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An Exploratory Study of Game-based M-learning for Software Project Management

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Abstract: Given that the virtues of m-learning have not yet been fully exploited in teaching Software Project Management (SPM), this paper embarks on a timely endeavour to explore the use of game-based m-learning for SPM by introducing a game called Mobile Application for Project management LEarning (MAPLE). A total of 55 graduate students were invited to participate in the evaluation study carried out for the MAPLE application. The evaluation was based on three design principles derived from the literature, namely, motivation, gaming and learning. Based on the preliminary evaluation, three major observations could be culled. One, game-based m-learning is a useful and an entertaining augmentation to traditional learning. Two, design principles namely motivation, gaming and learning and their appropriate blending is necessary to develop an effective m-learning game. Finally, appealing features in MAPLE are risk alerts, avatar creation and feedback.

Keywords: m-learning, software project management, motivation, gaming
Categories: L.5.1

1 Introduction

With the advancements in mobile ICTs such as mobile phones, wireless PDAs, tablets and other handheld mobile devices, in-class learning practices can be augmented in a mobile environment [Du, 10]. Mobile learning (m-learning) refers to the acquisition of knowledge through the use of mobile devices [Sandberg, 11]. It offers anytime-anywhere learning experiences and is popularized by the affordability of handsets and the availability of plethora of learning applications [Laine, 10].

As a way to enliven individualized learning, educators have incorporated games which enable mobile learners to acquire new knowledge at their own pace based on individual learning style, preferences and needs in a fun manner [Namsoo, 11]. Specifically, game-based m-learning has emerged from formally associating learning objectives with gameplay to promote learning in the cognitive, affective and/or psychomotor domains in a mobile environment [Sauvé, 07]. Such games assist context-aware knowledge transfer as players learn concepts through progressive development of skills including abstraction, strategy building, problem-solving and spatial representation [Whelan, 05]. Nonetheless, designing m-learning gaming

applications that seamlessly combine features supporting mobile technology, learning content and gameplay remains a challenge [Sharples, 09].

In parallel, due to the growing attention in Software Project Management (SPM) from both practitioners and academicians; SPM education is always evolving. For one, software projects are becoming more complex. Furthermore, the effectiveness of using classroom instruction exclusively to teach concepts of SPM is questionable since learners' skills may not be realistically elicited [Winter, 06]. An effective approach to address this concern is to augment traditional teaching by affording a simulated real-world experience where learners can acquire and practice SPM skills. However, except for limited budding efforts to design desktop simulation engines for SPM, little headway hitherto has been made in this direction [Martin, 00]. Given that the virtues of m-learning have not yet been fully exploited, we embark on a timely endeavour to explore the use of game-based m-learning for SPM by introducing a game called Mobile Application for Project management LEearning (MAPLE). Representing an initial phase of a larger effort, this paper has a two-fold objective. One, it seeks to introduce an m-learning game application, MAPLE which incorporates gameplay and the concepts of SPM. Two, it seeks a preliminary evaluation of the application and reports how participants perceive the prospects of MAPLE both as a game and a learning experience.

The rest of the paper is structured as follows. Section 2 offers a literature review on the principles for designing m-learning games and the technologies that support game based m-learning. Section 3 describes the design overview and the features incorporated in MAPLE, based on literature. Section 4 presents the research methodology and highlights the evaluation of the game, based on the data collected from the 55 participants. Thereafter, in sections 5 and 6, results and discussion follow. Finally, section 7 concludes the paper with suggestions for future improvements.

2 Literature Review

2.1 Principles for Designing M-learning Games

Three general principles which pertain to game-based m-learning identified from extant literature are motivation, gaming and learning. Motivation is an intrinsic impetus that drives players to get involved in a game and is therefore essential to ascertain players' engagement. Motivation can be established in a game by means of three constituent principles namely (1) flow, (2) curiosity and (3) players' autonomy. Flow is a state of deep absorption in an activity that is pleasurable when players are focused on their play and performance [Csikszentmihalyi, 90; Prensky, 02]. Flow is achieved when players strike an optimal balance between their skills and the challenge presented [Admiraal, 11]. Curiosity consists of two variants namely, sensory curiosity which refers to an arousal of interest in the senses, and cognitive curiosity which develops through the semantic content of information. Sensory curiosity can be addressed by offering an emotionally appealing fantasy whereas cognitive curiosity can be aroused through random elements of surprise such as introducing new information at different stages of the game and through non-deterministic outcomes [Malone, 81; Pivec, 04]. Players' autonomy is established

when they perceive themselves as the originators of their action. Players look for optimal challenges when they feel autonomous [Csikszentmihalyi, 90; Charles, 08].

The gaming principle entails the very act of playing a game by utilizing the standard features which are provided to evoke entertainment and enjoyment in players. A fulfilling gaming experience can be ensured through five constituent gaming principles namely (1) goals and rules, (2) player's control, (3) challenge, (4) feedback and (5) rewards. Game goals outline the objectives to be achieved whereas rules specify how to accomplish the goals. Clear goals and rules help players' cognitive development, especially enhancing abstract thinking and organizational skills [Garris, 02]. Players' control is the ability of players to regulate their gaming activities and direct command elements of the game to suit their learning styles, strategies and previous experiences [Quintana, 06]. Players' control is an essential factor to create individualized learning leading to mastery of subject matter as well as to develop positive attitude towards learning activities [Blumenfeld, 06]. Challenges must necessarily be progressive within the game to encourage players to compete with themselves and improve their previous accomplishments [Inal, 07]. In order to facilitate learning, players must be offered optimal challenges with activities that lie just outside their ability. In other words, activities should neither be too simple nor too difficult to attract increased effort and performance [Vygotsky, 78]. Feedback allows players to assess their current performance and seek improvements to reduce any discrepancy between goals and performance [Wagner, 94]. Feedback can be provided in several ways such as reporting correct or incorrect individual answers or indicating the number of correctly solved problems out of a total score which enable players to either pass or fail to proceed to the next level [Whitehall, 93]. Finally, the structure of the rewards and the manner in which they are delivered is essential to create a positive gaming experience [Squire, 03]. A variety of rewards that can be implemented include currency rewards, rank rewards, emotional rewards, mechanical rewards and new toys, places or artefacts [Troconis, 10].

The learning principle underpins acquisition of knowledge which is one of the primary objectives of an m-learning game. The three constituent principles that support learning through games are namely (1) Constructivist learning, (2) Situated learning and (3) Kolb cycle. Constructivist learning suggests that an m-learning game should enable players to construct and refine knowledge structures through cognitive learning techniques. It considers learning as being a self-oriented and active process of building knowledge through constant involvement in mental exercises [Schmidt, 04]. Situated learning takes places when an m-learning game is able to offer case-based problem solving under varying situations or circumstances [Naismith, 04]. It suggests that learning is highly contextualized and that knowledge is acquired more effectively through situated interaction rather than a mere analysis of inert factual data [Feinstein, 10]. The Kolb cycle emphasizes that an m-learning game should constantly engage players in decision making and learning actively from making discoveries for themselves. It suggests that learning happens through four successive stages namely, concrete experience, reflective observation, abstract conceptualization and active experimentation [Kolb, 84]. Table 1 illustrates a summary of the design principles.

Design Principles	Constituent Principles	Description
Motivation	Flow [Admiraal, 11]	Achieved when players strike optimal balance between their skills and the challenge presented
	Curiosity [Pivec, 04]	Aroused by introducing new information at different stages of the game and through non-deterministic outcomes
	Players' Autonomy [Csikszentmihalyi, 90; Charles, 2008]	Established when they sense themselves as the originators of their actions
Gaming	Goals and Rules [Garris, 02].	Assist in players' cognitive development, especially enhancing abstract thinking and organizational skills
	Players' control [Quintana, 06]	Enables players to regulate their gaming activities and direct command elements of the game
	Challenge [Inal, 07]	Encourages players to compete with themselves
	Feedback [Wagner, 94]	Guides players to reach their goals by indicating outcomes of their actions and status of their performance
	Rewards [Troconis, 10]	Create a positive gaming experience
Learning	Constructivist learning [Schmidt, 04]	Suggests that an m-learning game should enable players to construct and refine knowledge structures through cognitive learning techniques
	Situated learning [Naismith, 04; Feinstein, 10]	Takes place when an m-learning game is able to offer case-based problem solving under varying situations or circumstances
	Kolb cycle [Kolb, 84]	Emphasizes that an m-learning game should constantly engage players in decision making

Table 1: Design Principles

2.2 Technologies supporting Game-based M-learning

In order to facilitate game-based m-learning, mobile technology devices need to demonstrate at least six essential characteristics. One, they must be highly portable so that they can be easily carried and be available to a user whenever one needs. Two, they should enable individual adaptability based on a user's learning ability and learning style. Three, the devices must be unobtrusive to facilitate unconstrained learning. Four, they must be adaptable to the context of learning, and evolving skills and knowledge of the user. Five, they should facilitate ease to use to a novice user. Six, in addition to efficient communication, they should provide anytime-anywhere access to information [Sharples, 06]. A number of mobile devices that can incorporate m-learning include laptop computers, tablets, PDAs, smart phones and portable media players to name a few.

In recent times, the popularity of tablets has surged owing to their compactness, light weight and a near-computer experience [Korucu, 11]. Specifically, tablets have distinct advantages over netbooks and laptops in terms of better portability, size and provision of handwriting/drawing interfaces. Touch screens and stylus afford a digital alternative to the conventional black board education and have since been incorporated in lecture presentations. Moreover, tablets are also being used by students as a digital means for note taking and collaborative learning. Beyond classrooms, tablets serve as digital readers and therefore enable m-learning seamlessly [Ozok, 08]. One of the most popular examples of tablets is the Apple iPad which is expected to revolutionize education through its unique user-friendly touch screen interface integrated with multimedia, telecommunication and Wi-Fi features [Meurant, 10]. For this reason, the Apple iPad was chosen as the potential development platform for MAPLE.

3 MAPLE- Design Overview

MAPLE is an application that combines m-learning for SPM with gaming activities. The acquisition of SPM skills is addressed through the coverage of eight core areas, namely, time-, cost-, human resource-, risk-, scope-, quality-, procurement- and communication management in the game. The game encompasses project development phases like initiation, planning, execution and controlling. The various SPM considerations that are required during each of the phases are carefully crafted into the game to build players' decision making abilities.

The game interface provides a selection of three windows namely, the profile window called My Desk, chat window called VC Room and the game window called Office. Specifically, as shown in Figure 1, at My Desk, players can create their own avatars as project managers with options to customize their look. They can also review their profile records built over successive games, along with awards and remunerations earned, as shown in Figure 2. The VC Room allows players to communicate with other players through a chat window to clarify doubts, discuss their moves and collaborate on their decisions. The Office presents players with four stages of the game which represent four financial quarters as shown in Figure 3. Each quarter corresponds to a project phase and offers a different objective to be achieved with challenges that are progressively arranged to match the skills of the players. A

progress description of the previously played quarters is displayed to players advancing to successive quarters. The progress description comprises three project parameters, namely, days left for project completion, remaining budget and the level of team energy. These are outcome indicators of time-, cost- and human resource management skills respectively.

During the game, players are presented with a set of questions, exercises and puzzles designed to test their decision-making and analytical skills. For instance, players will be given a specific software project scenario for which they would have to develop project charters, choose issues to be communicated with stakeholders and generate work breakdown structures. Unexpected risks may emerge in the form of alerts to which players need to attend. Risks may correspond to sudden changes to project deadline, decline in the number of team members and software failure. The decisions players made in light of the context determine if they are rewarded through awards and remunerations or punished through depletion of project resources.

Figure 1: My Desk: Customize Avatar

Figure 2: My Desk: Personal Profile

Figure 3: Office: Game objective

3.1 Motivation Features

Flow is managed by the provision of different game levels and game cycles. Game levels can be chosen from easy, medium and hard to accommodate novice and expert alike. Game in the easy level offers fewer decision points and variables, and is more relaxed in terms of depletion of allotted budget, duration and team energy. For instance, a project with few deliverables to complete requiring simple work breakdown structures and few risks to handle would help a novice build confidence. A game cycle comprises four financial quarters corresponding to the four project phases namely initiation, planning, execution and controlling. Each quarter is also designed with progressive levels of challenge to accommodate player's growing skills. For instance, in the first quarter, only a limited number of project management issues are presented. As players progress to subsequent quarters, the project becomes more complex with the emergence of different risk factors. For instance, while developing a project deliverable schedule, players are confronted with problems such as non-availability of resources, and delays for materials procurement.

Curiosity in the game is aroused through risk alerts. Risk alerts are sudden pop-ups during the course of the game. They are intended to make gameplay unpredictable and enliven players' experience. Examples of risks alerts include new requirements from clients, software failure, budget cut down and unexpected unavailability of team members. Players will be required to respond to a risk alert by making a selection from a list of possible actions. The extent to which appropriate decisions were made determines whether project resources become depleted

Players' autonomy is ensured through customizable avatars. They can choose their own avatars whose appearances are customizable. By featuring personalized avatars prominently throughout the game, the sense of immersion is enhanced. Avatars display various moods after a major decision in the game including joy of making correct decisions, pride of achieving an objective and anger of a wrong move to reflect the range of human emotions in a work environment. This adds dynamism and helps players connect to the game emotionally, leading to suspension of disbelief.

3.2 Gaming Features

Clear goals take the form of a specific objective for every quarter defined in terms of project budget, project duration and team strength. Objectives may include undertaking tasks during project planning such as estimating project costs, duration and team size; or handling the project execution phase by deciding on the software to be installed, assigning work to team and testing prototypes. Rules governing the game may specify certain conditions to be observed while playing. For instance, players would be given one chance in the planning phase to alter the game-assigned project budget, duration and team size with their own estimates. After a decision is made, it cannot be undone. Furthermore, players are not allowed to return to a previously played quarter once they have advanced to the next quarter.

Players' control is extended to the choice of game levels as well as project topics from a pre-defined list to suit their interests and abilities. For example, project topics may range from designing and developing websites for client organizations, constructing organizational data warehouses and working on new product versions. Challenges are offered through increasing difficulty in the questions, exercises and puzzles posed during the game that put the players' decision making skills to test.

Feedback is offered in two forms. One, progressive feedback is given in the form of a progress description that displays parameters such as remaining budget, project duration and team energy during the game. Two, a comprehensive feedback in the form of a feedback sheet is provided at the end of each quarter to inform players of their apt moves which earned rewards as well as the shortcomings in their decisions which resulted in the depletion of project parameters. Likewise, rewards are also structured into two types. One, ranking rewards such as medals, trophies and certificates, and remunerations such as performance bonus are awarded to increase self-confidence. Two, project-specific rewards in the form of increased budget, project duration and team energy are offered to increase morale and motivation.

3.3 Learning Features

To support Constructivist learning, the MAPLE poses questions that are intended to elicit understanding on a range of SPM issues such as balancing the triple constraints of scope, time and costs, evaluating the critical paths, performing resource levelling or preparing Gantt charts. In this way, players are not only introduced to essential concepts of SPM which build their knowledge but are also acquainted with the process of performing SPM activities. Furthermore, as players make progress in the game, their cognitive skills will be honed to refine their previous knowledge through repeated practice and greater challenges.

Situated learning is facilitated through a contextual glossary and VC Room. Players can make use of the contextual glossary when they need to look up for an unfamiliar technical term they may come across during the game. The contextual glossary includes description of SPM terms such as critical path, PERT analysis, resource levelling and project escalation. Such a contextual glossary not only serves pedagogical purposes but helps players move along in at any stage of the game. Also, the chat window designed for online collaboration can be utilized by players to interact with other players and discuss possible solutions.

Informed by Kolb cycle, the game involves iterative rounds of decision making that allows for concrete experience, reflective observation, abstract conceptualization and active experimentation. For example, , MAPLE offers concrete experience by presenting players with decision-making opportunities to use various SPM techniques such as Gantt chart, Critical Path Method and Pareto analysis. Reflective observation is afforded in the form of feedback mechanisms which help players review their shortcomings in past decisions. Abstract conceptualization is experienced in the process of playing the game during which players acquaint with the SPM concepts. Active experimentation allows players to understand the causal effects between the judgements made under various project situations and their correspondence consequences. Table 2 illustrates the mapping of the design principles from the literature to the features of the MAPLE application.

Design Principles	**Constituent Principles**	**MAPLE Features**
Motivation	Flow	Project cycles and game levels
	Curiosity	Risk alerts during game play
	Players' Autonomy	Avatar creation and customization
Gaming	Goals and Rules	target project budget, project duration and team strength
	Players' control	Choice of project cycles, game levels and project topics
	Challenge	Increasing difficulty in the questions, exercises and puzzles
	Feedback	Progressive feedback and comprehensive feedback
	Rewards	Ranking rewards and currency rewards
Learning	Constructivist learning	Progressively aligned tasks
	Situated learning	Contextual glossary and chat window
	Kolb cycle	Iterative learning cycles of decision making

Table 2: Design principles and corresponding MAPLE features

4 Evaluating MAPLE

4.1 Participants

A total of 55 graduate students with an average age of 27 years were invited to participate in the evaluation study of MAPLE; carried out from September, 2011 to March, 2012; in an institute of higher education in Singapore. Of these, 20 were full-time students from Information Systems, Knowledge Management, Communication, Computer Science, Economics and Accounts. Barring a few Information Systems students who had attended the SPM course; the other full-time students had limited knowledge on SPM. The remaining 35 part-time students were working professionals

with IT background. 12 of them were highly familiar with SPM as they worked as project managers, project leads or program managers. The remaining 23 were software engineers, IT analysts and network specialists. All participants were familiar with the use of iPad, its touch screen navigation style and its virtual keyboard for writing text. Uniform familiarity with iPads among all the participants was extremely important here to avoid any biases and ensure a fair study.

4.2 Methodology

The data collection was divided into four stages, based on methodologies that have been adopted by scholars [Chua, 05; Coulby, 11; Pannese, 07] in similar studies for evaluating the effectiveness of e-learning and m-learning games. The first stage comprised of a pre-game briefing where the participants were introduced to the MAPLE game application and its underpinning features and rules. The intent of the application and how it should be played were elaborately explained. It was followed by a brief question-and-answer session to clarify their doubts.

In the second stage, the participants were actually made to play the game and were exposed to four possible usage scenarios: (1) creating avatar and customizing its look, (2) selecting a game level, playing the first financial quarter and viewing the progress description, (3) facing an unfamiliar term while playing and looking up a contextual glossary, and (4) responding to alerts on sudden risks. Each participant took about 15 minutes on average to complete the scenarios.

Thereafter, in the third stage, a questionnaire was administered to the participants. A combination of closed as well as open-ended questions on MAPLE's adherence to the three design principles of motivation, gaming and learning were asked. In addition, participants' opinions were sought on the general appeal of the game, the usefulness of its features and whether the game had the potential to teach SPM skills in an effective manner. The response rate to the questionnaire was 100% (N=55). Table 3 summarizes the items on the questionnaire against the variables they sought to measure.

Finally, in the fourth stage, the study was rounded off by conducting focus groups; a qualitative research methodology extremely useful for exploring how patrons respond to a new idea, service or product [Crowley, 02]. In particular, eight focus groups, each comprising seven participants on average, lasting for some 30 minutes were conducted; and the research team took notes of the discussion content. These post-game focus group sessions were used for the purpose of triangulation, and gave the platform for sharing and reflection of insights among the participants [Gredlar, 92].

5 Results

5.1 Motivation

When discussing motivation, participants felt that while flow was addressed by the project cycles and game levels, it was also necessary for all questions and exercises within each project cycle to be thematically chained. In particular, Participant 26

expressed that "*each financial quarter must be designed such that the exercises offer a continuation of concept and thought*."

Design Principles	**Constituent Principles**	**Sample Question Items**
Motivation	Flow	Do you think the concept of different project cycles and game levels can assist a player to progress based on his skills?
	Curiosity	Do you feel that introducing sudden risks and challenges during game play can make the game unpredictable and interesting?
	Players' Autonomy	Can the creation and customization of avatars address player's identity as a project manager in the game?
Gaming	Goals and Rules	Do you feel that the game can engage player with its goals which differ for each financial quarter?
	Players' control	Does the game offer optimal control by allowing player to select a game level or project of own choice?
	Challenge	Do you feel offering new challenges at each financial quarter can sustain player's interest in the game?
	Feedback	Do the two types of feedback proposed in the game can adequately update player about his performance?
	Rewards	Are the rewards outlined in the game capable of motivating the player?
Learning	Constructivist learning	Do you feel that the game concept offers an opportunity to understand and learn SPM concepts?
	Situated learning	Can the context glossary and chat window (VC Room) respond to player's conceptual doubts instantaneously?
	Kolb cycle	Can the game concept enhance judgement and decision-making skills by exposing player to new and unexpected project scenarios?

Table 3: Sample questions in the questionnaire

On curiosity, most participants agreed that risk alerts offered new challenges during gameplay and added the element of unexpected thrill to the game. However, a few participants namely, Participants 4, 16, 19, 40, 44 and 46 noted that though such risk alerts may "*add to thrill*", the required tasks "*must not be too daunting or time consuming*" such that the flow of the original game becomes broken. In particular,

Participant 40 felt that such sudden risks and challenges "*may not be appropriate for beginner level players*".

The features supporting the players' autonomy were also well received by participants. Participants seemed to like the look and feel of the avatars and the choice to customize their appearance. Participant 18 also commented that "*avatars give a sense of identity to the player which is necessary to get a personal feel and ownership of decisions made during gameplay.*"

5.2 Gaming

Under the gaming principle, participants pointed out that the layout of goals and milestones had the effect of instilling the urge to win the game. In addition, rules outlined to achieve these goals offered plausible limits without constraining their skills. In particular, Participant 25 asserted that "*MAPLE offers adequate goals and rules for a smooth gaming experience*".

Participants felt that the features offering players' control and challenge in MAPLE were just adequate in providing an optimum level of freedom and involvement. For instance, Participant 2 shared that "*MAPLE will be fair to both novice players as well as expert players as it provides different game levels to choose from*". While Participant 34 felt that challenge "*can also be a motivation*", Participants 36 and 41 pointed that "*too many challenges*" can be extremely "*annoying*" and "*frustrating*".

The features implementing feedback were appreciated by majority of the participants. In particular, participant 29 shared that "*The two ways of feedback in this game will be helpful to constantly update the player of his performance*". However, some other participants namely, Participants 14, 19, 24, 28, 38 and 44 noted that a "*strict*" feedback resulting from poor decision making may "*lower the confidence*" of a player, especially if the player was new to SPM. One way to overcome this was suggested by Participant 17 who said that "*the use of fewer evaluation parameters to gauge players' performance can make the game more lenient*". Participant 2 felt that it would have been more engaging to "*get feedback and assistance from some non-player character during gameplay*". When discussing rewards, participants suggested that the reward features in MAPLE were in line with the game concept and would be helpful in motivating players. In particular, Participant 10 expressed that "*the concept of rewards look realistic, something which real-life project managers would always look forward to*". Participant 33 however, indicated that the rewards would be more meaningful if the "*game can introduce competition with other players*".

5.3 Learning

In supporting Constructivist learning, majority participants agreed that MAPLE facilitated an effective and interesting style of learning SPM since it not only familiarized players with the concepts but helped them build skills progressively at their own pace. Participants with non-SPM background particularly Participants 8, 11 and 20 also mentioned that MAPLE was an "*entertaining way*" of being introduced to SPM. However, Participant 33 felt that the game lacks in comprehensive "*examples*" and "*guidance*".

Situated learning was also considered important by participants. Participants felt that contextual glossary and chat window helped players get instant help whenever they confront a difficult term. These features were particularly appreciated by non-SPM participants. But Participants 34, 36, 39, 42 and 54 disagreed. In particular, Participant 34 pointed that "*no one wants to look up at the glossary frequently. So it should be integrated with the game in a better way*".

With regard to incorporating Kolb cycle, though participants agreed that MAPLE is an effective way to help them develop decision making skills, they were concerned that the game alone would not suffice to help them manage real-life projects. However majority agreed that the game was a novel way to augment traditional learning. In particular, Participant 27 commented that "*Since SPM is not just about understanding theory, MAPLE will be a means of practising SPM in the virtual world*".

6 Discussion

The results yield three major findings. One, MAPLE was perceived unanimously to be an enjoyable way of learning. It was considered as an effective method to complement traditional classroom learning mainly because of its learner-centricity as opposed to the traditional classroom learning which is largely instructor-led. This is not surprising since different learners have different learning styles which may not be easily accommodated in a typical classroom environment. Therefore, game-based learning has emerged in the recent years as an individualized approach that efficaciously combines entertainment with learning [Charles, 11]. MAPLE, which uses gameplay to meet players' learning needs, represents a realization of such an approach.

Two, the findings suggest that motivation, gaming and learning principles are essential ingredients of an m-learning game. Each of these must be hung in balance to ensure sustained interest over the game. For instance, lack of motivation results in boredom and under-stimulation which eventually diminishes enjoyment of playing the game. This causes a decline in players' performance as well as their failure to meet the learning objective [Retalis, 08]. Similarly, an m-learning game which primarily offers entertainment but does not incorporate a systematic learning structure serves no pedagogical purposes. On the other hand, a game which is incapable of entertaining players, despite a well-organized learning structure and motivation techniques, will not sustain players' interest and will probably not be played often [Boyle, 08].

Finally, of all features in MAPLE, three most appealing features were risk alerts, feedback and avatar creation. One, in addition to arousing curiosity in the game, risk alerts also seemed to facilitate the urge for learning more. Players would be drawn to addressing the risks in order to hold their game as a result of which they would be introduced to new concepts in SPM. Two, the feedback structure seemed to surface as a tool for learning by self-improvement. Players would be able to evaluate their performances from the two types of feedbacks and aim to improve in their next gameplay by taking better decisions during the game. Both risk alerts and feedback seem to propagate an environment of learning through fun. Specifically, while playing games, players display distinct attitudes favourable to learning such as being interested, competitive, results-oriented and actively looking for solutions. The

learning content embedded in the games is also acquired along the way resulting in unconscious learning [Garris, 02]. Three, avatar creation and customization was perceived as quite appealing and seemed to indicate the significance of pure entertainment and the need for a virtual world to invigorate learning through escapism from reality and through experiencing fantasy. Virtual worlds are known to expose students to multiple contexts through concrete simulations where players can understand complex concepts by relating themselves to the game environment [Akkerman, 09].

7 Conclusion

This paper introduces MAPLE, an m-learning game for project management which provides an entertaining way to learn SPM concepts and skills. The paper explains the design principles used in developing the game; namely, motivation, gaming and learning. Based on the preliminary evaluation, three major observations could be culled. One, game-based m-learning is a useful and an entertaining augmentation to traditional learning. Two, design principles namely motivation, gaming and learning and their appropriate blending is necessary to develop an effective m-learning game. Finally, appealing features in MAPLE are risk alerts, avatar creation and feedback.

The significance of this paper lies in two fronts. One, it illustrates the feasibility of designing and developing m-learning games for SPM in feature-rich tablet platforms such as iPads, thus providing game designers with a new venue to explore. Two, educators can look beyond the traditional confines of classrooms and consider the use of game-based m-learning to augment the conventional text-based SPM education.

However, two limitations should be acknowledged in the research. One, all the participants (N=55) were graduate students of an institute of higher education in Singapore. So, the scope in which the fieldwork was conducted was constrained. A much larger sample size (in the order of 100) consisting of both students and professionals with different profiles is needed to enhance the overall generalizability of the findings. Two, the study adopted a pre-dominantly qualitative research paradigm. A mixed method approach consisting of both qualitative and quantitative data might have been more informative. Nevertheless, overall MAPLE received positive feedbacks from the participants as a potential m-learning game which could complement traditional classroom learning. . Also, since the game was designed for iPads, participants were optimistic of the ready acceptance of MAPLE.

Having evaluated the effectiveness of MAPLE based on motivation, gaming and learning; it must be confessed that a much large-scale study is needed to establish its feasibility as a sustainable curriculum component for SPM education. One potential direction for future research includes translating the stand-alone MAPLE game to a multi-player game that would make it more competitive and interesting. As pointed out by Participants 33, 34 and 55, it would have been much more engaging to play the game had there been "*competition*" among the players. Also, extensive evaluations need to be carried out with a larger cohort of participants regarding the usability aspects of MAPLE. Further research can also delve into how social media can be used in conjunction with m-learning games; thereby shaping social networking into social learning.

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