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Flipped Classrooms: Providing a Scaffolding Support System with Real-time Learning Interventions

Kumaran Rajaram

College of Business, Nanyang Business School, Nanyang Technological University (NTU)

Correspondence:

Name: Dr Kumaran Rajaram
Address: College of Business, Nanyang Business School, Nanyang Technological University, S3-B1A-04, 50 Nanyang Avenue, Singapore 639798
Email: rkumaran@ntu.edu.sg

ABSTRACT

Despite the benefits of a flipped classroom, for instructors unfamiliar with the format, it can create unease and ambiguity when they intend to structure and organise a flipped classroom with meaningful activities. This paper proposes an improvised flipped classroom framework embedded with an e-scaffolding learning support system which can be adopted in 'real-time' during class. For instructors, the framework would facilitate the development of a structured and systematic approach which would enable them to achieve their course's intended learning outcomes. The proposed framework comprises pre-class online learning and face-to-face seminars, with the goal of helping students be more engaged in their learning through collaborative activities, to think deeply and critically in the process, and be involved in peer learning. The face-to-face seminars are enhanced through technology-enabled learning interventions and are built upon the foundation of pedagogies such as active, experiential and blended learning, where collaborative and team-based learning are the focal points. Pre-class online learning takes the 'information transmission' aspect of lectures out of the classroom and students enjoy freedom and flexibility in learning. A post-course survey was carried out with 59 undergraduate business students, from which twelve were interviewed about their experience of this flipped classroom learning design and the e-scaffolding learning support system. The results indicated that the majority of students had a positive learning experience in terms of the course design enhancing levels of engagement, collaborative learning, and enabling higher levels of critical thinking. The student feedback also indicated that they would like to see more of such a course design. A comparative analysis was also carried out on student performance before versus after they had gone through the flipped learning. The findings were positive, providing validation that the flipped learning approach enables more thinking, which leads to better comprehension of course content, eventually leading to better academic performance.

INTRODUCTION

The flipped classroom model, where students prepare for class by accessing lecture-type resources beforehand, creates greater opportunities for instructors to engage students in meaningful learning activities during class than merely delivering lectures in a traditional classroom. At the same time, these opportunities come at a cost for instructors designing the classroom activities. Like a blank page which intimidates an author struggling with writer's block, being faced with hours of course time to fill with untested learning activities can be intimidating to an instructor, especially when he is accustomed to conducting lectures in the traditional format. Furthermore, instructors adopting the flipped approach would also have to take extra care in class to monitor the learning activities, and not to unintentionally marginalise students and increase their confusion.

The millennials, a term believed to be coined by Howe and Strauss (2000), refer to the generation that spans from about 1982 to 2004 (Horovitz, 2012). As the current batch of higher education undergraduate classrooms comprise of mostly millennial students, it poses different teaching challenges for instructors compared to the classrooms of Generation X and before. Karakas, Manisaligil, and Sarigollu (2015) proposed three key challenges in today's management of education. Firstly, it is managing millennial students' short attention spans during lectures and tutorials, in particular their inattentiveness due to being distracted by the prevalence of technology gadgets. Secondly, there is difficulty in keeping millennials engaged during traditional lectures and tutorials. Lastly, millennials themselves face challenges related to social isolation or alienation.

Although the theoretical antecedents of the flipped classroom are somewhat solid, substantial research questions remain unanswered, for example regarding the efficacy of flipped classrooms in relation to qualitative work into student learning and students' experiences of this approach (Abeysekera & Dawson, 2015). To address these teaching challenges and current research gaps, we developed a flipped classroom framework embedded with an e-scaffolding learning support system. Although the literature on flipped classrooms is comprehensive, there remains an explicit gap when it comes to an examination of learners' engagement levels and their perceived effectiveness of the learning process. This context will be addressed further in the next section "Theoretical Background: Flipped Classroom". There is also little research that investigates the sequential process of implementing flipped classrooms from both the in-class and out-of-class contexts. The findings of this study include the learners' collective perspectives on levels of engagement, self-learning efficacy, and their perceived effectiveness through (a) an improvised and contextualised flipped classroom framework, and (b) learning intervention through an authentically designed in-class scaffolding support system.

In the improvised framework, we clustered the activities into two parts, namely pre-class online learning and in-class activities which emphasise reflective, deep learning. In the pre-class online learning, a number of authentic interventions were introduced, namely (1) self-designed and developed animated short videos in which dry and complex content have been converted into easy to comprehend and relatable ones; (2) a brief weekly reflection journal in which learners reflect on and apply the essential takeaways of the lesson. The unique feature is the connectivity of the mini-cases in the reflection journal that shows the links between the topics. Hence, learners are able to appreciate how these weekly topics are interrelated, which allows them see beyond the standalone content and focus on the intertwined links which reside within them; (3) the self-reflective and short interactive assessment quizzes are another vital highlight that engage learners through formative feedback during the learning process. During the in-class learning activities, the focus is on the critical thinking and deep learning process achieved through peer and collaborative learning. (1) Instructors do not conduct lectures, instead students participate in an interactive dialogue session engaging instructors using a mind map of the session; (2) This is followed by interaction between the instructor and the class where they revisit the online reflection journal and engage in formative feedback; (3) The focus is geared towards the application of course content to assigned problems, which are based on real-life issues, through a process of peer and collaborative learning, with the cultivating of critical thinking and deep learning as the intended goal. To achieve the intended learning outcomes, the in-class scaffolding support system builds in a collection of varying perspectives that give students the opportunity to hone their critical and deep learning skills, and ultimately focus on the learning process, instead of focusing on the expected possible answers. Through this improvised framework which leverages on the flipped classroom philosophy and an authentically self-designed, developed scaffolding support system, our ultimate goals are: (1) to keep millennials more engaged in learning through a structured collaborative approach; (2) have them think more deeply and critically about the course content, and learn from their peers. Students are able to access the course materials outside the class, usually online, and thereafter apply the acquired knowledge with their peers during class, under the instructor's guidance. This approach draws on the theoretical foundations of pedagogical approaches such as flipped classrooms, blended learning, active learning and technology-enhanced learning. Although the framework was developed with undergraduate courses in mind, it is flexible enough to be modified and adapted by instructors in any learning context.

THEORETICAL BACKGROUND

Flipped classroom

A flipped classroom is generally defined as a swap of what is commonly done in the classroom with learning activities usually conducted outside the classroom (Lage, Platt, & Treglia, 2000). It focuses on a learner-centred environment, and involves interactive group learning activities during classroom time and online learning outside the classroom (Bishop & Verleger, 2013). The flipped classroom serves as a platform to achieve a collaborative and organic learning environment. To meet the challenges and complexities of the 21st-century workplace environment, there has been a shift and adoption of an organic learning environment in the business community. Similarly, universities and accreditation bodies in business schools are moving towards developing competency-based curricula where learners foster lifelong learning skills through a process of self-directed learning. There appears to be two common characteristics which encapsulate a flipped classroom: (a) an easily adaptable learning environment that facilitates active learning (DeLozier & Rhodes, 2017; Hamdan, McKnight, McKnight, & Arfstrom, 2013; Little, 2015), and allows students to develop different skills and competencies (Hamdan, McKnight, McKnight, & Arfstrom, 2013; Little, 2015); (b) a student-centred learning culture (Bishop & Verleger, 2013; DeLozier & Rhodes, 2017; Hamdan, McKnight, McKnight, & Arfstrom, 2013; McLaughlin *et al.*, 2013). If there is no close monitoring of the classroom learning activities, students might be inadvertently marginalised, and may experience misperceptions in the classroom. For example, they may presume that there is a lack of a clear and organised approach in the facilitation of course content, or they may not be able to appreciate the autonomy and flexibility that characterises the flipped approach, even if it is driven by clear learning outcomes. This could be challenging and stressful for an instructor to achieve the intended learning outcomes effectively. In contrast, during a traditional lecture, the instructor has control over the amount of information to be taught and delivered.

The literature on flipped classroom design is somewhat long on stories and short on efficacious evidence. In its most basic implementation, course instructors of flipped classrooms assign videos of their lectures as homework and then have students do "homework" problems in class (Mazur, 2009). In Mazur's case, he reframed his classroom time to have students answer multiple-choice questions (MCQs), and then have them discuss the questions in pairs to resolve discrepancies in their answers. In the years since the earliest implementations of the flipped approach, students have shown greater facility in answering critical reasoning questions about physics (Crouch & Mazur, 2001). However, nothing mandates that a flipped design needs to foster greater communication between students. Much to his students' dismay, Enfield (2012) assigned

video lectures and content-based quizzes prior to class to open up more time for instructor-led demonstrations during class. When you think about the fundamentals that constitute the "content coverage before class and homework during class" version of the flipped approach, what remains is an instructional model in which students use resources to prepare for class activities prior to the session so that more time would be allocated to those activities (Herried & Schiller, 2013). With this understanding, flipped classrooms offer instructors more freedom to choose how students will discuss, use, and build upon these resources as they actively think through a topic, instead of passively receiving the content. However, this freedom of choice should be tempered with limits, for having too much freedom has been shown to decrease choice satisfaction and stifle creativity (Iyengar & Lepper, 2000).

A flipped classroom design also serves as a gateway for greater student engagement (DesLauriers, Schelew & Wieman, 2011). If course designers have the time to incorporate more in-depth activities, they can integrate "high-impact" activities into the course. High-impact activities include having meaningful contact with course instructors, deep discussions with instructors and/or peers, differentiated instruction, and prolonged collaborations. These activities correlate with student self-reports of engagement (Kuh, 2003). Student engagement is then correlated with participation in public service, self-reported learning gains, increased student achievement (Carini, Kuh, & Klein, 2006), and job engagement (Busteed & Seymour, 2015).

While a course coordinator may design a curriculum using the flipped approach filled with high-impact and meaningful activities, it still falls on the shoulders of the course instructors to optimise these opportunities. Perhaps the greatest limiting agent on student learning is that not all instructors are created equal (Hattie, 2003). Just because one instructor can administer high-impact activities successfully does not mean a replacement instructor can deliver the same results. Much of an instructor's learning in tertiary settings comes from personal experience (Kember, 2009). However, communities of practice oriented towards enhancing teaching and learning can be used to guide new instructors towards the community's particular and more effective teaching practices (Lave, 1991). In the context of courses conducted by a small group of instructors, each course group behaves like a community, with the course coordinators serving as the centre of such communities. With the right support, course coordinators can scaffold the learning of the other instructors as they adopt the community's teaching practices. This scaffolding can take place via workshops, formal and informal professional conversations, and through deeper reflection, and dialogues with the help of appropriate tools and platforms.

Technology-enhanced learning

One distinct characteristic of the millennial generation is the ubiquity of technology in their lives (Blue & Henson, 2015). Millennials expect multimedia to feature prominently in their education (Blue & Henson, 2015; Patrick & Martin, 2015), and one way in which this occurs is via technology-enhanced learning (TEL). As defined by Patrick and Martin (2015), TEL refers to "all approaches in which technology is used to support the learning or teaching process", which includes web-based learning, game-based learning, the simple usage of animation or computer-generated pictures and movies.

Higher education institutions constantly face technological and educational challenges, and increasing demands to meet the needs of relevant stakeholders (Adams Becker *et al*., 2017; Chai, Koh, & Tsai, 2013; Wamboye, Adekola, & Sergi, 2015). Rather than being merely subject matter experts, teachers must also be adept facilitators and keep pace with rapid developments and innovations in education and technology (Ifenthaler *et al*., 2014; Rajaram, 2015a, 2015b & 2015c; Rajaram, Bednall, Honal, & Rundshagen, 2017). They must be adept at providing learning experiences that support discovery, knowledge generation and reflection. Increasingly, teaching is being delivered in a blended mode, incorporating experiential, participative, social and collaborative learning (Delcker, Honal, & Ifenthaler, 2017). Greater digital literacy among students has necessitated a substantial curriculum redesign with greater use of digital learning platforms, mobile applications and other innovative approaches or devices (Brooks, 2015). Teachers face various challenges in adapting to these changes. On one hand, the teacher's role in this new environment can be unclear. For instance, they often struggle with selecting the types of learning techniques that would optimally enhance student engagement and learning performance. On the other hand, they are not always aware of the technological tools, innovative concepts, digital platforms or mobile applications that are available, particularly those appropriate for teaching. Furthermore, it is unclear what capabilities are required for teachers to successfully harness these technologies and how they may be trained. Finally, there is an open question of how technology can best be used to prepare students for their future careers in the business world.

Some scholars have argued that the exact role of TEL in the learning experience needs further exploration (Kirkwood & Price, 2014). The Higher Education Funding Council for England (2009) proposed three potential benefits that TEL may bring (depending on the type of technology used): efficiency, enhancement and transformation. Efficiency refers to improving existing processes in a "cost-effective, time-effective, sustainable or scalable manner"; enhancement refers to a general improvement in the existing processes and its outcomes; transformation refers to a profound and positive change in the current processes

or even the introduction of new processes. In developing our improvised flipped classroom framework, TEL has been leveraged in both pre-class and in-class learning to meet evolving student needs as well as enhancing the instructors' ability to facilitate courses productively in today's complex and evolving learning environment.

Blended learning

Blended learning is defined by Maarop and Embi (2016) as a teaching and learning approach that blends online instructional methods and face-to-face learning in a brick-and-mortar location (often referred to as traditional learning). The inclusion of these two modalities enables integration into the cohesive learners' experience.

The subtle distinctions between blended and flipped learning needs to be appreciated to ensure that both approaches are utilised appropriately and effectively to achieve the intended learning outcomes. In blended learning, classroom time between instructors and students is not substituted by online delivery. Instead, the online component comprises of content and activities that complement in-class lessons. It usually involves online resources such as online journals, quizzes, voice-overs and/or audio podcasts, interactive games, and videos. Learners can access these online resources from anywhere and they are usually delivered through a university-wide learning management system, blogs or contextualised learning systems. The important point to understand about the blended approach is that traditional learning has not been replaced by online learning; rather, the two elements complement each other to provide learners with an inclusive and holistic learning experience. In contrast, the flipped classroom's primary focus is on the reversal of the traditional content delivery mode of learning. A traditional learning approach involves listening to lectures, watching demonstrations or visuals, understanding the content in the classroom and completing assignments at home. In a flipped classroom, course materials are prepared such that learners have access to the materials prior to their classes, at their own pace and time. Actual class time is then utilised to clarify concepts and run learning activities that emphasise content application, with facilitation and guidance from the instructor. The different types of online platforms adopted in-class serve to enhance and work towards higher levels of student collaboration, engagement and a holistic learning process.

Collins and Moonen (2001) report "flexible learning" as referring to learners' choice, specifically learners being able to make decisions about when, how, and where they will study. The ultimate intention of blended e-learning is to provide learners with choices as to what, how, and at what pace they

wish to learn. E-learning also facilitates the opening up of different avenues for formative assessment which helps learners to review course materials and take the assessment activities again when they feel that they are ready or want further practice. In addition, the blended approach allows learners to quickly move through the courses they are comfortable with and spend more time on areas where they struggle. Siemens (2004) in his theory of connectivism explains that (a) the capacity to know is more critical than what is currently known, (b) learning may reside in non-human appliances, and (c) decision-making itself is a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality, in the sense that while there is a right answer now, it may be wrong tomorrow due to alternatives in the information climate affecting the decision. This clearly emphasises the shift in the design and incorporating the pre-and-post blended learning platform. This implementation facilitates students to achieve deeper levels of learning with more emphasis placed on collaboration, cooperative and participative context beyond just mere information delivery.

Spanjers *et al*. (2015) conducted a meta-analysis which indicated that on average, instructors found blended learning to be more effective than traditional learning. Some of the benefits of blended learning include increased student-to-student and student-to-instructor interaction, enhanced student engagement (Alebaikan & Troudi, 2010; Korr, Derwin, Greene, & Sokoloff, 2012), and flexibility in class design (Alebaikan & Troudi, 2010). Similar to the flipped classroom framework, the evidence from the literature suggests that there have been many studies in which instructors have shared about the difficulties involved in implementing blended learning, especially due to the high demands placed on the instructors' time and workload in order to design the right blend between the two types of learning (Maarop & Embi, 2016). There is also little evidence in the literature regarding the development and implementation of any detailed framework (Boelens, De Wever, & Voet, 2017).

CONCEPT AND FEATURES OF THE FRAMEWORK

Our improvised and contextualised conceptual framework is designed to fill the "gap" of not having a scaffolded, comprehensive and effective flipped classroom design that helps instructors to fully utilise the available technology, both in the pre- and in-class phases. The authenticity of this framework is reflected in the following components: (1) a holistic and thorough pre-class online learning comprising an engaging and comprehensive learning design embedded with students' data analytics; (2) authentically created animations which make it easier for students to comprehend complex, dry theories

and concepts; (3) a reflection journal that provides a link across all course topics, with an in-class dialogue session and a reflective learning process; (4) incorporating an in-class team-based collaborative scaffolding support system that equips students with the "harder skills" of management competencies.

The variety of teaching techniques and activities involved in this learning design is especially targeted at capturing the millennial students' attention, who are known to have shorter attention spans. There are two components to the conceptual framework: pre-class online learning and face-to-face seminars enhanced by real-time technological interventions through the scaffolding learning support system. Figure 1 is a summary of the conceptual framework, while Appendix D contains a weblink to a trailer about the framework for flipped classrooms embedded with technology-enabled learning.
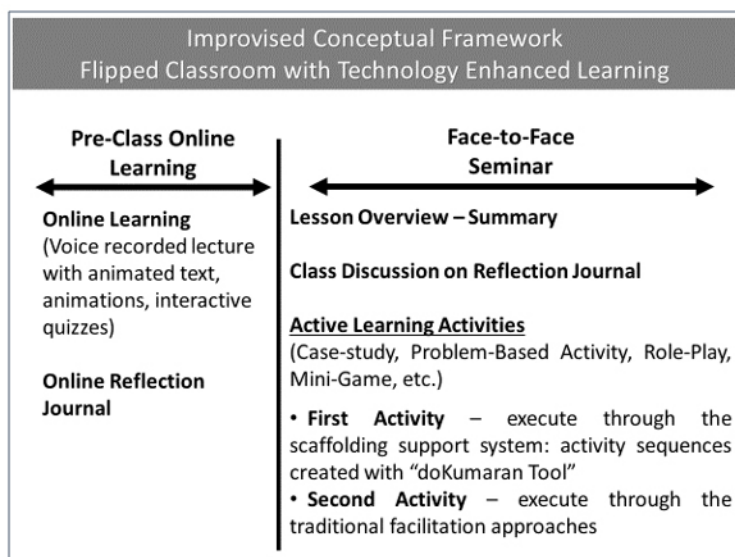

Figure 1. Improvised conceptual framework – flipped classroom with technology-enabled learning.

Pre-class online learning

The pre-class online learning comprises two parts. The first part is the online learning where students have online access to the lecture materials. The lecture materials are presented using a mix of different, such as a lecture with voice-over, animated text, animations, and/or interactive quizzes. Each segment would be no more than 10 minutes, to ensure that the material would be engaging and exciting for the students. At the end of the lecture videos, students have to complete either a timed and graded quiz, or an ungraded quiz at their own pace to reinforce what they have learnt. They have to complete all the online lessons for a topic 24 hours before the 3-hour face-to-face seminar for the same topic.

After completion of the online learning, students have to do an online reflection journal entry, which will be followed by an interactive classroom discussion. Evidence shows that such reflective activities encourage students to reflect on and review their own thinking processes (metacognition), help to boost students' critical thinking skills and assist in the preparation of course assignments and final examinations (Homik & Melis, 2007). The reflective portion also reinforces students' understanding of the applicability of key concepts which they learnt through the online lectures, ensuring that they are not just passively watching the videos. There are 12 reflection journals which students need to complete over the 3- to 4-month semester. They first have to read a case study; then, using knowledge acquired from lecture materials, they write down their responses to the questions related to the case study. They are expected to write between 50 to 200 words for each reflection. The case study material for each of the 12 reflection journals are designed to be interrelated to the other lessons so that the links become evident to students. The reflection journals serve as an application activity which is incorporated as the last activity for each pre-class online learning session. Instructors would be able to track the weekly journal submissions and correspondingly students' participation. The completion and quality of the journal submissions would be tagged to the students' pre-online learning course assessment, and hence serve as an effective control to monitor their course performance.

Face-to-face session: Applied and active learning, scaffolding learning support system

During the face-to-face classroom session, the instructor would begin with an overview of the lesson, displayed as a mind map. This would be followed by a discussion with the class about their reflection journal submissions. During the lesson overview, the instructor would engage in interactive dialogue with the students for 15-20 minutes, presenting a summary of the lesson on a Powerpoint slide. Following the class discussion, the instructor would summarise key points from the journal submissions and address any queries from students.

Following the discussion, the instructor may choose from a variety of activities to facilitate the active learning portion of the lesson, such as a case study, a problem-based learning activity, role-play and mini-game, or more. These team learning activities are facilitated differently from the traditional approach in two distinct ways, namely (1) specific roles would be assigned within the teams, for example, leader, scribe, or any assigned position based on the activity (team manager, supervisor, client); (2) at the end of the activity, each student would have to evaluate their team in terms of one primary competency. This serves as a peer review competency exercise that would enable every student to be trained not only on the course content but also the skills required to perform the assigned role.

A new, innovative, synchronous, and collaborative feature called the "doKumaran" tool (dKT) has been developed and included within the Learning Activity Management System (LAMS). The dKT captures and documents collaboration amongst students in real time. It is an integration tool that allows for the subsequent creation of powerful and collaborative activity sequences. With the dKT, we introduced five activity sequences as the activity scaffolding support system. This support system (a) enables "real-time" collaboration and students have more opportunities to participate in active learning activities with peers and instructors; (b) focuses on the learning process; (c) archives student discussions and reflections; (d) increases the level of engagement by minimising disruptions between learning activities; (e) serves as a platform for students to apply what they learnt and hone their critical thinking skills. Details of the LAMS, dKT, and activity support system can be found in Appendix C.

Pre-class online learning: Components

Online learning enable students to access the course materials anytime and anywhere at their convenience. The online learning framework adopted for this module comprises several components, as listed below.

- **Voice-over video lectures**. In this framework, the pre-class online lesson includes short video lectures, usually presented as slides with a pre-recorded voice-over. Wilson and Gerber (2008) proposed the need for a modularised course structure, which breaks traditional courses into 'manageable units'. A distinctive feature of such video lectures is that the content would be succinct and easy to understand, and each recording would be no more than 10 minutes.

- **Animation**. Apart from the video lectures, the instructional materials in pre-class online learning also makes use of animations, which refer to "any display element that changes its attribute over time" (Schnotz & Lowe, 2008). Berney and Bétrancourt (2016) proposed several purposes for using animation. First, it directs students' attention to essential portions of the course materials. Second, it is a useful way to demonstrate abstract concepts which students would need to memorise and apply, such as completing puzzle rings and tying nautical knots. Third, it can help students gain a better understanding of a dynamic system that changes over time, such as a flushing system or a light formation. It can also be used to demonstrate a succession of steps.

  In Berney and Bétrancourt's (2016) meta-analysis, where they examined 140 pair-wise comparisons between animated and static graphic visualisations in multimedia instructional material from 61 studies, they found that the use of animation yielded positive effects in terms of learning enhancement

as compared to static graphic visualisations. A key finding was that the positive effect of animation over static graphics was only found when students had no control over the pace of the instructional material being presented.

The study by Stebner, Kühl, Höffler, Wirth, and Ayres (2017) yielded a similar outcome when they compared German high school students in learning environments which had different combinations of visualisation in their instructional materials (e.g. no visualisation, use of static pictures and animations). Their study showed that students needed to have visualisation to gain a better understanding of the learning material. The results also consistently show that learning environments which feature the use of animation yielded more positive learning benefits compared to learning environments which only used static pictures.

- **Quizzes**. After the students have gone through the course materials, they have to complete one of the following two types of quizzes: graded and timed quizzes, or self-assessment quizzes. Studies have shown the effectiveness of utilising quizzes in teaching. According to Cook and Babon (2017), when students are required to take online quizzes based on prescribed preparatory material, it leads to enhanced levels of student engagement and motivation to complete the online learning in preparation for the following class. This would improve students' participation in active learning classroom activities, for example, class discussions. It was found to be an effective tool that saved instructors' time (Cook & Babon, 2017). In the blended learning context, Spanjers *et al.* (2015) found that incorporating quizzes into the course had positive effects on the effectiveness of this approach.

  In a study by Khanna (2015), students performed better in the final exams when they were given continuous formative assessments (for example, quizzes) that are ungraded rather than graded formative assessments or none before the final summative assessment (for example, the final examination).

- **Online reflection journal**. Another way of assessing the quality of online learning is through the use of online reflection journals. This is the last activity in the pre-class online learning, where students write reflections of between 50 to 200 words for the assigned case study. The case studies have been carefully picked by the instructor, and these cases not only reflect the primary topic of the lesson itself but also connects with the other case studies in the course. At the end of the module, students can review all the journal submissions and see how they connect across the different topics in the course. This enables students to appreciate the larger context of the whole course and put things in perspective.

Face-to-face seminar with real-time technological interventions

With the instructional course material covered before the seminar, classroom time could be utilised more efficiently through active or experiential learning activities. These activities could be technology-enabled, for example supported by the scaffolding activity support system or executed through traditional facilitation methods. When students engage in meaningful learning activities, they are actively learning and in doing so, are more engaged (Prince, 2004). Experiential learning give students opportunities to develop leadership competencies in business programmes (Crossan, Mazutis, Seijts, & Gandz, 2013). Examples of such activities include (a) Fishbowl, where groups of students discuss and lead discussions on an assigned topic; (b) Test Questions, where students get to pose questions instead of just answering them; (c) the Pros and Cons Grid, where students discuss and develop a list of advantages and disadvantages about an issue related to the lesson, helping them to appreciate a topic from varying angles and develop analytical and evaluation skills; (d) Cross-Age Peer Tutoring, which leverages on peer learning where a student proficient in a course topic instructs another who is a novice.

The use of the activity sequences in dKT's scaffolding support system enhances overall class participation which enable students be to be more actively engaged in class. Studies indicate that students who appear quiet and shy tend to contribute more to synchronous online discussions than classroom discussions (Warschauer, 1995). This may be explained by the fact that many students, especially those of East Asian heritage (Paulhus, Duncan, & Yik, 2002) or with more introverted personalities (Caspi, Chajut, Saporta, & Beyth-Marom, 2006), tend to shy away from speaking up in class (Freeman, Blayney, & Ginns, 2006). With the use of an online tool, these students may feel more comfortable sharing their ideas online (Cain & Klein, 2015). Students tend to learn more when they participate in group work (Arbaugh & Benbunan-Finch, 2006). In a meta-analysis performed by Johnson, Johnson, and Smith (1998), studies since 1924 were reviewed and the findings indicated that when students learn together, academic achievement is enhanced. Moreover, the students were found to have higher self-esteem, and better quality of relationships (Johnson, Johnson, & Smith, 1998).

Millennials are used to participating in collaborative activities since young—at day care, schools, and volunteer projects, therefore it is believed that they would be open to engaging in collaborative learning in the higher education classroom (Blue & Henson, 2015). Furthermore, they would expect an increase in such collaborations when they graduate and enter the workforce, especially between colleagues and with clients. According to Bedwell, Fiore, and Salas (2014), interpersonal skills are critical to achieving success in today's business

environment. With the flipped approach, the interaction and collaboration between students may take place during the face-to-face seminar part of the framework. With the use of the activity sequences in dKT's scaffolding support system, synchronous collaborative activities can take place. The five activity sequences facilitate different forms of group collaborations and discussions.

The activity support system in this framework supports activities which enable students to hone their critical thinking skills, such as the peer review activity sequence. The rigorous process involved in peer review, encompassing inter- and intra-group activity sequences and the reflection phase, give learners the opportunity to think critically about ways to refine their solutions to the problems presented. Both the student reviewee and the peer reviewer can benefit from this exercise (Boase-Jelinek, Parker, & Herrington, 2013) of evaluating each other's written submissions (Sims, 1989). Students would be able to practice critical thinking when they critique the work of their peers. When the reviewee reflects on the peer reviewer's feedback, it is also an opportunity for them to critically consider the feedback received and ways to implement the suggestions. Apart from the peer review activity, the literature also suggests that both collaborative learning, through "discussion, clarification of ideas, and evaluation of others' ideas" (Gokhale, 1995), and high student engagement (Carini, Kuh, & Klein, 2006) enhance the development of critical thinking. Through the support of the framework in enhancing student engagement and collaboration, students' critical thinking skills may also be enhanced.

METHODOLOGY

We began the project by running a pilot of the learning activities within the context of a course titled "Management Principles, Skills and Competencies". A capstone course in the Nanyang Business School, 400 to 450 students take the course each semester. Enrolment is divided across 8 to 10 sections/classes by a team of instructors and overseen by a single course coordinator. Each session meets once a week for three hours, with one hour catered for pre-course online learning. We worked with the course coordinator to run a pilot of the new set of technology-enhanced learning (TEL) supported activities through the scaffolding support system within two sections of the course.

Phase 1 of study

An online post-course survey (n=59) was conducted to find out whether students responded positively to the pre-class online learning system, reflected in an increase in self-reported levels of student engagement, collaboration, and critical thinking. The survey questions can be found in Appendix A.

All students taking the two sections/classes were informed of the survey and could choose to participate or withdraw from it. Students who chose to withdraw would still be able to complete the course activities as part of normal education practice with no impact on their grades. Students who agreed to participate had to complete the survey at the end of the class, and members of the research team gathered and analysed the data, as well as coded the survey results.

Twelve students from the two sections/classes were randomly selected and interviewed to find out their experiences of the flipped classroom learning design and the usage of the e-scaffolding learning support system adopted in real-time in class. The interview questions can be found in Appendix B.

Phase 2 of study

As an independent measure, the research team analysed students' performance on one of the core summative course assessment items, a project work report, comparing their performance before and after the implementation of the improvised flipped classroom approach with technology-enhanced learning. For the pre-implementation (n=310) and after implementation (n=367), the reports were evaluated using an assessment rubric with the following criteria, namely (a) defining the problem; (b) devising strategies to solve the problem; (c) assessing implementation; (d) evaluating outcomes.

RESULTS AND DISCUSSION

Phase 1 of study

Overall, 95% of the students rated their pre-class online learning experience as ranging from "Somewhat Positive" to "Very Positive" (see Figure 2). 97% of the students indicated that they "Somewhat Agree", "Agree" or "Strongly Agree" that they would like to see more of this type of course delivery, which has both online and face-to-face learning activities (see Figure 3).
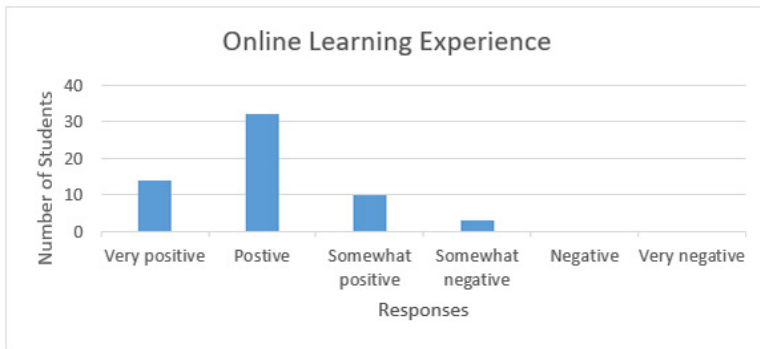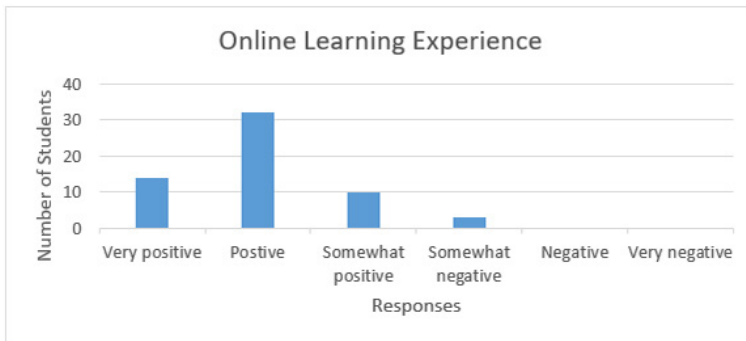

Figure 2. Students' responses regarding the online learning experience.

Figure 3. Students' responses regarding the appeal of this approach to students.

Survey findings

Flexibility

97% of students responded that they "Somewhat Agree", "Agree" or "Strongly Agree" to the statement "Online delivery for this course provided a flexible learning environment to help me understand the topics better" (See Figure 4).
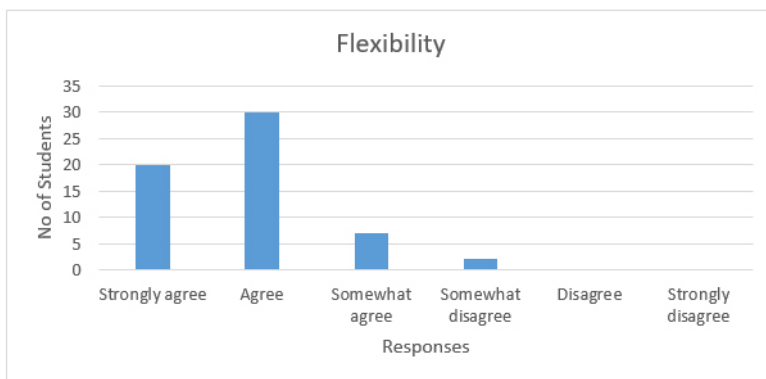
Figure 4. Students' responses regarding the level of flexibility of this learning approach.

When asked to provide their qualitative responses to the statement "What you like the most about the online content for this course", many students commented that being able to learn at their own pace is what they liked the most. Some of the responses included: "It allows me to do it at a pace I am comfortable with"; "I can digest the necessary information first before proceeding" and "without rushing through theories after theories." Some students also commented that it made learning very "convenient" and "flexible" as they were *"able to watch [the] lecture at anytime and anywhere"*. Another advantage of such flexibility in learning is that students can also revisit and review the material any time they needed to.

Levels of engagement

Many students commented that it was an "interesting" way of learning. They particularly enjoyed the visual presentations such as the animations, graphics and videos, which "aid deeper understanding of concepts" and "enhanced the entire learning process rather than providing us with only text and words". One student commented that "[in] addition, the animations and videos serve as a good learning aid by providing real-life examples, making the lessons much more interesting and engaging."

There was evidence of students being more engaged and sparked their interest to learn more, as indicated in the quote below:

> "I think online learning is a great way to learn. This is especially true when you are able to research and further find out theories and information that you are interested or unsure of. Through online platform learning, it allows me to gain a better insight of this module."

Critical thinking

In terms of their qualitative response to the statement "The online content for this course provided me opportunities to reflect on the topics and be able to apply them to other contexts appropriately", 100% of the students responded "Somewhat Agree", "Agree" or "Strongly Agree" to it (see Figure 5).
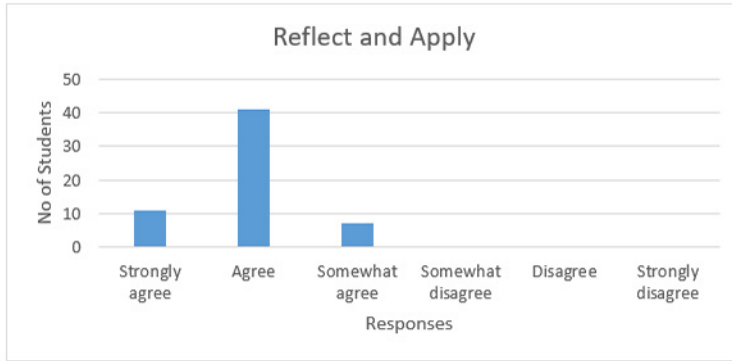

Figure 5. Students' responses on their ability to reflect and apply the content learnt.

Effectiveness

Many students found the online presentation of the course materials to be clear, concise and easy to understand. They felt that the course material were relevant to the workplace of the future and were "an effective way to learn information-heavy topics". For self-reported effectiveness, 97% of the students answered "Somewhat Effective", "Effective" or "Very Effective" (see Figure 6).
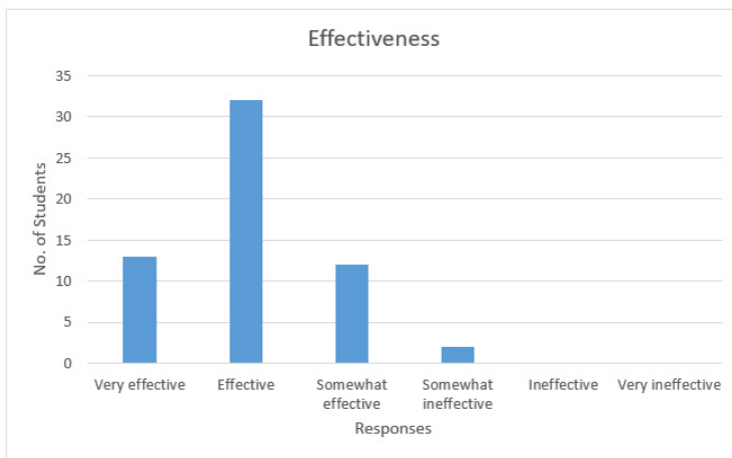

Figure 6. Students' responses regarding the effectiveness of the approach.

Further reflections from students

It was noted that many students found the pre-class online learning a very "efficient" method of learning as it allowed them to manage their time outside the classroom and "it minimised unnecessary time in class".

Phase 2 of study

We performed a comparative analysis of students' performance on their group project report, comparing the reports of those who have not gone through the improvised flipped approach versus those who have done so. Table 1 presents the findings of the analysis.

Table 1

Comparative analysis of students' group project report performance before and after flipped learning

	Group Project Report	
	Prior to the flipped learning (n=310)	**After implementation of flipped learning (n=367)**
	Mean Score (Total rating score = 3)	
Assessment Criteria		
Defining the Problem	2.61	2.67
Devise Strategies to Solve the Problem	2.44	2.49
Assess Implementation Feasibility	2.39	2.61
Evaluate Outcomes	2.25	2.52
Average	2.42	2.57

From the results, it is evident that the approach made a positive impact as there was an improvement in the mean scores across all four assessment criteria for the control group prior and after implementation of flipped learning. For the assessment criteria "Defining the Problem" and "Devise Strategies to Solve the Problem", there was only a small improvement within a range of 1.7% to 2%. As for the assessment criteria "Assess Implementation Feasibility" and "Evaluate Outcomes", there was a significant positive improvement in the range of 7.3% to 9%. There was also a 5% overall positive impact which positively reaffirmed and validated the adoption of flipped learning. We could conclude that flipped learning has enabled students to think and apply what they learnt in a holistic context that has enabled them to achieve higher average scores.

INTERVIEW FINDINGS

As for the face-to-face seminar, the research team randomly selected and interviewed 12 students from the course. Overall, students felt that the framework was effective as there was a lot more time during class for hands-on activities. They found it more "useful" and less "boring" as compared to traditional lectures. There was also more scope to learn from one another, as well as to learn through engagement with the instructor. The students also commented that the class supported by the framework "[changed] the whole dynamics of the class". With the course content being offered prior to the class and available to view at any time, it meant that class time was freed up for students to participate more active learning activities (Abeysekera & Dawson, 2015).

Collaborative learning capitalises on the energising confidence displayed by millennials, seeing them as accomplished, creative, and self-starting (Wilson & Gerber, 2008). Most students commented that the approach provided more opportunities for classroom collaborations and allowed an expansion of the discussion group to more students. More learning was achieved through interaction with peers which enabled specific mechanisms to affect the cognitive process (Arbaugh & Benbunan-Fich, 2006). These included resolution of conflicts during group discussions, acknowledging varying perspectives provided by more knowledgeable peers and enabling a process of self-reflection (Benbunan-Fich & Hiltz, 2003). There was less resistance to typing out one's answer onto mobile devices as compared to speaking in front of the whole class. Warschauer (1996) reported that quiet and reserved learners seemed to contribute more on online platforms than classroom discussions. Furthermore, with the technology-enabled in-class learning within the scaffolding support system, it enabled a two-pronged approach, first by allowing students to input their preliminary thoughts via the online platform, and second, enabling opportunities for collaborative engagement through students verbalising ideas collated from their group members. Students who work in groups online were able to reflect on others' written contributions and encourage elaboration of thoughts before writing it (Harasim, 1990). The key benefit of this approach is the learners' contributions being displayed concurrently on the device's screen. As such, everyone in the group can view this without any overlaps, similar to face-to-face dialogues. This exchange of ideas enabled learners to be exposed to varying perspectives of a topic, which widens students' thinking abilities and reasoning skills (Bakhtin, 1986). On the flip side, there is a possibility of causing slight confusion during the editing of text and making contributions concurrently, although learners eventually adapt to the digital flow of sharing and/or editing the inputs. Collaboration, knowledge building and meaningful learning are the expected outcomes from such blended learning interventions.

Students felt that the class was now more engaging compared to a traditional classroom in which only some students actively participated. They also felt more competent as active participants in the creation and dissemination of knowledge. The online platform also gave quieter students the opportunity to actively participate and provide their reflections in a conducive space without fear of being overshadowed by their more vocal peers (Kim, 2014). Students felt their opinions were valued and therefore felt more engaged. The scaffolding process ensures that students are fully engaged in the learning activities and were less distracted. Students also indicated that the collaborative aspect of learning, which characterised this approach, exposed them to diverse opinions and offered them opportunities to develop their critical thinking skills. They also mentioned that the peer review exercise, which included giving and receiving feedback as well as applying the feedback to improve their own answers, and considering different perspectives, enabled them to think more critically. This process led to the honing of higher order thinking skills (Webb, 1982), deeper reflection and discussios, and better collaboration. It also brought the group members closer together.

Further comments included how the framework enhanced efficiency and quality of learning as the inputs from team members were typed out concurrently instead of being offered in a staggered fashion as it usually occurs during a discussion. In addition, students commented on how the discussions challenged them to have a deeper consideration of the course materials. Generally, students who experienced the use of the scaffolding support system in class felt that there was a shift towards a more collaborative and engaging learning climate, the former enabling them to be more focused and participative in class. Furthermore, by being exposed to more diverse viewpoints and analysing others' answers, students felt that their critical thinking skills were being developed. Table 2 in Appendix F reports students' responses on their experiences on the use of activity support system.

LIMITATIONS, CONCLUSIONS, AND FUTURE REFLECTIONS

The survey results indicated three main areas of improvement for the pre-class online learning. First, many students found it to be lengthy with many concepts to grasp. Second, they preferred to have more interactions with their peers during the online learning. Also, they encountered occasional technical glitches which needed rectification.

We find that the first two points echo what Karakas *et al*. (2015) had suggested as the three key challenges in teaching management today: it is difficult to maintain students' attention for a long period of time and they desire more collaborative activities. Another possible reason for their feedback might be

attributed to their expectations of classroom design. Students may not fully understand that the content dissemination they tend to associate with classroom teaching will now take place outside the classroom, leaving actual classroom time for collaborative and active learning activities. They may be expecting to see traditional pre-class online activities that aim to pique their interest rather than conduct actual teaching. As for the third feedback item, we will work with the development team and ensure less technical glitches occur for future classes. One suggestion to enhance the scaffolding system was to provide colour coding of the inputs typed in; although students felt that it was creative, they suggested using a much lighter colour coding, perhaps in shades of the same colour.

For future research directions, this study will be conducted with multiple sections to better understand the effectiveness of such a framework with the students as well as with instructors. Also, the research may be conducted to examine whether more collaborative activities during the pre-class online learning may enhance students' learning experience.

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ABOUT THE AUTHOR

Kumaran Rajaram is a Senior Lecturer with the Nanyang Business School, NTU and a Research Fellow-Affiliate with the Centre for Research and Development in Learning. He is also the founder and Executive Director of the Research Lab for Learning Innovation and Culture of Learning. His research interests include pedagogical innovations and developing leadership competencies. He has published about management education, learning culture and culture of learning in multi-disciplinary contexts, learning analytics and the internationalisation of business education.

More details at: http://research.ntu.edu.sg/expertise/academicprofile/pages/StaffProfile.aspx?ST_EMAILID=RKUMARAN

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APPENDIX A. POST-TEL SURVEY

(Extracted from the post-survey performed by students attending a TEL course)

APPENDIX B. INTERVIEW QUESTIONS

1. What are your experiences of using this real-time in-class e-scaffolding support system?

2. How does it explicitly enhance (a) higher levels of collaboration; (b) make you think more critically; (c) better engagement with your peers in your group and others in the class?

3. What are your perspectives of the different activity sequences that this scaffolding support system supports and how do you learn better through the various activity sequences embedded in your group and class discussions?

4. What are your experiences on the flipped classroom embedded with technology enabled learning design?

APPENDIX C. LAMS, "*doKUMARAN*" TOOL, AND ACTIVE SUPPORT SYSTEM

APPENDIX D

The video trailer for Flipped Classroom embedded with technology-enabled learning could be viewed via the link
https://www.youtube.com/watch?v=0TIJrhlpFYc.

APPENDIX E

The process flows of the five activity sequences, namely (1) Group-/Instructor-centric; (2) Peer review; (3) Collaboration; (4) Jigsaw; and (5) Unstructured activity sequence can be viewed in the video trailers in the furnished link:

• dKT Learning Blog Site: https://blogs.ntu.edu.sg/learning-innovations/dokumaran/

• Research Lab for Learning Innovation and Culture of Learning: https://learningintervention.wixsite.com/researchlab/dkt

APPENDIX F. STUDENT RESPONSES TO THE USE OF THE SCAFFOLDING LEARNING SUPPORT SYSTEM ■