Context Rich Digital Games for Better Learnability in the IT Project Management Context

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Abstract: Application of serious gaming has become well known in corporate sector for training and development. It is often used for enhancing skills of decision making, analytical thinking, planning and execution. Though numerous games have been developed in training professionals in sectors such as manufacturing, education, health care and sports, very less have been developed for IT professionals. It has been proven in literature that the project management owing to its nature of work in IT organization is very different from these sectors. This also implies that the skills needed for project management must be very specific to IT industry. In our study, a game is designed with a primary focus on richness of context with a purpose of improving decision-making skills of a Project Manager in Information Technology (IT) organization. We conducted contextual survey along with literature review for identifying the scenarios, and user journey of project manager. Knowing the context, an analogy of hospital scenarios was applied for ideation and concept generation for this video game. The designed prototype was evaluated with fourteen users for meeting the learning and play objectives. Our findings suggest that serious games using an analogy (i.e., hospital scenario in this study) can be engaging and purposeful learning tools, when the user context is well understood, converted to an equivalent game play and situated in a metaphorical, fantasized or analogical world.

1 INTRODUCTION

The use of computer mediated learning in imparting decision-making skills is becoming popular. Based on the recent report (BankersLab, 2013), about 25% of Global Fortune 500 companies have already adopted serious gaming for training. These trainings are known for imparting skills (analytical, decision making, planning and execution) and cognitive processes that cannot be easily taught in a classroom setting due to lack of engagement (Keil et al. 2013). Also, the new generation professionals have lesser attention spans and seek info just in time (Pedreira et al., 2015). More recent studies also added patient choice education (Mihail, Jacobs, Goldsmith, and Lohr, 2015) and rehabilitation (Cornforth et al., 2015).

Studies have demonstrated the use of serious gaming in project management of various sectors (manufacturing; education; healthcare) (Mclaughlan and Kickpatrick 1999; Greitzer et al., 2007; Cowan et al., 2010; Caledron and Ruiz, 2016; Klaassen et al., 2016), however, very relatively fewer have focussed on decision making skills in an Information Technology (IT) organization. The IT context unlike the manufacturing domain is not yet at the maturity level, where project success can be guaranteed beyond a point. Estimates based on survey conducted in 2008 (Standish group, 2010) suggests that 24% of projects failed and while, 44% of the projects challenged (cost overrun, time overrun and impaired functionality) due to inappropriate project management. Project management involves decision making under uncertainty, software being handcrafted (or mind crafted), there is a lot of behaviour dependence (Nasir and Sahibuddin, 2011) involved in it.

In this study, the use of serious gaming for enhancing the decision-making skills in an organization is explored. The context of decision-making in project management of IT industry was selected for this study. Previous studies

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(Mclaughlan and Kickpatrick 1999; Kapp, 2012; Caledron and Ruiz, 2015; Caledron and Ruiz, 2016) related to serious gaming in other organizations cannot be directly applied in design of serious game for IT professionals. This is because it has been stated in literature that the project management owing to its nature of work in IT organization is very different from these sectors. Hence, the skills needed for project management must be very specific to the needs of the IT industry.

In this study, we explored a method, which is rich in context as well as engaging for designing serious games. The techniques in design such as contextual enquiry were utilized. The principles of engagement that were discovered from literature survey were also utilized. Our approach was as below:

- Gather insights form the real world including user journeys
- Think of creative options for engagement – use of analogy
- Design of game
- Evaluation of the game

The organization of paper is as follows. In Section 2, we discuss related work, in section 3 methodology, contextual inquiry in section 4, we discuss our game design in section 5, in section 6 evaluation of the game and results and finally in section 7 we have conclusions and direction for future work

2 RELATED WORK

Many studies have been conducted related to imparting decision making skills through computer mediated learning (McGuire et al., 1987; Hollingshead and McGrath, 1995; Walther et al., 1986; Lemus et al., 2004; Henrie et al., 2015). Various social platforms (facebook; Brown and Vaughn, 2011), wiki (Lee, 2010) and simulations (Gosenpud and Miesing, 1992; Wickenburg and Davidsson, 2002; Juan Martínez-Miranda et al. 2005; Crespo and Ruiz, 2012) have been utilized for imparting learning skills.

One such example is of electronic dialogue simulation that was introduced by Mclaughlan and Kickpatrick (1999) for imparting decision making process that was required for management of contaminated sites. The simulation was found to be valuable for participants in developing their negotiation and communication skill. In addition, the participants were able to get comprehensive dimensions (social, cultural, economic, and political) involved in management of their concerned problem. The major gap in this technique is that they are too much focussed on purpose rather than "play" characteristics, which is much needed for effective engagement (Franzwa et al., 2013). Moreover, the processes involved in contaminated site management and also the corresponding skills required are obviously very different from that of IT project.

Henrie et al. (2015) provide extensive review on computer mediated learning and stated that these methods may not be perfect enough for including psychological and cognitive aspects of learners. Walther (1996) stated that computer mediated learning may reduce impersonal skills that may sometimes can impact working efficiency of project management teams. (Pinto, 2000). Wong (2007) critically reviewed eLearning techniques and suggested that these are not suitable for individuals without the self-discipline needed to complete all tasks independently. Besides, individuals may also need some prior training before enrolment to minimize any difficulties due to lack of Information and Communications Technology (ICT) background.

On the other hand, Wouters et al. (2009) concludes that the serious games potentially improve cognitive skills (knowledge and skills of problem solving, decision making). Moreover, it can be also potentially used for the acquisition of motor skills (acquisition and compilation) and also to accomplish change in mind-set.

He discussed various aspects for effectiveness of serious game by integrating alignment of learning outcome(s) with game type and complexity as well as human cognitive processes. These aspects should be considered and customized based on the objective of game and scenarios.

Though, lot of research has taken place in applications of serious gaming in education (Greitzer et al., 2007; Cowan et al., 2010; Kapp, 2012; Caledron and Ruiz, 2015; Caledron and Ruiz, 2016), but on the contrary, relatively few research has taken place in its application in project management. Navarro et al. (2004) introduced SimSE, an educational simulation game for teaching software engineering processes. This is a single player game, where a player has to take a role of project manager and is responsible for engaging employees in various aspects of management. However, these game interventions appear to be more of learning tools or what-if simulator in terms of the content, rendering, and experience rather than 'playable' games.

Garris et al, (2002) highlighted the need of key game characteristics such as fantasy, goals, mystery, challenge, sensory stimuli and control in refining theoretical formulations of effective instruction required for design of game. Moreover, it laid emphasis on "motivational" aspect of game, where game play triggers repeated cycles of user judgments (e.g., enjoyment), behaviour (game play), and feedback. Moreover, fantasies can also provide analogies for real world scenarios that allow participant to experience phenomenon from different perspective (Malone and Lepper, 1987).

Further Franzwa et al. (2013) demonstrated the need to balance elements of play and learning. Therefore, for a play and game for Project management, it is essential to have important characteristics as well as analogies. As explained by Nokes and Ross (2007), conceptual learning can be enhanced significantly using analogies and explanation.

3 METHODOLOGY

Our research objective is to find out a way to design context rich and engaging game for decision-making in project management context. Following approach was adopted to achieve the goal:

a) We did literature survey to see present state of art in applications of context rich games in project management.
b) We conducted user interviews as part of tried and tested contextual enquiry technique used in design.
c) We conceptualised a method to design game using combination of principles derived from (understanding disempowering narratives, externalizing problems and game design as interventions) (Paredes et al., 2013)
d) We designed a game as a case study using analogy to enhance conceptual learning (Nokes and Ross, 2007)
e) We evaluated the game using field experiments involving 14 students

For contextual enquiry, fourteen project managers from various IT organizations like TCS, Infosys, Wish book, Info services, Click Labs etc was approached followed by telephonic conversation. These project managers belong to different socio-economic background, gender (male or female) and also wide age groups (27 to 55 years). For better understanding, special attention was paid for including mix of employee in terms of experience (fresher's or experienced) and also co-workers in interview schedule. The data obtained, hinted to embedding of gaming in this domain.

4 CONTEXTUAL ENQUIRY

We identified ways in which context could be integrated in game design. We thought it would be appropriate to use contextual enquiry for this particular research work.

Research findings from contextual enquiry after refining through literature are as follows:

From the interview, various assets and resources of the project managers required in managing in the projects were identified. Most of the project managers use agile methodology for their project pipeline and use various project management tools like MS Excel, Jira, Basecamp, Asana, Trello, etc. Various scenarios and critical situations, which could occur in their management in IT organizations during a project were discussed and noted. The attitude, behavior and decision-making skills were captured. Further, information related to their Activities, Environment, Interaction, Objects, Users (AEIOU framework), which developed the building block of models that ultimately address the objectives and issues of the project managers were obtained.

4.1 Context Informed Design

On the basis of literature review in the project management domain (Pich et al., 2002; De Meyer, 2002), required entities that will form the part of the game were derived. They were further divided into two parts.

Firstly, the challenges in management like managing distributed & matrix management items, issue tracking, resource management, prioritization, synchronization. Secondly, prioritization is done on the following basis: cost of project development & implementation, expected return on investment over time, contribution to strategic initiatives, potential risk & likelihood of success and timelines. Further mind mapping (Figure 1) was done and design parameters (Figure 2) were defined.

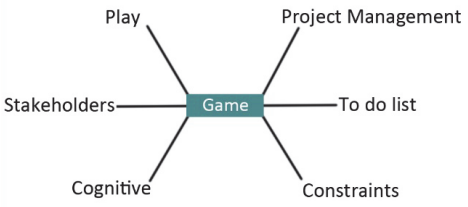

Figure 1: Mind mapping for obtaining design parameters.

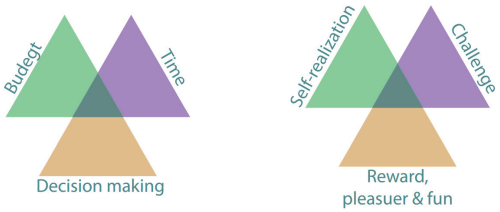

Figure 2: Identified design parameters based on mind mapping.

4.2 Phases of Mapping Context to Design

4.2.1 Phase I: Scenario Building

Different scenarios were extracted based on the responses provided by the project managers during user interviews. These scenarios include the most common situations faced by any project managers in IT function.

- Pressure of delivery on time: Change in demand of deliverable in the midway of a giant project
- Time duration constraint: Client doubles the fund and reduce the time duration
- Size of team as restriction: There is a need of increasing team size in a short time
- Motivation while taking tough decisions: Increasing the motivation
- Quick feedback: Bad performance of the team members
- Decision making: Conflict among the team members
- Restrictions: Unwanted happening to the server
- Management decisions: Managing meetings and deliverables

These scenarios will be implemented in the game as different levels. Further tasks will be introduced in these situations, so as to be completed by the user in order to clear that particular level.

4.2.2 Phase II: User Journey

The design of game flow is made similar to that of a journey; a project manager goes through during the project. The journey of project manager was identified based on the initial interviews conducted with IT professionals. In the beginning, he is provided with a brief, a problem statement and a vision statement by his supervisors or seniors. Then he prepared a team of assets and resources having required skills. He creates a project plan - assigning the roles and responsibilities to each asset and providing the timeline for various tasks. He verifies the project plan with his supervisor and begins with project execution. He tackles various challenges during the execution of the project. Some challenges might be due to unavailability of required asset, constraint in time and budget, extent of timeline by the assets, and if project manager or his supervisor is not content with the work output by assets. After tackling all the challenges, the project's output is tested and deployed. The team is rewarded for their work. The incentives and rewards are necessary to keep the working spirit alive among the assets. Later, the supervisor would again approach the same project manager for releasing the further versions of the products based on the reviews and feedback provided by users and customers.

5 GAME DESIGN AND IMPLIMENTATION

Figure 3 demonstrates steps adopted for design of serious game in this study. Leads for development of serious game to address researched issues were taken from literature. Learnability goals and approaches along with expectations of managers were then quantified from data obtained from contextual enquiry and research findings of the subject (decision taking situations of managers).

Litrature review- Observation- Mind mapping- Ques
Design parameters- Generating Senerios- Brain storming-
Navigation Chart- Interection Design Planning- Analogies-
Game strategy design- Game play- Mid prototype-
User testing- Iterations- Design process- Design translation-
Pre production- Story line- Story board- Animatic-
Character design- DG design- Production- Animation-
Production- Post production

Figure 3: Various steps (in sequence) involved in design of serious game.

This led to formation of data flow of how the game (refer to Figure 4) will proceed in order to embed

maximum possible situations and problems that should be addressed related to difficulties in relation to decision making amongst the group. Game environment including game mechanics and game design document (GDD) were formulated by analysing various scenarios for strategy making.

Figure: 4 Flow of data of game.

Brainstorming and mind mapping techniques were used for forming base strategy for game development. Initially based on strategy, a board game for testing was developed followed by a digital video game for final execution of the project.

5.1 Phases of Design Elaboration

5.1.1 Phase I: Ideation and Concept Generation

All the services and assets were identified, varied (if necessary) and mapped with the office environment. Also a team to be led by project managers needs to be formed. Services and assets that might be required in the hospital are identified and included in game design.

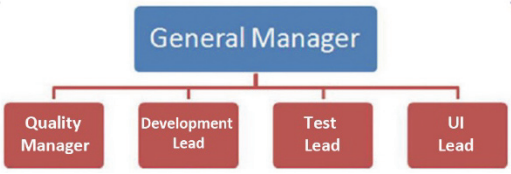

Figure 5: Sample team structure managed by general manager.

Fig 5 shows a sample team that could be formed for a project and is managed by a project manager. A project manager will be assigned projects and he needs to overcome various challenges (as also discussed in user journey) to complete his tasks and gain points. For the decision making, a project manager has to deal with quality manager, development lead, test lead, UI lead.

5.1.2 Phase II: Choosing Analogies

A game in an office environment might not be that interesting for the employees. It may be considered as a burden that may not capture their real life experience that is needed for evaluation as project manager. In order to make it interesting, various situations in which project management can be involved were brainstormed. Hospital scenario was finalized as it has advantages that no pre-requisites are required to understand the hospital's environment. Secondly, many of assets and resources from hospital scenario are more reasonable to match with that of project management in IT industry (Ford and Randolph, 1992). In addition, the scenarios that a project manager goes through in IT organization can be reasonably mapped with Doctor in hospital scenarios (Figure 6).

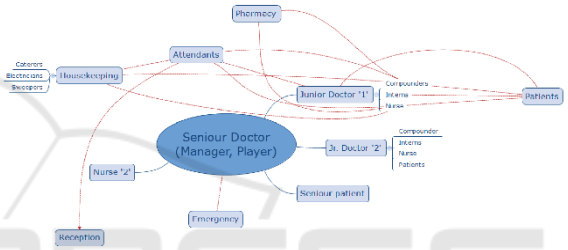

Figure 6: Project management analogy from hospital.

Then we went one step forward and listed down the assets and resources that might be needed in a hospital environment. Later we translated the situations and their answers, which we obtained from our questionnaire of office environment to the hospital environment.

5.1.3 Phase III: Board Game Prototype

The board game was developed to test the concept as shown in figure 7. Figure 8 shows the assets and resources that were made for the evaluation of the game.

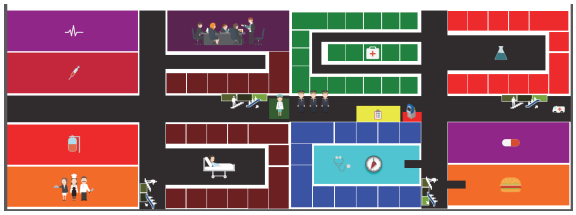

Figure 7: First iteration of designed hospital game prototype showing assets and resources of Hospital (cards, points and navigation).

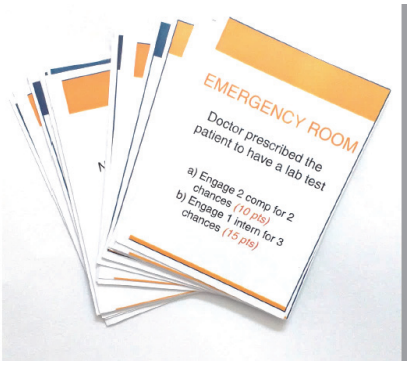

Figure 8: Assets and resources for user evaluations of board game.

5.1.4 Phase IV: Digital Game Prototype

The system architecture of the game is shown in figure 9. It can be seen that certain critical situations are also incorporated such as emergency room etc in the game.

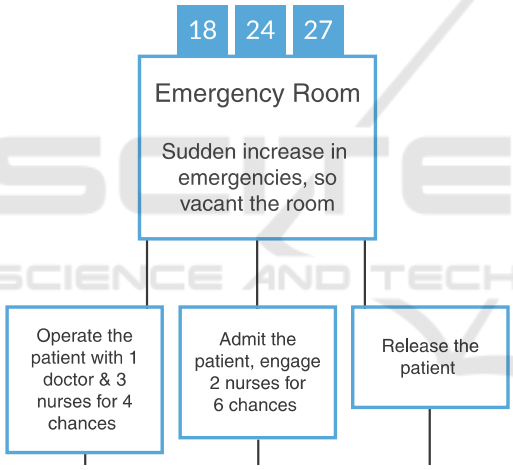

Figure 9: System architecture of the game.

The game was finally developed on a unity platform (3D game). 3ds Max and adobe Photoshop were used for developing scenario and texturing purpose respectively.

6 EVALUATION

With our assets and resources prepared (Figure 7 and Figure 8), we went for user evaluation (Figure 10) for our first iteration. For user testing, 14 students from IIT Guwahati participated in newly designed game. Feedbacks were obtained using surveys, which were conducted orally.

Figure 10.

The feedback was taken on spot at three different stages i.e., before, during and at the end of the game. The feedbacks from them were utilized for further iterations. The iterations included modifications in point system, assets, game flow and the system for rewards and incentive.

6.1 User Testing and Results

Three things were found from user testing i.e., 1) users involvement and competition 2) Incentive based approach for early completion as time taken was different for different users and 3) Active involvement of all assets. These are result of the context in which assets of hospitals were utilized by doctor (project manager) by dealing with its team mates (nurses and other people).

From user testing, it was found that at some instances, the players would require suggestions from outsiders during game play. This is an important user experience in terms of project execution, where project manager might have to reach outside of his/her team for achieving certain tasks for maintaining overall flow of the project. Also based on this feedback, features such as help lines can be planned for further inclusion in game. The time duration for completion of game (tasks) was different for different players. This further provide feedback from a project management point of view that either the deadline (lump sum time) can be fixed or even an incentive/bonus points (award) for earlier game (project) completion can be provided to the user (project manager) during game play. Some scenarios can be added, wherein very critical cases like heart attack (hospital scenarios) can be played with, for testing how a player would react in emergency conditions. A player should also take care that all the assets are actively involved

throughout the game play. This can be done by increasing the number of situational cards, which would also reduce the redundancy in the game. A player should also be notified about the progress of his peers, which would increase his motivation to work harder. Therefore, based on evaluation it can be understood that the users went into real life experience/simulations of a project manager.

7 CONCLUSION AND FURTHER WORK

A serious game was designed and developed with a primary focus on play and context richness for enhancing the decision-making skills of a project manager in an IT organization. In this study, analogy from hospital scenario was adopted for simulating project management experience related to IT industry to a user.

Based on evaluation, it was found that the game was able to provide user an immersive experience of a journey of project manager during project execution. Several instances or scenarios were simulated to test the user response.

From user point of view, hospital arena was useful in terms of providing experience as all the players had prior awareness of the functioning of the assets and resources used in hospital. The players were engaging themselves in playing the game with competitive spirit. Once aid was provided for few initial rounds, no other help was required for playing the game. However, it should be also noted that there was a gap between conditions of company and hospital in some cases. For example in hospitals, critical surgeries are irreversible. For example, death during surgeries cannot be reversed. Project cancellation cannot be equated to that of critical situation such as the death of a patient. These kinds of shortcomings can be incorporated in future games for increasing real life experience of project management to users. Nevertheless, these experiences from this newly designed game are dynamic and require quick and thoughtful actions. It gives insights into the essential characteristics (quick and efficient decision making) of an efficient project manager/team that is difficult to be captured using conventional interview sessions. Therefore, this study shows that context rich games can provide better learning and such games can be designed by balancing the play and purpose elements. Considering the limitations involved in current study, further studies are required in terms of digitalization of game and more comprehensive evaluation study. Also, the data analytics for serious games need to be considered. Data analytics for serious games are different from those of commercial video games, which mainly seek to enhance the 'enjoyment' value of players. Whereas, those with serious games, one need to *additionally* evaluate players' skill acquisitions and levels of expertise (Loh and Sheng, 2015). Further research plan would be to strengthen the immersive experience, by including more scenarios and simultaneously, conducting rigorous evaluation study.

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