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Research Report

Use of technology in the readiness assurance process of team based learning: Paper, automated response system, or computer based testing

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ABSTRACT

This qualitative study aimed at comparing and contrasting the feasibility, efficiency, and students' attitudes toward the use of paper, automated response system (ARS) and computer based testing (CBT) in the readiness assurance process (RAP) of team based learning (TBL). It also aimed at assessing whether the use of technology enhances cooperative learning when compared to paper. The first module of the clinical pharmacology course was conducted in the traditional way using paper. In the second and third modules, the paper-based TBL RAP component was replaced by ARS and CBT respectively. Forty-five third year medical students attended each of the three sessions. Both ARS and CBT based RAP were feasible and efficient, though with some technical constraints. The class during ARS was very interactive, but the test features had some disadvantages. The main problem with CBT was the suboptimal physical set up. When asked to rank their preferences for each method, most students (73%) ranked ARS as first, while paper and CBT almost equally ranked 2. Each method is characterized by peculiar strengths and weaknesses. Technology should be used in parallel to educational theories that support learning.

1. Introduction

The American University of Beirut Faculty of Medicine (AUBFM), similarly to other faculties, is faced with the Millennial or Net generation (Box 1) whereby technology use has become an essential part of various aspects of its members' lives across all personal, work and learning levels. Young people of the Net generation are more and more accustomed to technology driven learning and retrieval of information. They demand more interactive and constructive approaches to learning, in contrast to traditional static instructive approaches (Lynch, Whitley, Emmerling, & Brinn, 2000; Sandars & Morrison, 2007).

A panel of experts invited by the Association of American Medical Colleges (AAMC) has met and concluded that educational technologies provide various advantages in contextual and active learning. They noted that the current medical education literature has repeatedly shown, in different scenarios and settings, that both traditional and technology- driven learning methods are as effective (AAMC Institute for Improving Medical Education, 2007). In its directions for further research, the AAMC expert panel encouraged research that highlights the suitability of one technology method vs. another in a certain setting or for a certain goal (AAMC Institute for Improving Medical Education, 2007).

2. Theoretical background

2.1. Cooperative learning

Johnson, Roger and Karl defined cooperative learning as "the instructional use of small groups so that students work together to maximize their own and each other's learning" (Johnson, Roger, & Karl 2014). Cooperative learning classes create a context in which students can become engaged in stimulating real life situations. Students can master concepts and ideas that they cannot understand on their own and thus, perform better in collaborative groups (Slavin, 1990). The five pillars of cooperative learning are: (1) positive interdependence, (2) individual accountability, (3) promoting interaction, (4) group processing, and (5) social skills (Johnson et al., 2014).

In college settings, cooperative learning has both academic and social-emotional benefits (Jones & Jones, 2008). For instance, collaborative experiences were shown to promote greater social support than do competitive or individualistic experiences. This is important, since social support promotes productivity and achievement, physical health, mental health, and the ability to cope with stress and adversity (Glasgow, Cheyne, & Yerrick, 2010).

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Box 1 Definitions.

Net generation (Generation Y)
Net generation includes young people born between 1982 and 1991 that have grown up in a world surrounded by technology. Some describe them as digital natives.

Automated response system (ARS)
ARSs, known frequently as clickers, are small hand held devices used by students to anonymously choose an answer to a posted question. The questions posted by the instructor are part of a slide in Power Point presentation. After each question, a histogram is displayed showing the students' responses. A discussion for the correct answer follows with the instructor.

Learning management system (LMS)
LMSs are software applications for the delivery of e-learning. The majority of LMSs are accessed online using web browsers. Functions of LMS include posting of resources such as course syllabi and content information; discussion boards and chat rooms; blogs and wikis; and online examination tools.

Immediate feedback assessment test (IFAT) forms
These forms are self-scoring answer sheets that provide immediate feedback for the correct answer. Teams of students scratch off the covering of one of four – up to 5-boxes in search of a mark that indicates they have found the correct answer. They continue scratching until they find the correct answer, and their score is reduced with each unsuccessful scratch.

2.2. Team based learning

Team based learning (TBL) is an innovative form of cooperative learning. It is a small group learner-centered instructional activity that aims at the application of conceptual knowledge through application exercises. In contrast to classical lectures that focus on "covering content", the TBL instructional method aims at "applying knowledge" in a highly interactive setting. TBL consists of repeating sequences of 3 key components: (1) individual student pre-class preparation, (2) a readiness assurance process (RAP) that consists of individual and group readiness assurance tests (iRAT and gRAT respectively), and (3) in-class decision based application assignments (Parmelee, Michaelsen, Cook, & Hudes, 2012). Effective learning in TBL is based on key instructional principles that stress the importance of accountability and interactive discussions. The main pillars of TBL are both individual and team work and the use of immediate feedback. The latter allows for better active learning and interactivity between the students. TBL has been efficacious in improving students' satisfaction and performance as it enhances interpersonal skills, communication skills, teamwork skills, as well as giving and receiving feedback (Bou Akl et al., 2012; Zgheib, Simaan, & Sabra, 2010). For further information, please refer to a recent systematic review on TBL programs in medical schools (Burgess, McGregor, & Mellis, 2014), and a best evidence in medical education (BEME) guide on the effectiveness of TBL on learning outcomes in health professions education (Fatmi, Hartling, Hillier, Campbell, & Oswald, 2013).

2.3. The need for technology in TBL

At AUBFM, a clinical pharmacology course consisting of 7 bimonthly TBL modules is offered to third year medical students. The paper-based readiness assurance process (RAP) is often felt to be very tedious and inefficient, and may hence hinder other instructors' enthusiasm to run TBL modules especially that faculty buy-in is one of the critical factors in implementing TBL in courses and curricula (Thompson et al., 2007). Therefore technology is considered as a possible solution to the nonproductive time spent on grading. In addition, the use of technology has been found to positively impact team dynamics and knowledge acquisition. For example, the use of 3D virtual world in a large Asia online engineering education project was shown to increase the frequency and efficiency of team dynamics and facilitate tacit knowledge contribution (Zhang, Ordóñez de Pablos, & Zhang, 2012; Zhang, Ordóñez de Pablos, & Zhu, 2012). We looked for technologies that might enhance the key elements of cooperative learning, mainly accountability and immediate feedback as part of interactive discussions during the RAP of TBL.

To our knowledge little literature is currently available on the integration of technology with TBL, and no one has yet compared and contrasted the pros and cons of the different tools. For instance, Fujikura et al. and Pileggi and O'Neil implemented automated response systems (ARS) – also known as clickers – (Box 1) technology in the RAP of TBL, and showed that this instructional technology resulted in a high level of student interaction and engagement (Fujikura et al., 2013; Pileggi & O'Neill, 2008). In addition, Robinson and Walker described the use of a learning management system (LMS) (Box 1) for the reporting of complex team assignments and providing feedback on peer evaluation, as well as computer based testing (CBT) (Box 1) feature within the LMS during the RAP of TBL. They concluded that TBL is already "a great system" and that the use of technology in TBL may make few things easier (Robinson & Walker, 2009).

2.4. Choice of technology

We chose to introduce 2 technology applications – ARS and CBT – in the RAP of TBL in an attempt to improve the efficacy and interactivity of the process. Both technologies allow for proper identification of the students and thus accountability.

ARS – or clickers – have been used to increase interaction, assess preparedness or understanding of students, and perform quizzes (Caldwell, 2007). The use of ARS has been shown to improve student centered active learning, and to allow for enhanced reasoning and engagement of students (Johnson, 2005). In addition, Blasco-Arcas et al. have shown that the conceptual framework of interactivity, active collaborative learning, and engagement are the underlying forces for the positive effects and benefits of clickers in enhancing performance of students (Blasco-Arcas, Buil, Hernandez-Ortega, & Sese, 2013). ARS technology has also been used in peer instruction – another form of cooperative learning activity (Caldwell, 2007). Therefore, it seemed appropriate to try it in TBL.

As for CBT, it plays an important role in the support of both summative and formative assessment, and has been widely used in many international licensing examinations such as the United States Medical Licensing Examination (USMLE) and National Board Examinations (NBE). Advantages of e-assessment include efficiency and reliability, immediate marking, instant feedback and statistical analysis of grades (Ellaway & Masters, 2008; Peterson, Gordon, Elliott, & Kreiter, 2004). Feedback can be provided instantly to the learner and can be supplemented with suggestions and explanation of the answer (Ellaway & Masters, 2008; Ogilvie, Trusk, & Blue, 1999). Since CBT allows for the creation of specific test questions as well as random choice of questions from a bank, and since one has the option to shuffle questions and corresponding answers and hence display them in different sequences for every student, its application seemed also appropriate for TBL.