Effective technology to support cooperative learning in a virtual learning environment

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Structured abstract

BACKGROUND
The ability to work collaboratively is a sought after graduate attribute and is also of considerable value to the depth of learning experience itself. However, the skills to be an effective collaborator take practise and experience in cooperative task situations under effective guidance. The online environment can be a difficult environment in which to learn such teamwork skills, particularly where inappropriate technology prevents meaningful interactions and contributions. This paper is presented as a basis and methodology for planned future hardware trials which seek to improve student outcomes from group work in online settings.

PURPOSE
The purpose of this study is to investigate existing limitations to the delivery of cooperative learning tasks in order to identify appropriate technology and support strategies to facilitate its effective implementation in the online environment.

DESIGN/METHOD
A literature review was undertaken to establish known difficulties of existing cooperative learning implementation in traditional and online educational settings. The study has also included a review of various technologies used to facilitate group and team work in the learning and corporate environments. The findings of this study have been used to propose future trials which modify the way cooperative learning is offered in a number of online tutorials at Deakin University.

RESULTS
The literature review has revealed that appropriate technologies exist to facilitate some of the small group cooperative learning tasks that we wish to undertake in our online engineering classes. We suspect that with a few critical changes, such as accessibility to the correct hardware, we will enable significant improvement in the learning outcomes of our online students.

To this end, it is expected that a future trial of USB headset and tablet technology will reveal that significant improvements can be made to the cooperative engagement of students in small group work. We hope to facilitate the development of cooperative learning skills in order to enable students to extend into higher order thinking and more complex collaborative tasks.

CONCLUSIONS
Cooperative learning is an important formative step in the attainment of strong teamwork skills. We expect more meaningful interactions amongst students in classes and in small group work in these virtual learning environments, facilitated by the proposed access improvements to audio and tablet technology. We expect that this will thereby enhance the learning experience and allow students to develop valuable teamwork skills.

KEYWORDS
Cooperative learning, technology, online

Introduction

Cooperative learning is an established pedagogical strategy which utilises interdependency to promote learning via active engagement (Felder & Brent, 2013). It allows students to build their team working skills, learn about group dynamics and build an awareness of interdependency and accountability (Furlotte, 2013). These experiences allow students to be more successful in open-ended collaborative knowledge building tasks as well as in the types of team situations which they are likely to experience in their engineering careers.

It is noted that cooperative learning and collaborative learning are often interchanged as terms of reference. This paper adopts the term cooperative learning with reference to the structured, teacher centred, interdependent pedagogy where individuals work in small teams to reach a common pre-determined answer or goal (Felder & Brent, 2013). The term collaboration is taken to refer to the process of individuals engaging in work as part of a group to "…create new knowledge… [and to] think about and solve abstract problems…" (Furlotte, 2013). The emphasis here is placed on the higher level of cognition required to create new knowledge in a collaborative activity (Krause, et. al., 2007)).

As part of ongoing course developments, the authors sought to investigate whether improvements in cooperative learning outcomes for online students might be feasible. The study is therefore focused on investigating existing limitations to the delivery of cooperative learning tasks, with the goal being to identify appropriate technology and support strategies to facilitate effective implementation of cooperative learning tasks in the online environment.

In part, we are testing the hypothesis that it is technology which is holding the students back from effective collaboration in the online environment. We are thereby also testing the theory that the converse was true, that it was not technology that was limiting cooperative learning, but the way we are using it.

A literature review has been undertaken to establish known difficulties of existing cooperative learning implementation in traditional and online settings. The literature review includes a review of various technology tools which have been used to implement or support cooperative and collaborative learning environments, while also looking at teamwork and remote office experiences in the business sector.

Context

Collaborative, project based working experiences in tertiary education are often designed to provide parallels to typical team-based engineering work environments. Experience in these working situations has been widely recognised as of direct benefit to developing work-ready engineers (eg. Lantada, 2013).

Workplace situations often require collaborative tasks - in the form of meetings for instance - where engineers pool their knowledge about their respective areas of expertise in order to review, trouble shoot and improve the overall product and satisfy the project objectives. This collaborative work is typically of an iterative nature, in that the collaborative tasks are typically interspersed with periods of individual work. It might be rare for an engineer to need to create a written piece in a true collaborative space in the workplace, for example by using a Wiki. However, the same engineer would regularly draft or prepare sections of work individually, for review and discussion with colleagues to identify potential improvements or modifications. So the skills to be able to collaborate, to work and think as part of a team and to interact effectively with colleagues is important to preparing work-ready graduate engineers.

However, we find that the potential for developing these skills via collaborative learning work is often lost in later years of study, due to tasks being divided and completed individually, with little work undertaken together as a team. The authors have observed this is particularly noticeable for off-campus students in groups.

Whilst division of group workload has significant parallels with teamwork situations in industry, we believe that the potential benefits of collaboration are being lost. We propose that this is due primarily to a lack of appropriate tools and tool skills and the ability to work effectively in teams. It will also be shown in this paper that successful collaboration on project based work cannot be expected of students without prior attainment of a certain basic skillset in teamwork and that cooperative learning is the perfect environment in which to develop such skills. It will also be proposed in this paper that with the right tools and support, cooperative learning can be effectively implemented in the online context and can strengthen the learning outcomes for engineering students.

Synopsis of Literature Review

Cooperative learning goes well beyond the concept of working in groups. It requires a structured, teacher led environment where individuals work in small groups and must rely on each other to complete challenging activities (Felder & Brent, 2013).

Limitations to effective cooperative learning

Fostering effective cooperative learning can be challenging though, even in traditional settings due to a wide variety of reasons (Hutchinson, 2007). We will focus on a few of these issues herein, namely team cohesion and teamwork skills, particularly where they relate to the online facilitation of cooperative learning. We will demonstrate that these issues are of particular importance to effective cooperative learning in the online environment. The importance of a number of associated topics will also be discussed, including access to appropriate tools for the job, the skills and incentive to use these tools and of course, the provision of guidance and support.

The literature reviewed to date has indicated that the effectiveness of cooperative learning in the traditional setting is heavily linked with team cohesion and the teamwork skills possessed by the team members. We will now discuss these items in more detail.

Teamwork skills

One of the most commonly encountered limitations to cooperative learning in the traditional context is the lack of teamwork and communication skills (Felder, 2012). Communication skills include the ability to make clear and courteous statements, explanations and requests, provide constructive critiques and feedback and the ability to listen attentively and question. While teamwork skills include the ability to value the inputs of others including alternative viewpoints and methodologies, to fairly allocate and coordinate work, to be accountable, to use meeting tools (such as agendas and minutes for instance) and a knowledge of conflict resolution procedures is often pretty useful too!

Many of the teamwork and communication skills mentioned above can be learned over time through experience in teams, particularly where supervision and guidance are available. Equipping students to work in pairs and small groups on small complex tasks in tutorials is thus a valuable first step in this progression of skills. This step lends itself particularly well to the engineering student, where developing an understanding of specific engineering concepts is required for Unit success (incentive) and the complexity of the task is such that the benefits of cooperative work become immediately clear to the students (value). These methods are not particularly new and have been employed with success in traditional engineering contexts (Felder, & Brent, 2013). However, there are clearly some significant difficulties in facilitating these interactions in the online environment, and we will discuss these difficulties and our proposed solutions further in the following sections.

It should also be noted that some teamwork skills (such as conflict resolution, for instance) often need to be explicitly taught. The teaching of teamwork and communication skills can be time consuming (Skinner, 2012), however these skills play an increasingly important role for students as they undertake more complex projects within more demanding schedules in later years of study. Web based software is available which teaches these concepts though. For example, CATME (Felder, 2012), which offers a tool to facilitate structured group formation

and peer assessment, in addition to inbuilt educational modules which offer tuition in some of the important teamwork skills. Utilisation of such pre-prepared tuition tools as integrated components of a unit would allow these important skills to be taught whilst also preserving teaching time for technical concepts.

Team cohesion

Team cohesion is used here to refer to the relationships between team members which enable effective communication and allow the development of trust and interdependency in the group. Social interaction is important to the development of relationships and group culture among team members, and it has been demonstrated that teams who exhibit a high degree of cohesion typically produce higher standard artefacts (Venkatesh & Windeler, 2012). Facilitating social interactions early among the team is therefore important to the team's success.

A lack of team cohesion is fairly common in the online setting though, due in part to the limitations imposed by the particular form of communication adopted. In their 2012 article on collaboration using virtual world technology, Venkatesh and Windeler have shown the importance of visual cues in establishing interpersonal relationships. The means of communication we commonly adopt within online learning environments though are limited visually and do not have the capacity to transfer this important subliminal information between individuals. Asynchronous communications such as email often tend to be time consuming and lack tone, whereas general discussion boards tend to be disjointed and divergent, making convergence of ideas to build new knowledge difficult at best (Ioannou & Georgiou, 2012). Synchronous communications such as live text chat spaces are more helpful, in that feedback is relatively quick and communications thus tend towards continuous discussion. Live audio is better again, while video and virtual world characters can improve communications even further by facilitating the visual cues we use in traditional face-to-face communication (Venkatesh & Windeler, 2012).

The forms of communication we adopt in our online learning environments are therefore clearly important to how we interact with each other and thus to the success of our teamwork interactions. We seek communications which are as closely matched to real face-to-face interactions as possible so that our online students can experience the same benefits from teamwork as those students in traditional settings.

Discussion

Our research and experience has confirmed that there are already some great technologies out there to support our efforts in online education, from tablets to webcams and webinar software. Many of these tools have been made available to us at Deakin University, however we are finding that even when the right tools are available, they may not be adopted by our students or even by our staff! There are myriad reasons why the uptake of these tools might not be as popular as expected. For instance, the user may not be familiar with the tool, or not confident enough with computers in general. They may feel that they are too short on time to try to learn a new skill or they may already have an existing method of doing a similar task which allows them to get by. For students in particular, there is also the question of access to these tools. More often than not, our students are working on equipment without tablet or webcam capability or without access to the required software or appropriate internet connection speed. Any of these issues might be enough to prevent active online participation and engagement in real-time cooperative activities. We will now look at some of these items in a little more detail.

Access

One observation made by the authors during recent online tutorials is the recurring issue of difficulties with incorrect audio hardware. Weekly tutorials in a structural analysis unit are run using a program called Elluminate Live (which we refer to at Deakin University as eLive). eLive allows us to run up to 6 webcams and / or microphones simultaneously, and we

encourage students to leave their microphones on to encourage discussions throughout the class. However, we have found that without the correct equipment, we get too much feedback and background noise. This means that students need to turn their microphones off for most of class, which then affects the flow of the class and the level of discussion and participation.

Another observation made during these online tutorials is the limited participation of students who do not have access to tablet technology. By tablet technology, we refer to touch screens which facilitate hand written interaction and freehand sketching. Much of the content of these tutorial sessions is devoted to working through engineering problems. The tutor uses a tablet PC and the OneNote ® program (Microsoft, 2010) to solve these problems live on the screen using freehand equations and diagrams. These live solutions are appreciated by the students, but the authors feel that the experience could be even more valuable if students were able to write on the screen too. eLive also allows us to separate students into small groups in a private space called a 'break-out room' which has its own whiteboard. So, ideally, the students could assist in formulating the solution either in the main online space or as part of a small group in a break-out room. The authors believe that this is where cooperative learning could really come to the fore.

Experience

Even the most appropriate technology can be ineffective without buy-in from the user. Users might be too busy to invest the time or perhaps not confident enough with technology to take the risk of learning a new tool (Venkatesh & Windeler, 2012). These users need to perceive the value of the tool before they invest time to try it, but overcoming these perception issues can prove to be difficult. The authors suspect that this may be contributing to the limited uptake of eLive among staff in the Faculty of Science, Engineering and Built Environment (SEBE) at Deakin University.

eLive was introduced across the University in 2005, and – on the upside – has been employed in some innovative and valuable ways. Worth mentioning is the use of the program within the SEBE Faculty for peer teaching and student presentation sessions, which has somewhat levelled the playing field between on and off campus students in the units in which it has been implemented. It is, however, the remaining number of units which do not use the software which is of concern, with some Unit Chairs still opting out of the eLive experience altogether.

Voluntary training sessions have been employed over the last few years with some success and a recent initiative which makes eLive sessions a requirement for every unit across the faculty is expected to complete the transition. The training sessions run online and are run by people who use eLive within the faculty. The sessions are typically held within the eLive space, so that new users get some experience in the online meeting environment. This format also allows the participants to try the various functions and capabilities, and enables the facilitator to demonstrate the relative ease of use of the space.

With continued success in the existing eLive classes - particularly where it's being used in new and exciting ways - we expect that the good feedback from staff and students alike will help us change existing negative perceptions amongst the staff. We expect that with a combined approach of incentive, experience and support combined with positive, valuable learning experiences, perceptions will start to change. With time, our new experts will foster new users and the expertise and collective experience will grow and support further innovations in the use of the technology.

Recommendations

So, we suspect that although we are utilising a technology well at present, there is potential for improvement. Without the right hardware, the scope for cooperative small group activities in the online eLive environment is limited. With the right equipment, we hope to get some active, social engagement and valuable cooperative learning occurring in these online

spaces. The eLive break-out rooms (as they are known) are perfect for students to work through problems together and with the right equipment, students should be able to discuss, sketch and use hand written equations to work through problems together in small groups.

Appropriate equipment for these tutorials starts with a USB headset (which includes a microphone) and which are readily available for less than AU$30 each. We have found that the students often don't see the value in this equipment until a few weeks into trimester, and then they simply "make do" with their existing sub-standard arrangement for the rest of trimester. One of the trials we intend to carry out is the free-issue of USB headsets to a small off-campus cohort to test for an improved level of student activity during these tutorials.

Ideally, our online students would also have access to tablet technology in addition to the USB headsets. This would enable the type of interaction that is required to solve engineering and mathematical problems, such as writing equations and communicating information via freehand sketches and diagrams. With the widespread availability of android tablets has come a significant reduction in the purchase cost of tablets (Johnson et. al., 2013) so we do expect that the uptake of this type of technology will improve over time. However, we also intend to trial the roll-out of tablets to a selected cohort of students to allow a trial of small group cooperative problem solving tasks in some of our online tutorial classes.

Of course, each of these trials must be implemented within a good teaching framework in order to ensure the required scaffolding, resources, support, guidance and feedback are available and used with purpose. Specific attention must be paid to the explicit teaching of teamwork skills and to supporting and guiding team interactions and use of the technology to these ends.

Conclusion

The authors believe that technology in online learning environments should facilitate the communication of ideas and concepts in such a way that we do not notice the technology and we feel able to participate as though we were in a real space together. Appropriate technologies to facilitate some important cooperative learning tasks specific to engineering are now widely available, and it is our goal to test the relationship between the technology, teamwork and positive student outcomes.

Where implemented, the eLive tutorials have received considerable positive feedback from our off-campus students and have become a welcome substitute to the traditional tutorial classroom for this cohort. The clarity of the video and audio from these recordings, in addition to the accessibility (automatically uploaded, and easy to access via internet) has also meant that our on-campus students often use the recordings as a supplementary study tool.

We expect that the upcoming USB headset and tablet trials will significantly increase interactions within the tutorials and allow more immersive and meaningful interactions which will enable our students to work together to solve engineering and mathematical problems. These small group experiences will provide opportunities for our students to learn some valuable technical and teamwork skills and we hope that this will allow for more effective collaboration and teamwork in their future studies and careers.

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