

# AC-01 DESIGN OF AN E-LEARNING PROTOTYPE

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## ABSTRACT

E-learning has gained momentum over the years. Its features and benefits are well understood. Case-based learning is a well-established pedagogy widely adopted in higher education. However, while the two fields have been individually studied, the intersection of these two areas of research has not been thoroughly explored. This paper hence attempts to address this knowledge gap. In this research, several unique e-learning features, and key elements of case-based learning were reviewed and juxtaposed to design a framework for applying features of e-learning to facilitate case-based learning. Using the framework as guide, an e-learning prototype (CASPER) was developed to demonstrate its viability. Finally, the prototype was evaluated for its efficacy in engendering case-based learning. Results show a statistically significant improvement in quiz scores between CASPER and text-based delivery. Furthermore, participants expressed that CASPER provided a more interesting and engaging learning experience. This paper represents a step towards an uncharted research territory, and the promising results suggest that it is an area worthy of further exploration.

## Author Keywords

E-learning, Case-based learning, Multimedia, Role-playing, Gamification.

## INTRODUCTION

### Background

E-learning has experienced steady and continued mainstream adoption over the years. Particularly in institutions of higher learning, where the use of e-learning technologies is prevalent (Garrison & Kanuka, 2004). The advent of e-learning platforms is driven in part by the conveniences that it conveys. E-learning platforms leverage on Internet technologies to enable the sharing of learning resources, broadcasting of information, and facilitation of knowledge flows (Liu & Hong, 2009). It allows instructors to distribute and collect lesson materials easily by automating and digitalizing much of the administrative tasks. Aside from pure convenience factors, e-learning approaches have also been shown to improve learning effectiveness by allowing learners to undergo learner-centered and self-paced instruction (Zhang, Zhao, Zhou, & Nunamaker Jr, 2004). It is hence natural, that more and more educators are looking to adopt e-learning tools to enhance learning experience. In fact, analysts predict that the global e-learning market is expected to grow to approximately \$331 billion by the end of 2025 (Research and Markets, 2017). However, it should be noted that not all e-learning implementations thus far have been successful. In reality, educational platforms that are poorly designed, have been shown to not only produce no improvement on learning but may have negative implications on learner motivation (Van Merriënboer & Ayres, 2005). It is therefore critical that educators do not treat e-learning as a panacea to address the existent issues of classroom teaching. Educational technologies and tools need to be grounded with coherent instructional and cognitive theories (Bednar, Cunningham, Duffy, & Perry, 1995), and in order for an e-learning implementation to be successful, it needs to account for the underlying pedagogy and how the learning should take place online (Govindasamy, 2001).

Case-based learning has been widely practiced in programs conducted at higher learning institutes (Thistlethwaite, et al., 2012) as a means to convey key concepts to learners. Case-based learning has been applied across a wide range of specialized training courses including business, law, engineering, and medicine to help students understand concepts as practiced in real-world scenarios (Davis, 1999). The merits of case-based learning, lies in its ability to

stimulate in-depth analysis of a given problem scenario by allowing learners to examine the root causes of the problem from multiple perspectives and understand the theoretical concepts within context (Ridder, 2017). Such opportunities are hardly present in traditional lecture-based teaching (Pearson, Albon, & Hubball, 2015). Furthermore, the case-based learning approach has shown to promote learner motivation in higher education (Raju & Sankar, 1999) as it allows students to integrate various proficiencies and take a multidisciplinary approach to analyzing relevant real-world situations. This is perhaps why most MBA programs today choose to incorporate some level of case-based learning into their curriculum (Kim, Liu, & Bonk, 2005). However, the implementation of case-based learning is not without its challenges. Conventional case-based learning methods require learners to devote large amounts of time into reading and comprehending case materials on their own, and students who had not thoroughly acquainted themselves with the case beforehand were shown to be unable to participate and contribute actively during class discussions (Yadav, Shaver, & Meckl, 2010). Moreover, as most case materials are presented primarily in textual form, learners often lose themselves in the details of the case, requiring assistance from instructors to provide them with summarized insights and a broader view of the concepts in order to aid their understanding (Hillyard, Gillespie, & Littig, 2010). Therefore, there appears to be a potential opportunity for practitioners of case-based learning to adopt e-learning technologies to alleviate these issues.

## **Objectives**

E-learning has already been accepted as a mainstream technology used in higher education institutes (Garrison, 2011). Numerous preceding studies have already been conducted on its various features, and the potential benefits that it can enable. Case-based learning is also a long-established pedagogy that has been extensively studied for its implications on classroom learning (Thistlethwaite, et al., 2012). However, there appears to be a lack of understanding on how to effectively apply e-learning features to facilitate case-based learning (Lee, Lee, Liu, Bonk, & Magjuka, 2009). A review of the state of the art of current types of online case-based learning platforms, reveals that most implementations continue to present case resources primarily in the form of text (Feloni, 2015). Such setups fail to exploit the breadth of features that e-learning can offer to facilitate case-based learning. It is clear that the intersection of these two areas of research has not been thoroughly explored, which hence creates a knowledge gap that is worthy of our study. Therefore, in attempt to address this knowledge gap, we divide the objectives of this study into three areas. First, we shall design a framework for applying the features of e-learning to facilitate case-based learning. Second, we shall develop an e-learning prototype to manifest this framework and demonstrate its viability. Third, we shall evaluate the efficacy of the e-learning prototype in enabling and engendering case-based learning. The first section of this paper begins with a review of existing literature to identify several unique e-learning features, and the key elements of case-based learning. The integration of these two areas of understanding will culminate into our framework for applying e-learning features to facilitate case-based learning. The next section, discusses the details of the e-learning prototype and how it serves to embody our theoretical framework. Finally, results of the evaluation process are presented, accompanied with discussion on the findings of our evaluation.

## **WHAT IS E-LEARNING**

E-learning is defined as the use of information and communication technologies in the various aspects of education to support and enhance learning (Bullen, 2014). This includes the usage of information and communication technology as a supplement to traditional classroom teaching, online learning or a some combination the two (OECD, 2005). The basic features of e-learning tend to center around leveraging on the capabilities of the internet to enable the sharing of learning resources, broadcasting of information, and facilitating the flow knowledge (Liu & Hong, 2009). E-learning provides the flexibility of time and place (Capper, 2001), and learners are not limited by scheduling (Chhibber, 2014) or instructor capacity. This asynchronous approach, means that materials are accessible anytime and anywhere (Simmons, 2005), and learners can dictate their own pace of learning (Amer, 2007), thereby decreasing stress and increasing satisfaction (Algahtani, 2011). E-learning is also unique in that it makes the learning process interactive, self-paced, and customizable (Twigg, 2001). Such an environment helps support the learning needs of the individual and enables flexible learning schedules (Tao, Yeh, & Sun, 2006), making it a very beneficial technology to adopt for classroom teaching (Valentina & Nelly, 2015). By incorporating

e-learning features to enhance traditional classroom teaching learners are provided with a more interactive and visual experience as compare to conventional textbook teaching methods (Monika, 2013). Such online learning environments also stimulates student participation and promotes more in-depth understanding (Karayan & Crowe, 1997). In fact, in some studies e-learning was shown to have produced some degree of improvement in student scores as compared to traditional teaching methods (Cook, 2009). This is perhaps why, e-learning has gained mainstream recognition and many parents and teachers have adopted it as an educational tool (Shea, 2002).

However, while the benefits of e-learning seem very appealing for instructors and educational institutes to adopt, caution must be paid to the approach in which the e-learning facilities are incorporated. Underlying pedagogical principles are commonly neglected during the implementation of e-learning systems (Bixler & Spotts, 2000), and this has often lead to ineffective results (Bates & Poole, 2003). Educational platforms that are poorly designed, have been shown to not only produce no improvement on learning but may have negative implications on learner motivation (Van Merriënboer & Ayres, 2005). Therefore, educational strategies and technologies need to be based upon sound learning and cognitive theories (Bednar, Cunningham, Duffy, & Perry, 1995), and successful implementations require a careful redesign of the fundamental methodologies of teaching and learning, rather than simply grafting IT onto inappropriate teaching practices. Most importantly, e-learning materials must be designed properly to engage the learner and promote an effective learning experience. By implementing features such as games, simulations, role-playing, stories, competitions and assessment quizzes, lessons can be designed in a way that helps entice and maintain learner focus, while also giving them a big-picture view of their learning objectives (Dobrovolny, 2006).

## **E-LEARNING FEATURES**

### **Multimedia Instruction**

Multimedia is defined as the amalgamation of multiple media sources including videos, graphics, animation, audio, and text, accessed by means of a computer (Harris & West, 1993). Multimedia instruction is hence the use of multimedia for the purpose of conveying knowledge to leaners. This includes the use of presentations, online tutorials and web-based instruction (Yu, Williams, Lin, & Yu, 2008). Other examples include the use of spoken text, or graphics that appear in the form of photos, maps, charts, table graphics or video animations (Mayer R. E., 2003). The use of multimedia content such as animation, graphics and sounds help attract the learner's attention and reduce boredom (MacKenzie, 2013). Most importantly, the strategic use of multimedia can help learners summarize important concepts and improves their understanding (De Sousa, Richter, & Nel, 2017). Studies also show that learners perceived higher quality learning experiences when multimedia was used during teaching (Cairncross & Mannion, 2001). In recent years, videos have gained popularity as one of the more effective information delivery media in student learning (Guo, Kim, & Rubin, 2015). Students are better able to grasp concepts and generally experience better learning when combining both textbooks and videos (Moreno & Ortegano-Layne, 2008). The continuous visual flow and motion introduced in video lectures enhances the learning experience and promotes learner interest in the lecture contents (Ilioudi, Giannakos, & Chorianopoulos, 2013).

Through the use of multimedia instruction, educators are able to use media such videos and animation strategically to provoke deeper thought and stimulate curiosity in a particular subject matter (Spiro, Feltovich, Jacobson, & Coulson). This helps students establish stronger connections with the given topic as compared to traditional text-based approaches (Fletcher & Tobias, 2005), and can be used tactically to help inculcate problem solving and other higher order thinking skills (Najjar, 1998). However, the use of multimedia instruction can be complex, and there are no clear guidelines for educators on how to apply multimedia instruction effectively (Cairncross & Mannion, 2001). Studies have shown that simply applying multimedia applications to traditional teaching styles has had little to no impact on enhancing learners' knowledge (Rogers & Scaife, 1997). To avoid such pitfalls, key features of multimedia should be applied purposefully in ways that serve to enhance learning outcomes (Aldrich, Rogers, & Scaife, 1998). It is hence recommended that when designing multimedia learning applications, it is important to consider not only the interactive systems perceptive, but also the educational value (Cairncross & Mannion, 2001).

## **Role-Playing Simulation**

Role playing is a learning tool that requires learners to immerse themselves in the role of the decision makers and encourages them to instantly apply the knowledge that they have learnt (Erturk, 2015). Role playing depicts drama, simulations, games, and demonstrations of real life cases which and is an interesting example of an active learning and teaching strategy (McSharry & Jones, 2000). When designing lessons, teachers often face the challenge of incorporating elements to engage learners to help them digest knowledge better (Race, 2010). Role playing hence presents a potentially effective way to engage learners and make learning more enjoyable (Erturk, 2015). In institutes of higher education, role play has gained enormous recognition from teachers and trainers as a powerful technique for student development and skills training (Bolton & Heathcote, 1999). During role playing, students are encouraged to make the decisions based on the facts and information given to them (Bhattacharjee & Ghosh, 2013). This enhances the student's capabilities in understanding themselves and others, as well as improving their problem-solving skills (Pourghaznein, Sabeghi, & Shariatinejad, 2015).

The increased involvement in online role play activities (Harasim, Starr, Teles, & Turoff, 1995) also enables students to understand complex issues more efficiently (Freeman & Capper). According to (Boud & Prosser, 2002) and (Siemens & Tittenberger, 2009) learners are more engaged with online role play as it provides a safe environment for practicing skills in a simulated social context. More importantly, role playing allows students to immerse themselves in real-life cases and motivates them in seeking in-depth understanding of the contents (McKeachie, 2003). Well-designed role plays, often include a reflective debriefing phase to facilitate learners in moving between theory and practice and co-construction (Wills, 2012). It is hence recommended that for online role play activity to be effective, an adequate amount of background information should be provided along with the questions, and task structuring. Furthermore, student learning should be reinforced by incorporating debriefing with reflections and discussions on the role play activity (Smouse, 2013).

## **Online Quizzes**

E-learning techniques represent a collection of teaching strategies (Lahwal, Amaimin, & Al-Ajlan, 2009) such as individual-assessment quizzes, tutoring and platforms for discussion, which facilitate powerful mechanisms for collaborative learning (Nevgi, Virtanen, & Niemi, 2006). Among these, assessment provides an essential tool with the ability to promote learning and measure or certify the outcomes in a learning and teaching environment (Clements & Cord, 2013). Online assessment methods automate and reduce much of the administrative work required to mark assessments. This helps to alleviate the teacher's workload, and reduces human error therefore allowing faster feedback to students regarding their learning outcomes (Whitelock, 2009) Furthermore, studies show that the incorporation of online quizzes into learning environments has produced better academic results than traditional examinations alone (Lorenzo, Antonio, & Laura, 2012). These self-check quizzes provide an effective way to engage students to complete required readings and helps them to monitor their own understanding of the materials (Kearns, 2012). Online quizzes therefore bring benefits for both instructors and learners (Cairncross & Mannion, 2001). With online quizzes, instructors can measure their teaching effectiveness, evaluate student knowledge and provide immediate feedback (Romo, 2010). As for the learners, online quizzes allow them to assess their knowledge, identify gaps in their knowledge and helps them to retrieve and retain information related to lectures (Roediger, 2015).

## **Gamification**

One of the most widely known definitions of Gamification, is the use of game design characteristics in non-game environments (Deterding, Dixon, Khaled, & Nacke, 2011). Put more specifically, Gamification drives desire and motivation by incorporating gaming elements into non-gaming applications such as social activities, educational sectors, customer engagements, marketing and websites (Gabriela, Nadezhda, & Lina, 2014). By using game-based mechanics, aesthetics and game thinking (Kapp, 2012), gamification has the ability to influence the behavior patterns of learners and increase motivation (Muntean C. , 2011). The main goal of the gamification is to hence encourage the engagement by using game-like techniques such as scoreboards, personalized and immediate feedback (Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011), to enable learners to gain a sense of ownership while engaging with tasks (Pavlus, 2010). In educational settings, just as in games, students usually begin by

working on tasks that are relatively less complex and slowly progress to more challenging tasks as they increase in proficiency (Juho, et al., 2016). Often, these performances would then translate to rewards and allow learners to feel motivated with the joy of the learning process (Gabriela, Nadezhda, & Lina, 2014). The following are examples of some of the common gamification features that have been shown to motivate students to be more engaged in their learning processes.

### *Points*

One way to motivate learners to gain a deeper understanding of learning contents, is by offering points as rewards (Coppens, 2016). A points system provides instant feedback to learners about their progress and also leverages on a learner's basic psychological urges such as goal-setting, sustained achievements, and the need for status and recognition to drive greater levels of engagement (Antin & Churchill, 2011).

### *Badges*

Studies have shown that earning badges has significant effects on student learning behavior, examples include encouraging students to pay greater attention during exercises and motivating them to manage their time during practice (Antin & Churchill, 2011). Furthermore, badges can promote student self-reflection as they become more aware of the benefits gained from their actions (Lasse Hakulinen, 2013).

### *Leaderboard*

Leaderboards are one of the common approaches to gamification which tap into the learner's competitive spirit (Landers & Landers, 2015). Leaderboards can also be used to encourage learner collaboration, social learning, competition and knowledge sharing (Richard N. Landers & Callan, 2017). The inclusion of a leaderboard, along with other gamification elements, motivates students to participate actively, and drives them to explore and learn on their own accord (Muntean C. I., 2011).

## **WHAT IS CASE BASED LEARNING**

Case-based learning (CBL) has been used extensively in several areas of professional education such as business, medicine, information systems as an alternative instructional method to the traditional lecture (Garvey, 2000) (Lee, Lee, Liu, Bonk, & Magjuka, 2009). CBL integrates textbook knowledge and real-world practices in a range of settings within the focus of student-centered learning. It promotes students' learning and guides them to determine their perspectives, as the case studies promote reflection, teacher-student communication and group conversations (Ferrario, 2003). CBL is a method that promotes the active and reflective learning of students for the development of critical thinking and effective problem-solving skills (Tomey, 2003). Furthermore, CBL focuses mainly on the learning journey and it requires students to take part in actual or hypothetical problem situations by demonstrating the experiences that naturally occur in the discipline under study (Ertmer & Russell, 1995) (Kaddoura, 2011). Case studies not only present the information about a given situation at face value, but also challenges learners to examine the problems that appear in the cases and make reasonable deductions (Snyder & McWilliam, 2003). The advantage of case-based learning is that it enables comprehensive analysis of a unique situation and allows students to scrutinize the causes of the given problem, which leads to a better understanding of the theory in context (Ridder, 2017).

In implementing CBL, teachers can adopt different methods to introduce examples to a class, such as the guided inquiry, case seminars and role plays (Srinivasan, Wilkes, Stevenson, Nguyen, & Slavin, 2007) (Annette Marlow, 2008). CBL requires constant engagement from students as it reinforces professional practice goals by encouraging learner-teacher interactions. Such opportunities are unusual in traditional lecture-based teaching. While it is true that CBL can be used to improve understanding, teachers are finding it difficult to effectively conduct such practices. In fact, some studies show that there were no obvious differences in the learners' conceptual understanding and critical thinking while using CBL, as compared to conventional lectures (Hoag, Lillie, & Hoppe, 2005). Other studies show that the increased interest about CBL did not automatically lead to better learning results and understanding of the theory (Yadav, Shaver, & Meckl, 2010). This therefore suggests that the successful implementation of the CBL approach can prove to be tremendously challenging.

## **ELEMENTS OF CASE BASED LEARNING**

### **Critical Decision Points**

A case is an actual problem encountered by different parties (Roy & Banerjee, 2012). Usually, case studies depict a situation with detailed background, and this situation is related to several core concepts. A case can be presented in the form of a narrative or report to help students to improve the effectiveness of learning in class (Kunselman & Johnson, 2004). The reader is then required to draw conclusions after a detailed evaluation of the case (Antill, 2007). The objective of such an exercise is to forge a connection between theory and the real world (Nkhoma, Sriratanaviriyakul, & Quang, 2017). Students are presented with stories and put in the role of decision makers. Through story presentation and decision simulation, CBL encourages a vigorous studying atmosphere where students strengthen their critical thinking skills. (Yalçınkaya, Taştan-Kırık, & Boz Y, 2012). Studies show that, learning experiences based upon critical decision-points are one of the key factors for creating a case-based learning environment (Choi, Kim, Jung, Clinton, & Kang, 2006). Such an environment fosters critical thinking as students are forced to look at a situation from multiple perspectives, think open-mindedly, and state the problem from their individual assessment (Birgili, 2015). These critical decision points, stimulate learners to pay attention to key details based on the scenario and conditions given, and make comments and decisions, hence applying their logical thinking and understanding of the case (Seferoglu & Akbıyık, 2006). Through this process, students are able to utilize the knowledge they have acquired, and develop higher order thinking skills (Saltan, Özden, & Kiraz, 2016).

### **Summarization of Concepts**

Cases provided in CBL often study an individual, organization, companies, events in a certain time, a specific place or environment (Crowe, et al., 2011). The content of these cases may not be designed in a way that tells an interesting story, but it contains a clear subject, related theories, detailed content, and discussions (Thomas G. , 2011). During case learning experiences, the focus tends to be centered on several key problems or issues and theoretical concepts (Herreid, 2007). In order to give students a broader understanding, the case text usually provides additional information, such as a case background, company or stakeholder information, and a story timeline. However, traditional text formats restrict the type and richness of information provided (Felsoni, 2015), and may not provide complete details and a full picture of the story. In order to facilitate class discussions, students are required to spend long periods of time reading case details. During this time, there is little to no interaction (Shouhong & Heping, 2004), which creates a tedious and laborious process that students have to undergo to participate in CBL environments. Furthermore, long and detailed case articles also make it difficult for students to find key information or concepts from the case text (Poletti, Seaboyer, Rosanne Kennedy, & Douglas, 2014). Therefore, it is recommended that practitioners of CBL teaching assist students by providing summaries of key concepts to facilitate richer and more detailed discussions (Fletcher & Tobias, 2005).

### **Self-Driven Construction of Knowledge**

Critical thinking is one of the main factors of a successful case study learning environment (Choi, Kim, Jung, Clinton, & Kang, 2006). When answering questions during case study sessions, students must be able to recognize the existence of problems and to identify the causes of the problems (Popil, 2001). They must also possess the skill to engage in activities with reflective skepticism and think open-mindedly (Walker, 2003). Therefore, students are required to embark on their own self-learning journey to think independently, use their existing knowledge and bring their questions into the class discussions (McDade, 1995). During hands-on practice or class discussions, students combine theory with practice to achieve higher order thinking. By motivating students to participate in self-learning and connect theory to practice, the learning process becomes more fertile for the development of critical thinking skills. As a result, CBL lectures are shown to be more productive in improving students' critical thinking than the normal ones (Hong & Yu, 2017). CBL has a strong stimulating effect on a student's self-learning as compared to the non-CBL classes (Rotgans & Schmidt, 2012). A study conducted among 70 medical students, revealed that majority of the students indicated that CBL lessons helped improved their independent learning skills, ability to retain information, and preparation for examinations, as compared to traditional teaching methods.

## Assessment of Understanding

Case studies provide detailed background information and well-defined problems. Learners apply their background knowledge as well as newly learnt concepts to solve the problems (Kaddoura, 2011). Through the process of problem-solving, students learn how to apply their knowledge and to think more systematically (Klunklin, Subpaiboongid, Keitlertnapha, Viseskul, & Turale, 2011). One research finds that such processes in CBL improves subjective and objective problem-solving abilities in fresh graduates (Yoo & Park, 2014). Through interaction and discussion, students are confronted to apply their knowledge (Braeckman, Kint, Belaert, Cobbaut, & Janssens, 2014), and have opportunities to talk about real-life situations and find their own answers (Chen & Lin, 2003). During the discussion of a case study, students tend to carry out processes of in-depth thinking for responding to the questions. They are sometimes required to dig deep into previously acquired knowledge in order to decide which concepts to apply to a particular question or case study (GHOLAMI, et al., 2016). A recent study shows that students who systematically solve problems will attain greater knowledge within a case study class (Gallego, Fortunato, Rossi, Korol, & Moreton, 2013). Other studies have demonstrated that students only remember 5% of what they have learnt from lectures but retain 75% to 90% of knowledge gained when they participate in learning activities and case-based assignments (Heath & Weege, 2017). It is therefore crucial for CBL environments to provide opportunities for learners to apply and assess their own understanding of key case concepts.

## APPLYING E-LEARNING TO CASE BASED LEARNING

The purpose of our study, is to explore the intersection between e-learning and case-based learning. In the preceding sections of this paper, we have identified several unique features in e-learning and developed an understanding of the key elements of case-based learning. In this section, we shall attempt to synthesize the two aforementioned areas together to design a framework for applying the features of e-learning to facilitate case-based learning. The resulting framework that we have designed is as illustrated in Figure 1.

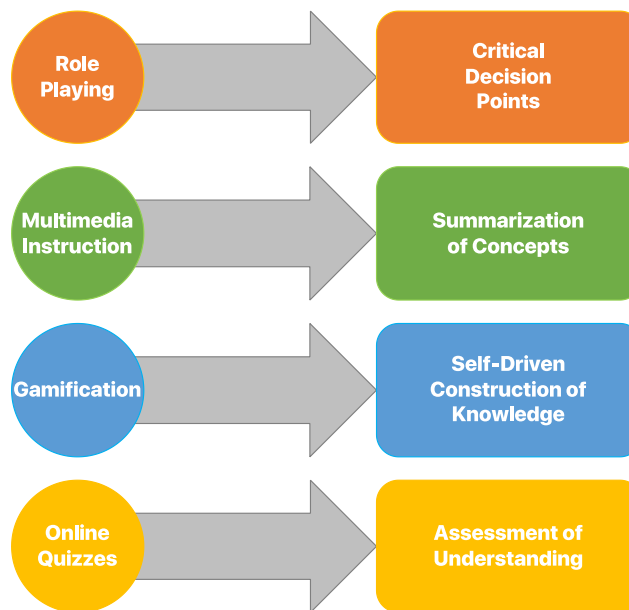


Figure 1. Framework for applying e-learning features to CBL

### Critical Decision Points

Case-based learning presents learners with information on a particular scenario. From the information presented, learners are often required to think about the choices made by key stakeholders, and the implications it has on the overall outcome of the situation (Baumberger-Henry, 2005). These critical decision points, are crucial for creating a case-based learning environment to foster critical thinking (Carlson & Schodt, 1995). Role playing is a learning

tool that puts the learner into the role of the decision maker, by presenting them with specific scenes, perspectives, and information (D'aquino, Le Page, Bousquet, & Bah, 2003). In simulating the decision-making process at the critical decision points, learners are able to better appreciate the context and consequences of the decisions made by the key stakeholders. E-learning helps to facilitate this role-playing simulation process, by creating a dynamic sandbox where appropriate information can be presented based on the respective choices made (Polzar, 2007). This allows learners to be able to carry out the decision making and receive immediate feedback on the positive and negative implications of each choices, which would help them better understand the significance of the decisions.

### **Summarization of Concepts**

The cases used in case-based learning, tend to focus around several key central issues and concepts (Herreid, 2007). However, in order to provide learners with a broader appreciation of the context that the case is set in, cases are required to furnish various additional background information pertaining to the scenarios presented. Given that conventional methods of presenting cases are primarily in text (Feloni, 2015), the richness and amount of information that is provided is restricted. If a case attempts to convey too much information in textual form, it runs the risk of causing readers to experience information overload (Fletcher & Tobias, 2005) and dilutes the focus of the learning objectives. Multimedia instruction alleviates this challenge by offering multiple modes of information delivery. For example, the text could focus on core details related to the case, while additional background details could be deferred to the richer mediums of images and videos. Moreover, the strategic use of multimedia such as graphics and videos can help learners to summarize concepts into engaging and digestible formats to aid understanding (De Sousa, Richter, & Nel, 2017). E-learning helps to facilitate the delivery of multimedia instruction by allowing anywhere anytime access to content over the internet (Motiwalla, 2007).

### **Self-Driven Construction of Knowledge**

Critical thinking is a key tenet of the case-based learning approach (Choi, Kim, Jung, Clinton, & Kang, 2006). Students are constantly encouraged to think open-mindedly and to consider the problem from different angles and perspectives. This requires learners to thoroughly analyze the issue and question themselves in order to reach a conclusion (Rowles & Brigham, 2005). Such a process often involves learners embarking on their own self-learning journey to connect theory to practice and apply higher order thinking skills (Hong & Yu, 2017). However, studies show that students are often feel unmotivated to take on more active roles in their learning processes (Brown, Smith, & Ushioda, 2007). Such tendencies could impede the knowledge acquisition process in case-based learning environments and has potential ramifications on the overall effectiveness of this approach. This research hence proposes the adoption of Gamification as a means to help encourage self-driven construction of knowledge. Gamification employs the use of game mechanics and aesthetics to drive learner engagement (Muntean C. , 2011). Through using game elements and metaphors to reinforce positive behaviors within the e-learning system, learners are motivated to embark on self-driven productive learning activities and gain a sense of ownership while engaging in such tasks (Pavlus, 2010).

### **Assessment of Understanding**

In case-based learning environments, students are required to integrate and apply their knowledge to solve problems (Kaddoura, 2011). Solving these problems has shown to greatly help learners to improve their understanding and retention of knowledge (Heath & Weege, 2017). Hence, case-based learning environments need to be able to provide avenues for learners to apply their knowledge and test their understanding. E-learning provides an effective and efficient way to accomplish that through the use of online quizzes. Online quizzes are accessed through the internet and available at any time (Bourne, Harris, & Mayadas, 2005), allowing students to pace their own learning (Rhode, 2009), and take the assessments when they feel that they have reached a sufficient level of comprehension to attempt them. Furthermore, students are able to receive relatively fast feedback through the online quiz platform, allowing them to quickly gauge their level of understanding and work on their errors (Desouza & Fleming, 2003). In the case of close ended multiple-choice questions, feedback can be automated and provided immediately to display results and highlight the errors that the student has made. In the case of open ended questions, an instructor



would be required to vet the answers given, however feedback is still provided relatively quickly through an electronic response sent over the internet.

### CASPER: CASE BASED E-LEARNING PLATFORM

CASPER is an online e-learning platform prototype developed to manifest our theoretical framework and demonstrate its viability. We have designed the system to embody the intersection between e-learning and case-based learning. The prototype system was developed using opensource frameworks such as Angular 5, Bootstrap, and jQuery, and hosted online using Amazon Web Services (AWS). For the purposes of this research, we have chosen to use the case of “Airbus A380” as our example case study. The aim of this online e-learning platform is to facilitate the acquisition of knowledge related to the case and improve the overall learning experience. CASPER consists of the following six major components: Dashboard, My Profile, Videos, Articles, Stakeholders, and Quiz.

### Dashboard

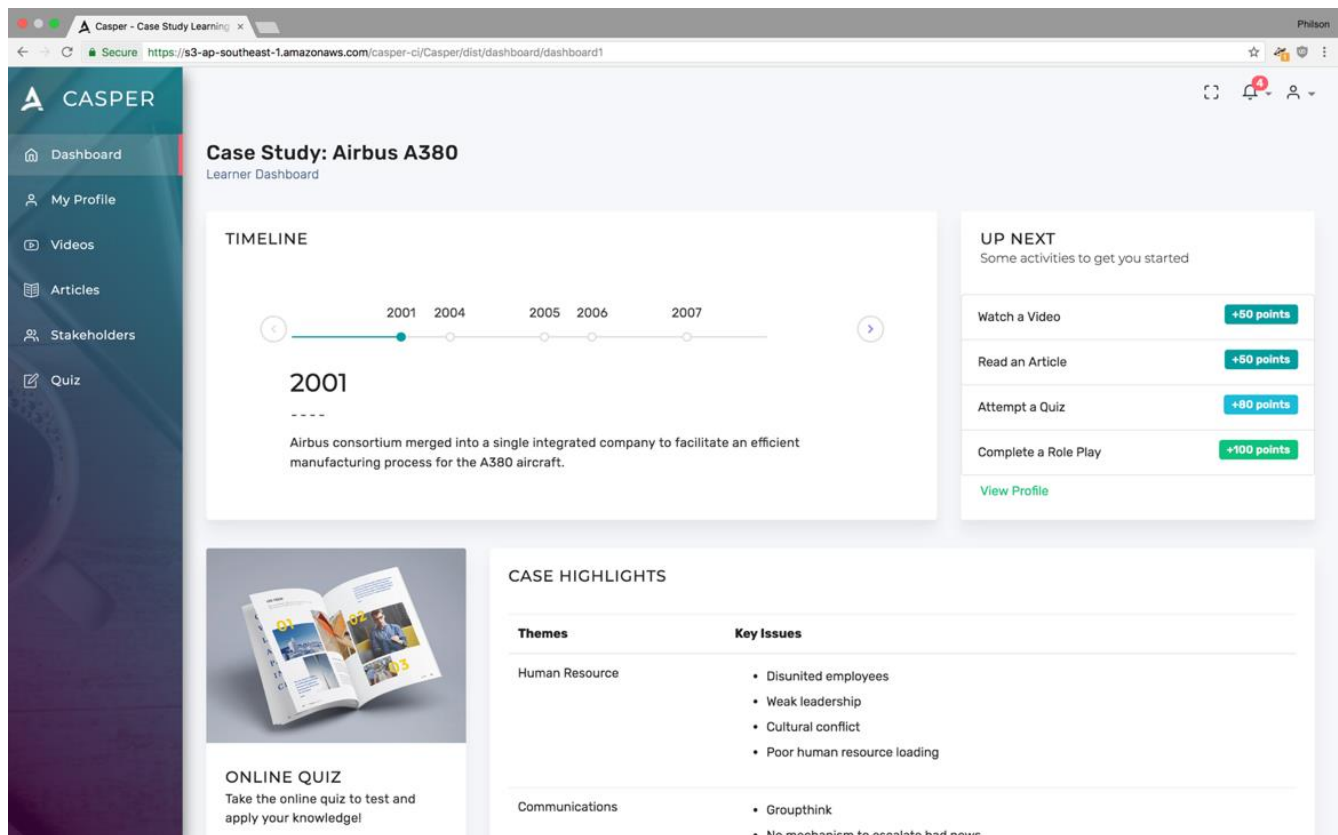


Figure 2. Learner Dashboard

The learner dashboard provides learners with a quick overview of the key concepts and information related to the case. Using elements such as an interactive timeline, helps learners to visualize key details and summarize concepts related to the case. To facilitate the use of Gamification, as well as to build in visual affordances to guide users on how to begin using the system, we have an “Up Next” panel to recommend learning activities for learners to engage in and earn points. The dashboard also contains panels with explanation related to each of the other components: Videos, Articles, Quiz and Stakeholders. Overall, the design of the learner dashboard is in line with our aim of promoting self-driven construction of knowledge. Learners are free to explore the different aspects of the e-learning platform, however appropriate affordance are provided to help users navigate the system confidently.

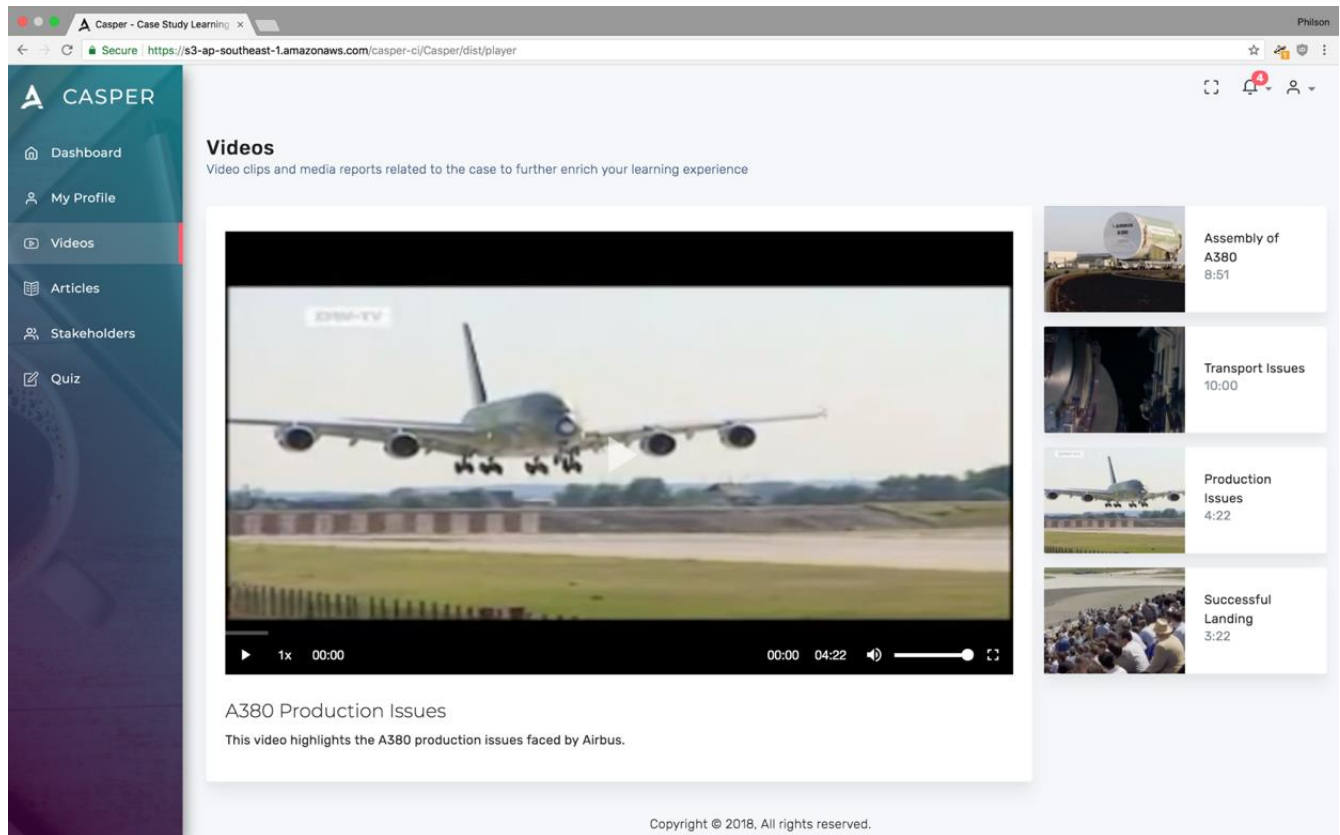
## My Profile

#	Name	Rank	Experience Points
1	Alton	Divine	2599
2	Philson	Grandmaster	1001
3	Fei	Master	956
4	Ya Min	Master	845
5	YOU	Master	466

Figure 3. Learner Profile Page

The user profile page provides the usual user related information such as profile picture and ID, but also serves as the main console for consolidating the Gamification features. Simple badges are used to display the number of activities that the learner has completed. A “Personal Progress” panel shows the experience points that the user has accumulated, as well as a progress bar to denote how far they are from reaching the next level. A leaderboard is displayed to show where the learner ranks among their fellow friends and serves to stimulate healthy competition to motivate further learning. Overall, the combination of Gamification features used, aims to promote self-driven construction of knowledge. Additional features include checking of their “Friends” list (Appendix A, Figure 1) to view their profiles or send messages.

## Videos



The screenshot displays the 'VIDEOS' section of the CASPER learning platform. The page header includes the CASPER logo and navigation links: Dashboard, My Profile, Videos (highlighted), Articles, Stakeholders, and Quiz. The main content area features a video player with a thumbnail of an Airbus A380 in flight, titled 'A380 Production Issues'. Below the player, a description reads: 'This video highlights the A380 production issues faced by Airbus.' To the right of the main video is a vertical list of four video thumbnails with their respective titles and durations: 'Assembly of A380' (8:51), 'Transport Issues' (10:00), 'Production Issues' (4:22), and 'Successful Landing' (3:22). The browser's address bar shows the URL: 'https://s3-ap-southeast-1.amazonaws.com/casper-cj/Casper/dist/player'. A copyright notice at the bottom of the page states: 'Copyright © 2018, All rights reserved.'

**Figure 4. Videos Page**

The “Videos” page aims to further enrich the learning experience by providing media clips related to the case. It is positioned to serve two purposes. First, is as a supplement to the case text to furnish various additional background information pertaining to the case scenarios, in order to stimulate learner interest and provide a richer context to the case. Second, is to help learners to summarize concepts into engaging and digestible formats to aid understanding by means of video. Learners are further encouraged to complete the watching of the videos and they are also awarded experience points for doing so (Appendix A, Figure 2).

# Articles

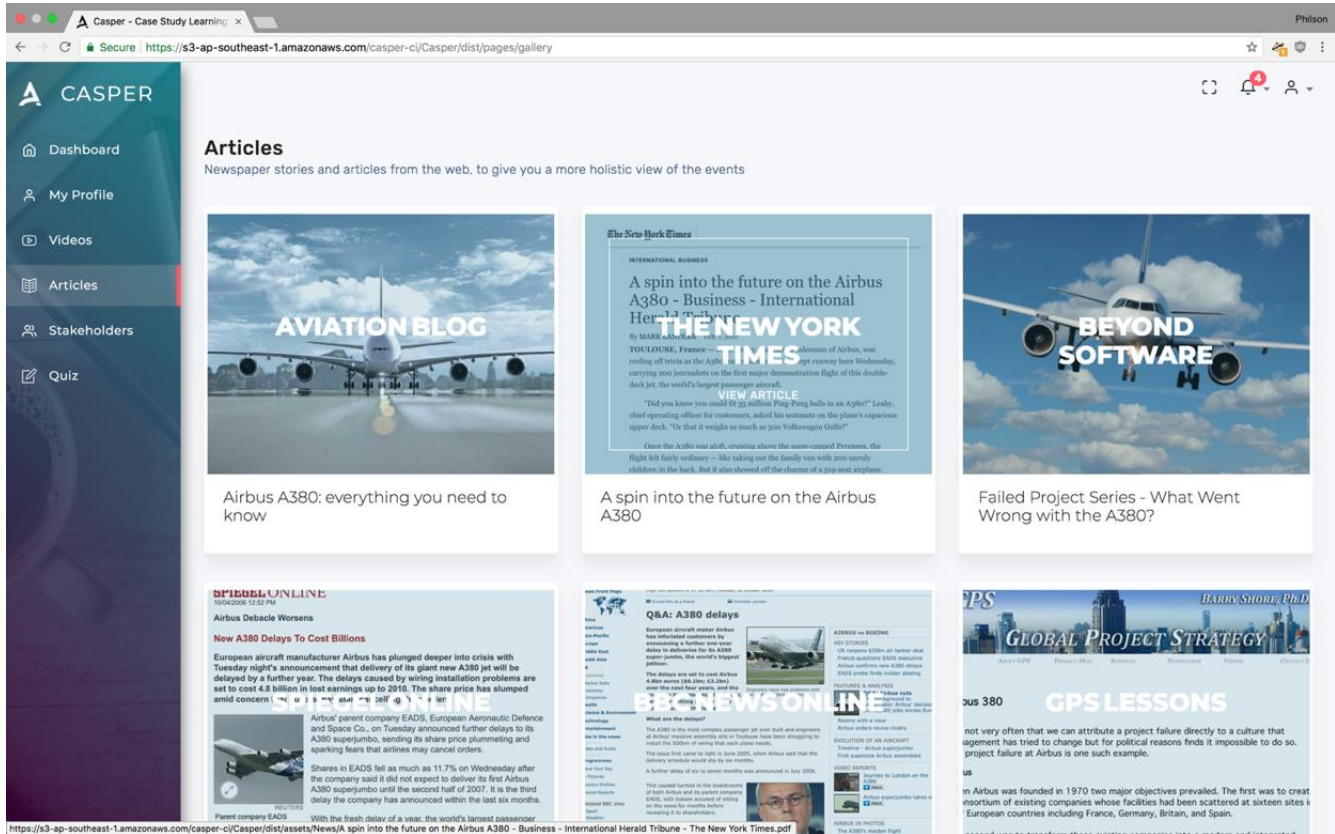


Figure 5. Articles Page

The “Articles” page provides another prong to the multimedia instruction approach. Here, learners are able to view additional news articles and online journals related to the case, which hence provides a more holistic picture of the events that occurred and allows learners to appreciate different perspectives from what was written by the author of the case text. Furthermore, while these nuggets of information are helpful, they are not paramount to the core understanding of the case and can be left out of the main case text. This helps to prevent information overload, and also allows learners the freedom to explore further details on their own.

## Stakeholders

The screenshot shows a web browser window with the URL <https://e3-ap-southeast-1.amazonaws.com/casper-ci/Casper/dist/ukit/textutilities>. The page is titled "Stakeholders" and features a sidebar with navigation options: Dashboard, My Profile, Videos, Articles, Stakeholders (highlighted), and Quiz. The main content area displays three stakeholder profiles in a grid. Each profile includes a photo, name, title, a quote, and a "Role Play" button.

Name	Title	Quote	Role Play Button
CHRISTIAN STREIFF	[New] Chief Executive Officer	"Airbus is not yet an integrated company.. Airbus doesn't yet have a simple and clear organization.."	Role Play
JACQUES CHIRAC	French President	"When the plane takes to the skies, it will carry the colors of our continent, to even greater heights"	Role Play
HENRI COURPRON	Airbus' Head of Procurement	"Success got to our head a bit.. It is a lot easier to be the challenger than to be the title-holder [leapfrogging Boeing]"	Role Play

Figure 6. Stakeholders Page

The "Stakeholders" page provides a list of the different stakeholders involved in the case. Additionally, the photos of the stakeholders are provided along with quotes taken from the case text. This allows users to be able to better identify the different parties and establish rapport with the key stakeholders of the case. From this page, learners are also able to initiate a role-playing simulation for each of the stakeholders (Appendix A, Figure 5). The role-playing simulation presents the learner with a realistic scenario based on the case information and provides the learner a number of options to choose from. Based on the decision taken by the learner, CASPER will display the potential positive and negative implications based on their choice (Appendix A, Figure 6). This would serve to help learners develop a deeper appreciation of the critical decision points in the case.

## Quiz

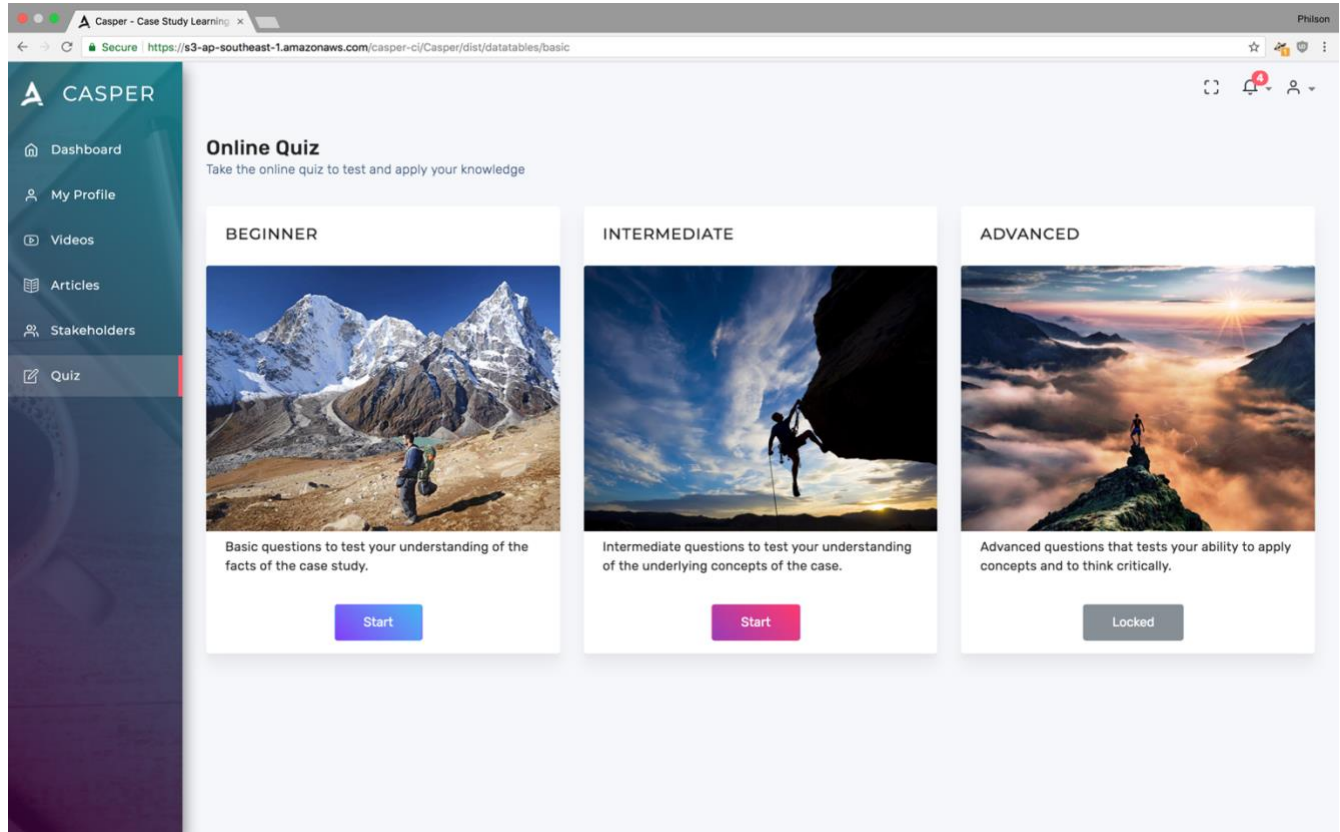


Figure 7. Online Quiz Page

The “Quiz” section provides an avenue for learners to apply their knowledge and therefore enables assessment of understanding. The online quizzes are divided into three levels of difficulty: Beginner, Intermediate, and Advanced. To unlock the Intermediate and Advanced quizzes, learners are required to have passed the preceding level of quiz. This helps to prevent learners from attempting quizzes that are too challenging for their current level of understanding, while it also gradually builds up the learners’ competency and confidence. Results from the close-ended quizzes (Appendix A, Figure 3) are automated and displayed immediately upon completion. It reports to the learner their scores, as well as highlights question which they have gotten wrong (Appendix A, Figure 4).

## RESEARCH METHODOLOGY

A total number of 20 participants (12 males and 8 females) aged between 20 to 55 years old were recruited from the student population of the Wee Kim Wee School of Communication and Information to participate in the research study. Pertaining to the demographic diversity in the research, participants were selected based on different gender, age, and case-study learning experience. The data collection method of the research study is questionnaires. The questions were categorized into four sections. First section contains the demographic information of the participants. The second section includes a quiz with multiple choice questions to evaluate the participants’ understanding of case contents. Each question has only one correct answer. The third section consists of Likert scale questions ranging from 1 (strongly disagree) to 5 (strongly agree) to measure the participants’ experiences and the overall effectiveness of the learning methods. Lastly, qualitative questions were conducted to capture the participant’s feedbacks and suggestions of their overall learning experiences. Prior to the experiment, a pilot study was conducted to examine the feasibility of the approach that is intended to be used in this study and to identify potential problems (Teijlingen & Hundley, 2002).

A before-and-after with within-participant experimental design was used to evaluate the improvement of learner's knowledge acquisition and overall learning experience by cooperating CASPER into the conventional case-based learning. Participants were divided into three groups with each group monitored by one evaluator for the experiment. In the first phase of evaluation, participants were provided the case-based document which presented the case content with text. The document contained the required information to answer the quiz. They were given 15 minutes to read through the document. Following which, the evaluator provided the four sections of questionnaires and participants were instructed to provide the answers with the timespan of 15 minutes. Thereafter, in the second phase, participants were asked to engage in learning activities on CASPER for 15 minutes. Afterwards, they were requested to reattempt the questionnaires, and provide information based on their experience with CASPER. However, participants were not allowed to refer back to the case-based document and denied access to CASPER during the questionnaire assessments.

In order to differentiate the results between the traditional text-based document learning and the CASPER learning experience, two separate set of forms were filled out by the participants. The responses were collected and entered into a Microsoft Excel spreadsheet to create the data set for data manipulation and analysis. To evaluate any differences in participants' quiz scores after incorporating CASPER into the case-based learning process, a paired t-test was used. Thereafter, we performed a percentage calculation of the framework validation results (Likert scale) to measure the participants' experiences on the overall effectiveness of both learning methods. Finally, qualitative feedback from the participants regarding their overall learning experiences were categorized and analyzed.

## RESULTS AND DISCUSSION

### Analysis on Quiz Scores

The results indicated that the quiz scores were significantly improved after participants engaged in CASPER (Table 1). There was a significant difference in the quiz scores for text-only learning ( $M = 8.9$ ,  $SD = 2.654$ ) and CASPER ( $M = 11$ ,  $SD = 2.575$ ) conditions ( $t = 5.385$ ,  $p < 0.000$ ). On average, the scores were 1.55 points higher after conducting CASPER (95% CI [1.284, 2.916]). Therefore, CASPER appeared to help improve the students' understanding on the case contents and helped them to remember the key points and highlighted concepts.

Outcome	Text-only Learning		CASPER			95% CI for Mean Difference		t	df
	M	SD	M	SD	n				
	8.90	2.654	11.00	2.575	20	1.284, 2.916		5.385	19

$P < 0.000$

**Table 1. Results of T-test for Text-Only Learning and CASPER**

### Analysis on Effectiveness of Learning Methods

After reading text-based case study (Table 2), about 80% of students agreed that they were able to identify the key decision points and stakeholders in the case study. 85% of students strongly agreed that they are aware of the context and concepts and continue to gain a deeper understanding as they progressed through the study. Furthermore, 65% of students agreed and strongly agreed that they had the freedom to explore and plan their own learning. 90% agreed that they were able to apply the concepts that they had learnt. On the other hand, 30% of students neither disagreed nor agreed that they were able to identify the key concepts and had the freedom to plan their own study. Lastly, 40% neither disagreed nor agreed that they felt motivated to explore the case study.

After participants engaged CASPER e-learning platform (Table 2), there was a change in the audience's response. Within the 9 questions in the quiz, more than 90% agreed and strongly agreed that they were able to validate their understanding and plan their study. However, 20% neither disagreed nor agreed that they were motivated to

continue to explore more about the case, or that they were able to identify areas where they lacked understanding. Overall, the responses from the second quiz revealed that most of the students agreed that they were able to understand key content, stakeholders' decisions, apply their knowledge, and summarize the lessons learnt.

After Reading Text-Based Case Study						
	1 = Strongly Disagree	2 = Disagree	3 = Neither Disagree nor Agree	4 = Agree	5 = Strongly Agree	
1. I was able to identify the key decision points of the Case Study			2	3	14	
2. I was able to identify the key stakeholders involved in the Case			1	2	17	
3. I understood why the decision makers chose their course of actions			2	5	9	4
4. I was able to identify the key concepts introduced in the Case Study			2	6	8	4
5. I was aware of the context of the concepts that were introduced			1	2	16	1
6. I felt able to confidently summarize the key lessons learnt			1	5	12	2
7. I had the freedom to explore and plan my own learning			1	6	9	4
8. I gradually understood more as I progressed through the study			2	1	15	2
9. I felt motivated to continue to explore more about the Case			2	8	6	4
10. I was able to validate my understanding of the Case Study			1	4	15	
11. I was able to identify areas where I lacked understanding			2	7	7	4
12. I was able to confidently apply the concepts that I had learnt			1	1	18	
After Participants Engaged CASPER E-learning Platform						
	1 = Strongly Disagree	2 = Disagree	3 = Neither Disagree nor Agree	4 = Agree	5 = Strongly Agree	
1. I was able to identify the key decision points of the Case Study				2	10	8
2. I was able to identify the key stakeholders involved in the Case				2	9	9
3. I understood why the decision makers chose their course of actions				4	5	11
4. I was able to identify the key concepts introduced in the Case Study				1	7	12
5. I was aware of the context of the concepts that were introduced				1	5	14
6. I felt able to confidently summarize the key lessons learnt				2	8	10
7. I had the freedom to explore and plan my own learning				2	8	10
8. I gradually understood more as I progressed through the study				2	8	10
9. I felt motivated to continue to explore more about the Case				4	7	9
10. I was able to validate my understanding of the Case Study				2	11	7
11. I was able to identify areas where I lacked understanding				4	6	10
12. I was able to confidently apply the concepts that I had learnt				2	11	7

**Table 2. Results of Survey on Effectiveness of Learning Methods**

### Analysis on Qualitative Feedback from Participants

After reading text-based case study, 35% of the students felt that reading the case study was effective for their learning. However, 65% of students gave feedback that it was boring to read, difficult to find key points, had no discussion involved or that there was a lack of time for reading. Nearly 75% of students indicated that they were not confident in holding a discussion of this case study after the reading. 60% of students were not able to appreciate the context of the case and the stakeholders, and they felt confused about the names and couldn't pay attention to the details of the stakeholders. Some suggestions given include to highlight important information, make learning more visual, provide more background stories and to include more interaction.

After participants engaged CASPER e-learning platform, all the students recognized that the case-based e-learning platform made their study more effective, particularly through the inclusion of interesting content, and an interactive environment which allowed them to more effectively recall information from the case study. Moreover, all the students agreed that they were more confident now in holding a discussion of the case. 95% of students indicated that they were able to better appreciate the context of the case and felt that the multimedia and role play helped them to better understand the stakeholder's perspective. Most of the students suggested that the e-learning platform can continue to improve on the multimedia, user interaction, elements of gamification, and engage more using the discussion forum & feedback section.

### Key Findings

The main challenge with the traditional text-only modes of delivering cases, is that learners often find it difficult to find critical information quickly. Some also find it boring to read large amounts of text with no interactivity, and others indicated that they felt confused by the copious amount of content presented in the text. Through our study, we have found that learners generally felt that the CASPER e-learning platform helped them to gain a better understanding of the key concepts and the case content. Results also showed that learners were able to better remember detailed case information such as stakeholders' names, case related issues, specific dates and figures.



While the conventional text-based approach was also somewhat effective in helping participants acquire knowledge, it may have been difficult to sustain longer periods of attention from participants. Our evaluation results indicated that participants showed little interest in reading the document as they found it to be rather boring. In contrast, according to feedback, most participants felt that a web-based e-learning platform such as CASPER, which was designed to be touch-friendly and mobile-friendly, provides them with greater flexibility on the way they acquire their knowledge. Such a platform allows information to be accessible on any device at anytime and anywhere.

The integration of gamification features to stimulate engagement and a sense of competition could have been one of the contributing factors to the overall effectiveness of CASPER. Participants were able to informally compete against each other in progression and compare scores with one another thus fueling their competitive spirits. Moreover, the combination of various multimedia such as photos, graphics, videos and text helped to trigger deeper levels of engagement with participants to help them remember the information that they have learned. We received several informative feedbacks for improvements. Participants responded that CASPER could be further improved by incorporating more interactive elements, adding of a discussion forum, and better categorizing of multimedia resources. However, on a whole, feedbacks regarding CASPER were generally positive, with most participants stating that it was beneficial in facilitating an engaging case-based learning environment. Drawing from the lessons we learnt from this study, it is therefore our recommendation that developers of case-based e-learning platforms, take into account the expectations of the modern tech savvy learner. By incorporating engaging e-learning elements as well as user-friendly UI design, as demonstrated in CASPER, the effectiveness of case-based learning can be significantly improved.

### **Limitations and Future Research**

There are two main limitations in our study. First, the findings must be interpreted in light of the limited sample size of 20 participants. As the nature of research requires specific knowledge (case-study learning experience), we used purposive sampling in recruiting participants. Consequently, the demographical background of respondents can pose limitations for our study to be generalized to a larger population, considering that majority of the respondents were students who have undergone higher education. Therefore, expanding the number of participants and inviting more students with diverse demographic backgrounds, different educational levels and learning experiences can be considered for future research to make the results more reliable.

Second, the CASPER e-learning platform was designed specifically with consideration of the “Airbus A380” case. It is noted, that the preparation of case materials requires significant effort, and that instructors may wish to modify and adjust certain elements of the system based on the structure and requirements of their lessons. A possible extension of our current work, would be to hence develop a system with more customizable with modular components, to allow instructors to modify, add, or remove components based on their teaching needs. Additionally, future work may wish to consider incorporating some of the valuable suggestions provided by the participants. Particularly, the inclusion of more interactive elements and multimedia, and the provision of a discussion forum to facilitate social interaction.

### **CONCLUSION**

E-learning has experienced widespread adoption by educators and institutions over the years. The flexibility it enables by being accessible at anytime and anywhere has brought about much convenience to both teachers and students alike. Well-designed e-learning applications have been shown to positively impact learning effectiveness. Conversely, poorly designed e-learning environments not only produce negligible improvements on learning but have negative implications on learner motivation. Hence, it is crucial that educators do not abuse e-learning tools by simply applying them to incoherent teaching strategies. Additionally, it is important for e-learning platforms to be designed around established pedagogical theories. Case-based learning has been extensively practiced in a variety of programs at higher learning institutions. The crux of the case-based learning approach, is that it allows learners to analyze problem scenarios through multiple perspectives to appreciate the application of theoretical concepts within real-world contexts. This has been shown to help stimulate learner curiosity and develop critical thinking skills. Traditionally, case-based learning methods have required learners to devote long periods of time

into reading and understanding case materials to enable them to partake in class discussions. Moreover, case materials have primarily been presented in textual form, requiring additional aid from instructors to help learners summarize key concepts and insights. Thus, there exists a potential opportunity to apply e-learning technologies to enrich the learning experience of case-based learning methods.

However, while the features and benefits of adopting e-learning technologies are well understood, and case-based learning as a pedagogy has already been thoroughly studied, there appears to be a lack of research into understanding how to effectively apply e-learning features to facilitate case-based learning. In this research, we have taken a three-fold approach to address this knowledge gap. First, we reviewed several unique e-learning features, and examined the key elements of case-based learning. By integrating the two areas of understanding, we designed a framework for applying features of e-learning to facilitate case-based learning. Second, using the framework as guide, we developed an e-learning prototype (CASPER) to demonstrate its viability. CASPER was built using opensource web technologies and subsequently hosted onto web servers to enable evaluation. Third, we conducted a before-and-after experiment to evaluate the efficacy of our e-learning prototype in enabling and engendering case-based learning. The results of this preliminary evaluation seemed promising. Quiz scores were significantly improved over traditional text-only case delivery, indicating better knowledge retention and understanding of the case. Analysis on the effectiveness of learning methods also showed a shift in sentiments after participants engaged with CASPER, as majority of students agreed that they were able to understand key concepts, appreciate the stakeholder decisions, apply their knowledge, and summarize lessons learnt. Participants also indicated through qualitative feedback, that the CASPER system allowed them to better understand case content and provided a more interesting and engaging learning experience.

We must acknowledge that there are limitations to our study. Firstly, the findings should be interpreted in light of the limited sample size of 20 participants. Furthermore, purposive sampling was used in recruiting participants, thereby limiting the population demographics. Secondly, the CASPER e-learning platform was designed specifically with consideration of the “Airbus A380” case. Consequently, the flexibility and customizability of the e-learning platform in supporting other types of cases has not been explored. Therefore, future research may wish to look into addressing these two areas of limitations. Expanding the number of participants and inviting students with diverse demographic backgrounds would likely improve the credibility of results. Further extensions of CASPER to incorporate more interactive features, and to make the system more customizable and modular would likely allow instructors better tailor the e-learning platform to suit their teaching requirements. Nevertheless, this research contributes to the body of knowledge by exploring the intersection between e-learning and case-based learning. We hope that future research develops on the groundwork laid by this paper to examine other features of e-learning and their potential applicability to facilitating and enabling case-based learning.

## **ACKNOWLEDGEMENTS**

Our team would like to take this opportunity to express our gratitude to the parties that made this critical inquiry project possible. Firstly, we would like to thank our supervisor, Prof. Alton Chua Yeow Kuan for his guidance and assistance throughout the project. His invaluable advice and feedback helped us to chart clear directions for our research and drove us to take the quality of our work to greater heights. Secondly, we would like to express our appreciation for the twenty participants that took part in our evaluation. Their kind cooperation and participation allowed us to gather the data necessary for our study. Thirdly, we would like to thank the school, Wee Kim Wee School of Communication and Information, Nanyang Technological University, for giving us the experience of carrying out such a fulfilling critical inquiry project. Last but not least, we would like to sincerely thank our close friends and classmates in the MSc in Information Systems (MSIS) program for the moral support and camaraderie established along the way. For without them, this journey would not have been as enjoyable. Thank you.

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# APPENDICES

## Appendix A – Screenshots of CASPER (<http://bit.ly/CasperCI>)

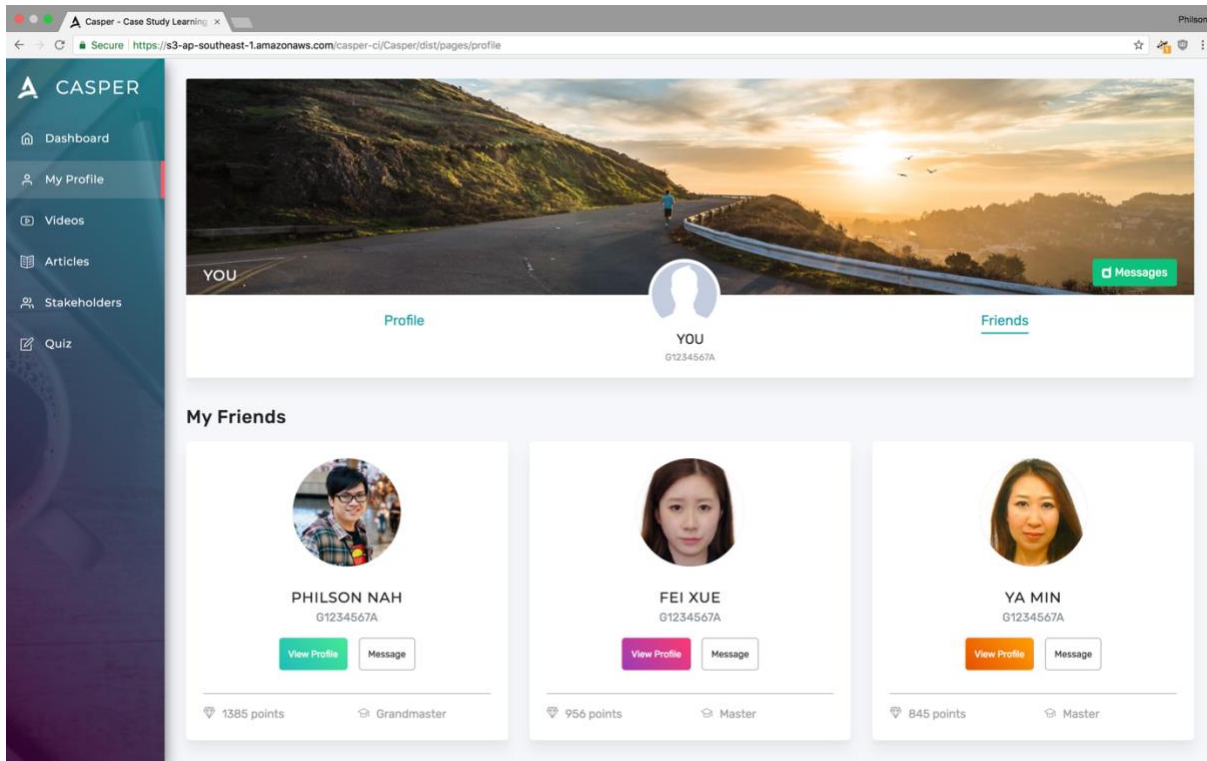


Figure 1. My Profile – “Friends” Page

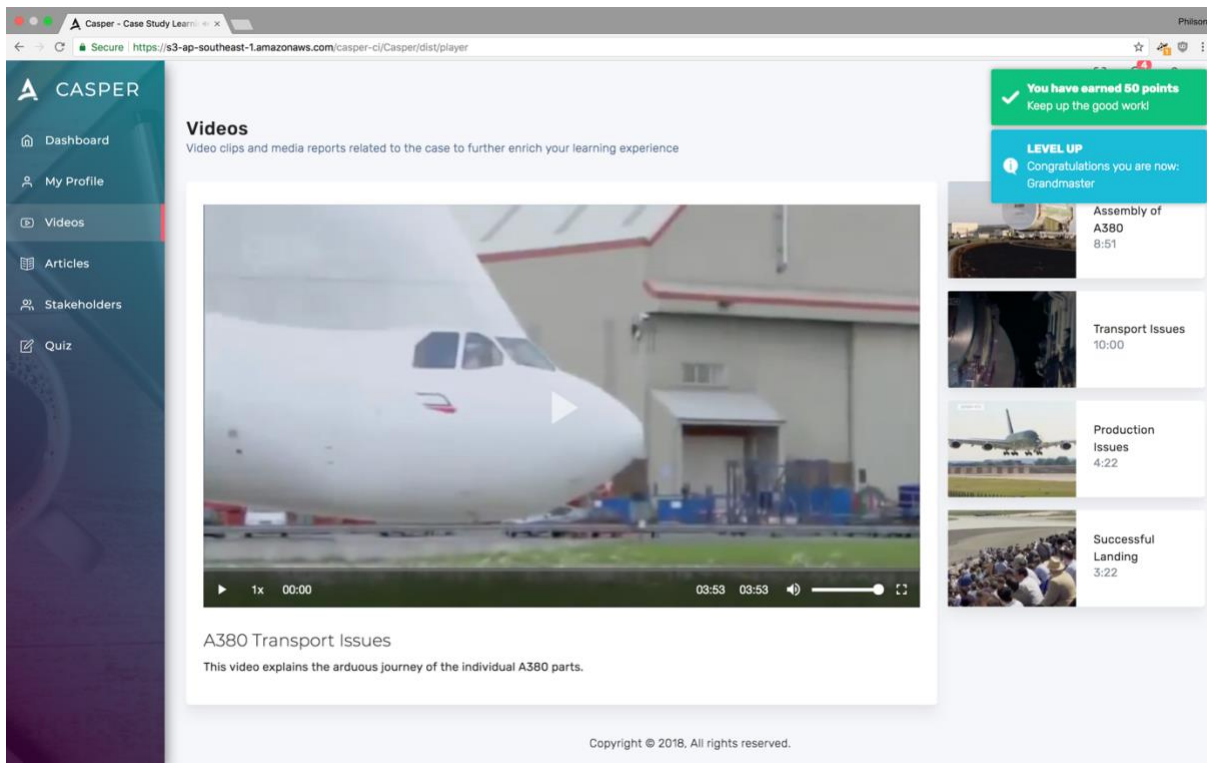
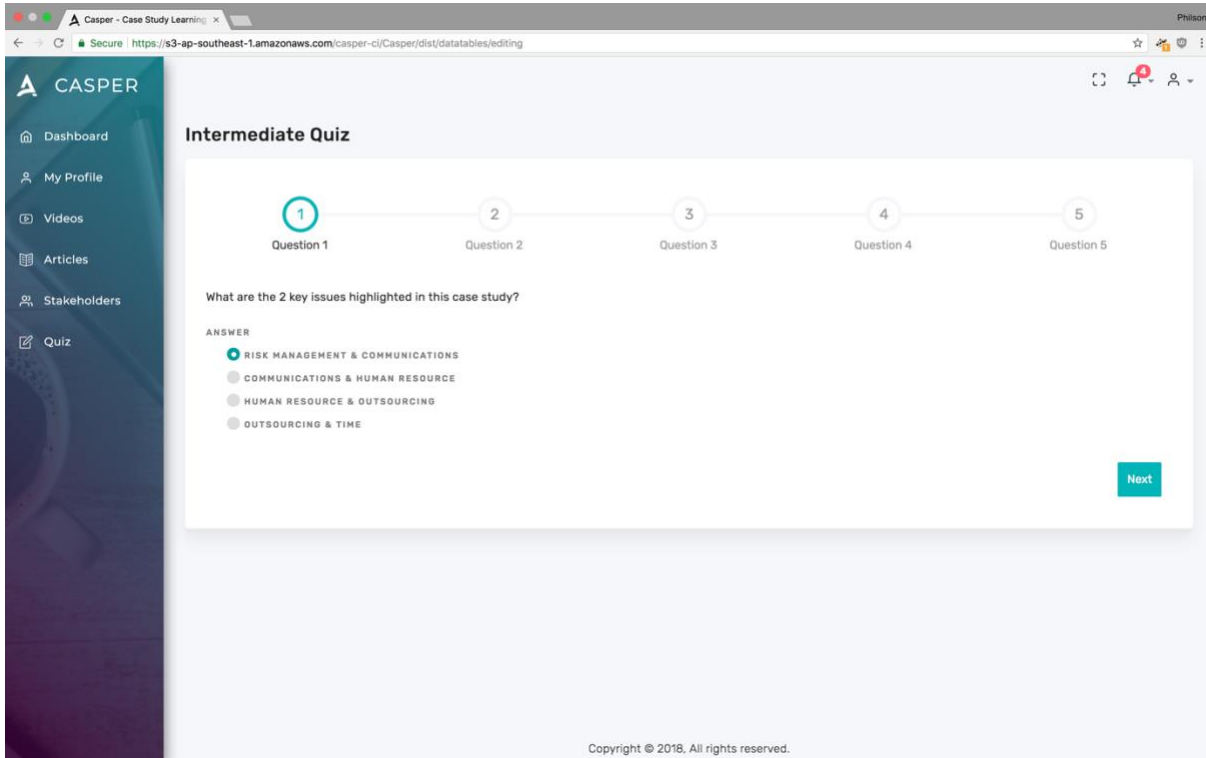
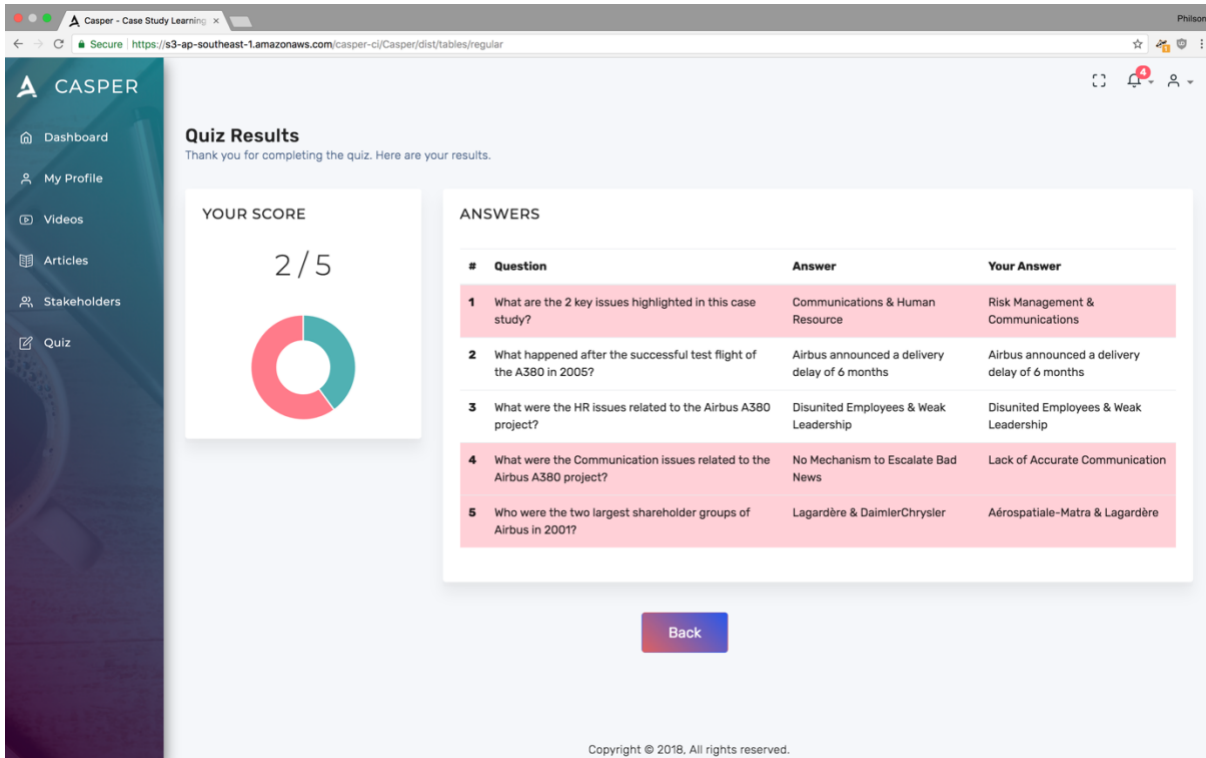


Figure 2. Award of Experience Points and User Level Up



**Figure 3. Close Ended Quiz Questions**



**Figure 4. Quiz Results – Scores and Answers**

Figure 5. Role Playing Scenario

Figure 6. Role Playing Decision Outcome

## Appendix B – Evaluation Questions

### Demographic Information

1. What is your age?

- 21 to 30
- 31 to 40
- 41 to 50
- 51 and above

2. What is your gender?

- Male
- Female

3. What is type of student category are you currently being matriculated as?

- Undergrad
- Postgrad
- Others: \_\_\_\_\_

4. Do you have “case study” learning experiences before?

- Yes
- No

## Case-Study Quiz

1. When was the first A380 aircraft handed over to its first buyer?

- 2005
- 2006
- 2007
- 2008

Answer: 2007

2. What is the fuel capacity of A380?

- Less than 1000,000 liters
- 100,000 to 1999,999 liters
- 200,000 to 2999,999 liters
- 300,000 liters and above

Answer: 300,000 liters and above

3. What was the price tag of each A380 aircraft?

- US\$180 million
- US\$280 million
- US\$380 million
- US\$480 million

Answer: US\$280 million

4. What is the A380 seating capacity for passengers?

- Less than 300 passengers
- 300 to 399 passengers
- 400 to 499 passengers
- 500 passengers and above

Answer: 500 passengers and above

5. Prior to its launch as the A380, what was the project name for Airbus' twin-deck aircraft?

- A3XX
- A3000
- A3YY
- UHCA

Answer: A3XX

6. Which countries were involved in building the A380 components?

- a. UK
- b. Italy
- c. Germany
- d. Denmark

- a & b
- b & d
- a & c
- b & c

Answer: a & c

7. What was the estimated cabin length of the A380 aircraft?

- 30 meters
- 40 meters
- 50 meters
- 60 meters

Answer: 50 meters

8. How much was the total loss for the A380 project?

- US\$ 4.1 billion
- US\$ 5.1 billion
- US\$ 6.1 billion
- US\$ 7.1 billion

Answer: US\$ 6.1 billion

9. What were the main issues that caused the A380 project delay?

- a. Human Resource
- b. Communication
- c. Risk Management
- d. Cost Management

- a & b
- b & d
- a & c
- b & c

Answer: a & b

10. In 2004, different parts of the A380 were transported for assembly in a single location at Toulouse, and the mechanics identified an installation issue. What was the cause of the issue?

- Lack of human resource
- Design and structure
- Incompatible design software
- Technical complexity

Answer: Incompatible design software

11. Which factors should Airbus consider to facilitate efficient manufacturing processes for the A380?

- Engineering proficiencies & Sophisticated technologies
- Political support & Infrastructural investment
- All of the above
- None of the above

Answer: All of the above

12. What were the attributes that caused Airbus's mismanagement of the A380 project?

- a. Lack of proper communication
- b. Lack of technical expertise
- c. Poor design inspection
- d. Lack of cohesion between employees

- a & b
- b & d
- a & d
- b & c

Answer: a & d

13. What is one of the main contribution factor that caused the failure of A380 project?

- Ineffective leadership
- Unrealistic expectations
- Inaccurate cost estimations
- Lack of project document

Answer: Ineffective leadership

14. During the assembly of the A380 parts, German mechanics found out about the wiring problem, but why didn't they escalate it to the management?

- Inaccurate time and effort estimates
- Lack of effective communication at all level
- Inadequate technical skills
- Lack of project requirements clarity

Answer: Lack of effective communication at all level



15. Which are the contributing factors that lead to groupthink in the A380 project?

- a. Complacency
- b. Unquestioned beliefs
- c. Positive thinking
- d. Peer pressure

- a & b
- b & d
- a & d
- b & c

Answer: a & b

## Framework Validation Questions

Please answer the following questions in relation to your learning experience with the Case Study learning that you have just completed. These questions relate to the thoughts and feelings you may have experienced throughout the duration of the learning. There are no right or wrong answers. Think about your experience and the overall effectiveness of the learning methods. Answer the questions using the rating scale below.

### Rating scale:

1 = Strongly disagree

2 = Disagree

3 = Neither disagree nor agree

4 = Agree

5 = Strongly agree

<p><b>A. Critical Decision Points</b></p> <p>1. I was able to identify the key decision points of the Case Study</p> <p>2. I was able to identify the key stakeholders involved in the Case</p> <p>3. I understood why the decision makers chose their course of actions</p>	<p>1 2 3 4 5</p> <p>1 2 3 4 5</p> <p>1 2 3 4 5</p>
<p><b>B. Summarization of Concepts</b></p> <p>4. I was able to identify the key concepts introduced in the Case Study</p> <p>5. I was aware of the context of the concepts that were introduced</p> <p>6. I felt able to confidently summarize the key lessons learnt</p>	<p>1 2 3 4 5</p> <p>1 2 3 4 5</p> <p>1 2 3 4 5</p>
<p><b>C. Self-Driven Construction of Knowledge</b></p> <p>7. I had the freedom to explore and plan my own learning</p> <p>8. I gradually understood more as I progressed through the study</p> <p>9. I felt motivated to continue to explore more about the Case</p>	<p>1 2 3 4 5</p> <p>1 2 3 4 5</p> <p>1 2 3 4 5</p>
<p><b>D. Assessment of Understanding</b></p> <p>10. I was able to validate my understanding of the Case Study</p> <p>11. I was able to identify areas where I lacked understanding</p> <p>12. I was able to confidently apply the concepts that I had learnt</p>	<p>1 2 3 4 5</p> <p>1 2 3 4 5</p> <p>1 2 3 4 5</p>

## Opinion and Effectiveness Questions

1. How do you feel about the overall effectiveness of the learning approach? Please elaborate.

2. Do you feel more confident now in holding a discussion about the case? Why?

3. Were you able to appreciate the context of the case and the stakeholders involved? Why?

4. How do you think this case study can be presented better?

5. Any further suggestions on how to improve the overall learning experience?

## Appendix C - WKWSCI Institutional Review Board Approval



Wee Kim Wee School of Communication and Information

Reg. No. 200604393R

8 March 2018

WKWSCI IRB Code: **CI201718S2-016**

A/P Alton Chua, Principal Investigator

Nah Zheng Xiang, Philson

Xue Fei

Ya Min Oo

### **WKWSCI Institutional Review Board Approval Project Title: Design of an e-Learning Prototype**

I refer to your application for ethics approval with respect to the above project submitted on 28 February 2018.

The school board has deliberated on your application and noted from your application that your research involves survey with participants

You have also confirmed that informed consents will be obtained from the participants and you have guaranteed the confidentiality of your participants' biodata obtained from them.

The documents reviewed were:

- |   |                  |
|---|------------------|
| a) Epigeum Certificate of Completion                | 28 February 2018 |
| b) Participation Information Sheet and Consent Form | 28 February 2018 |
| c) Questionnaire                                    | 28 February 2018 |
| d)  |                  |
| e)  |                  |
| f)  |                  |

The board is therefore satisfied with the ethical considerations for the project and approves the ethics application under Exempted Review. The approval period is from 8 March 2018 to 7 March 2019. Please use the WKWSCI IRB Code **CI201718S2-016** for all future correspondence.

The following protocol and compliances are to be observed upon WKWSCI IRB approval:

1. All research involving procedures greater than minimal risk on minors (individuals who are less than the legal age of 21 years old) requires IRB approved written Parental Consent and assent from the participant to be obtained before any research protocols can be administered. Minimal risk refers to an anticipated level of harm and discomfort that is no greater than that ordinarily encountered in daily life, or during the performance of routine educational, physical, or psychological examination.

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[www.ntu.edu.sg/sci](http://www.ntu.edu.sg/sci) Email: [WKWSCI-IRB@ntu.edu.sg](mailto:WKWSCI-IRB@ntu.edu.sg)

2. Only the approved Participants Information Sheet and Consent Form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject should be given a copy of the signed consent form.
3. No deviation from, or changes of, the protocol should be initiated without prior written WKWSCI IRB approval of an appropriate amendment.
4. The Principal Investigator should report promptly to WKWSCI IRB regarding:
  - a. Deviation from, or changes to the protocol.
  - b. Changes increasing the risk to the subjects and/or affecting significantly the conduct of the trial.
  - c. All serious adverse events (SAEs) which are both serious and unexpected.
  - d. New information that may affect adversely the safety of the subjects of the conduct of the trial.
  - e. Completion of the study.

**WKWSCI Institutional Review Board**

On behalf of the Associate Chair-Communication and Information (Research)

(This is an auto-generated letter. No signature is required.)