeking clarification, helping each other and performing mutual regulation. These activities activate a list of cognitive functions such as knowledge activation, externalisation, regulation and internalisation (Hron & Friedrich, 2003). When teachers are willing and able to guide, engage and encourage students to learn collaboratively, they open up ways for students to gain access to many useful ways of thinking and using language (Mercer, 2004). It is therefore important for teachers to develop collaborative learning as a core component of their pedagogical skills.

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## *Appendix A: Structuring Activities for Transiting from Cooperative to Collaborative Learning*

| | **General Definitions** | | **Specific Instructional Elements** | | | |
|---|---|---|---|---|---|---|
| | ***Group:** processes & management* | ***Individual:** self-direction of learning* | *Topic Selection* | *Learning Processes* | *Identification of Resources* | *Outcomes of Learning* |
| **Level 1** *(Structuring for lowest level of SDL & CoL; most structured levels of scaffolding)* | Teacher will group according to Jigsaw method, determine roles and tasks for each group member, direct all instructional activities, monitor the group, etc. Students' roles are primarily to follow directions and participate in the group activities. | Teachers direct all individual learning activities, and students' are expected to follow directions. Progress and individual contributions are monitored by the teacher. Teachers help students to stay on-task, to try harder, and to contribute more. | Teacher assigns topics for expert and home groups in the Jigsaw setting. | Teacher provides very detailed directions describing what the students are to "hand in". Teacher communicates expectation for what the students should deliver, and can show model answers or outcomes. | The list of resources is fixed by the teacher. Students engage with the same materials and resources with minimal variation. | Teacher provides basic "fill-in-the-blank" templates, and discusses required formats and criteria. The teacher shows lots of examples. |
| **Level 2** | Teacher sets guidelines for group formation and division of labour, students form their own groups accordingly. After establishing the basics students decide for themselves task management, task allocation, consulting with the teacher when problems arise. The teacher closely monitors the groups' processes and progress, but refrains from "hand-holding". | Students can identify or reflect on their own learning and identify gaps, and how they are contributing to group activities. Teachers and peer leaders to play key roles to help each student to meet their learning needs, and to encourage sharing, communication and participation. | Teacher presents a limited list of possible topics/ questions/ problems. Students select from the list, or perhaps vote on the topic. Teacher might facilitate a brainstorming activity to generate lists of possible topics/ questions/ problems. | Students will decide what the final deliverable will be, but based on general guidelines from the teacher. The teacher also tries to trigger ideas, and/or to encourage creativity or unique responses. Students might make their choices based on a limited set of options given by the teacher. | A starter list of resources is given, but students are encouraged to find their own, as well. The teacher might suggest search strategies or how to "filter" information. | Teacher lays out the various communication or production requirements, but students will agree among themselves who will be responsible for what. Students can explain why the various duties were allocated the way they were. |
| **Level 3** *(Structuring for highest level of SDL & CoL; least structured levels of scaffolding)* | Groups are expected to form on their own, manage their own progress, divide up labours, establish milestones, monitor progress, and troubleshoot problems. Teachers act as stimulators, coaches, facilitators and consultants, not as managers. | Students identify their own strengths and weaknesses and learning gaps for the task, and devise strategies to bridge the gaps and monitor learning progress. Teachers act as facilitators and consultants, not as managers. | Students have a free-choice of topics/ questions/ problems according to their own decision-making process (voting, consensus, etc.). | Students set their own agenda for what they want to achieve or deliver, but will seek experts' help when necessary. The teacher consults and encourages, but refrains from showing "model answers or projects". | Students are to locate, select, and filter resources relevant to the learning task. | The final presentation and communication are organised, allocated and managed by the team. Both team and individual elements are highly productive and functional. |

***Appendix B: Lesson Observation Record Form***

| Name of Observer: | **Lesson Observation Record for Collaborative Learning with/without ICT** | | | |
|---|---|---|---|---|
| Name of teacher | | Subject | | |
| School/JC/Institute | | Class | | |
| Date & Time | | Lesson/Unit | | |

Open-ended Observation Record (Describe the major events of lesson observed chronologically)

**TEACHER COMPONENTS**

| **CONSTRUCTS** | | **Indicators (Checked observed indicators)** | | **Comments (Explain and support the observed indicators)** |
|---|---|---|---|---|
| 1. | Structures for Collaboration among Students | • Creates multiple and appropriate platforms and networks to generate and promote collaborative work among students (e.g. selects appropriate ICT tools to support collaborative learning activities for appropriate topics) | ( ) | |
| 2. | Structures for Effective Group Processes | • Develops students' communication skills and interpersonal skills (e.g. provides appropriate scaffolds for students to discuss their ideas as a group) | ( ) | |

| | | | | |
|---|---|---|---|---|
| | | • Provides conflict management strategies on resolving diverse or conflicting views | ( ) | |
| 3. | Assessment of individual and group learning | • Uses various assessment methods/modes to assess both individuals and group learning<br>• Provides feedback on individual learning and group learning | ( )<br>( ) | |
| *Additional Comments:* | | | | |
| | | | | |
| **STUDENTS' COMPONENTS** | | | | |
| **CONSTRUCTS** | | **Indicators (Checked observed indicators)** | | **Comments (Explain and support the observed indicators)** |
| 1 | Effective group processes | • Negotiates common goals for the group<br>• Communicates own ideas clearly, listens respectfully and considers other points of view objectively<br>• Asks appropriate questions to clarify and offers constructive feedback<br>• Takes on different roles and tasks within the | ( )<br>( )<br>( )<br>( ) | |

| | | | | |
|---|---|---|---|---|
| | | • Reflects on the group and individual learning processes | ( ) | |
| 2 | Ability to assume responsibilities in group and individual context | • Works towards achieving group goals rather than to complete individual's assigned tasks (e.g. completes assigned duties or helps resolve group conflicts and overcome difficulties) | ( ) | |
| *Additional Comments:* | | | | |
| | | | | |


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