

3-2016

SCRUM-X: An Interactive and Experiential Learning Platform for Teaching Scrum

Wee Leong LEE

Singapore Management University, wlee@smu.edu.sg

Follow this and additional works at: https://ink.library.smu.edu.sg/sis_research



Part of the [Databases and Information Systems Commons](#), and the [Higher Education Commons](#)

Citation

LEE, Wee Leong. SCRUM-X: An Interactive and Experiential Learning Platform for Teaching Scrum. (2016). *The 7th International Conference on Education, Training and Informatics (ICETI 2016)*. Research Collection School Of Information Systems.

Available at: https://ink.library.smu.edu.sg/sis_research/3378

This Conference Paper is brought to you for free and open access by the School of Information Systems at Institutional Knowledge at Singapore Management University. It has been accepted for inclusion in Research Collection School Of Information Systems by an authorized administrator of Institutional Knowledge at Singapore Management University. For more information, please email libIR@smu.edu.sg.

SCRUM-X: An Interactive and Experiential Learning Platform for Teaching Scrum

Wee-Leong Lee

School of Information Systems
Singapore Management University
80 Stamford Road
Singapore 178902

Abstract—Motivating and engaging the current generation of technology-savvy students and improving the quality of learning is becoming more challenging with traditional instructional methods. Educational games and simulations are gaining more ground, both in formal and informal learning environments. With experiential learning, learners can enhance their management skills and ability to make decisions by analyzing different scenarios and paths that the project could have taken if specific decisions were made during the project. This paper presents Scrum-X, a computer-based simulation game to teach Scrum, an agile project management methodology, to graduates and professionals with IT background. In the game, players plan, execute and manage a software development project using Scrum methodology. Players will experience the entire Scrum process from Sprint planning to Sprint execution and finally, Sprint review and retrospective. A pilot run was conducted with very promising results.

Keywords—Scrum; Agile; Project Management; Experiential Learning; Simulation; Educational Games

I. INTRODUCTION

The current generation of technology-savvy students are cognitively more sophisticated, and want learning to be fun, engaging, hands-on, challenging and interactive. At the same time, the problems faced at the workplace are becoming increasingly complex. Traditional content-centric classroom instructional methods may not be sufficient to motivate students of this generation. Employers would like their employees to be better prepared at schools and universities, so as to be able to cope with these unique challenges of the global information age.

An alternative to the traditional content-centric approach is educational games and simulations, which can provide various advantages as an instructional strategy. They can help to strengthen comprehension and to achieve deep learning within acceptable teaching time and instructor load. Educational games and simulation have been used for many years in many different fields [1,2], and are based on learning and development theories such as problem-based learning [3] and experiential learning [4]. Although the question over usefulness of simulations and games in a classroom has long been debated upon, many have still been used, yielding promising results [5,6,7]. Simulation games promote numerous cognitive benefits in learners, including a facilitation of increased interactions, motivation for learning, visualization, experimentation, self-efficacy, self-monitoring, problem-solving and critical thinking abilities.

In this paper, Scrum-X, a spreadsheet-based simulation game for teaching Scrum, an agile project management methodology, is presented. Agile project management methodology is characterized by its iterative and incremental delivery, and its ability to adapt to changing user requirements during the project lifecycle [8]. The principles of agile methodology are clearly stated in the Manifesto for Agile Software Development [8].

The Scrum lifecycle is divided into small iterations that last between two to four weeks, called Sprints. The Scrum Team consists of a Product Owner, a Scrum Master and the Development Team. The Product Owner is responsible for specifying the requirements of the product to be implemented, and producing the Product Backlog, a document containing all the requirements of the project, also known as user story. The Product Owner also prioritizes the user story and evaluates the delivered product at the end of each Sprint [8]. The Scrum Master is responsible for ensuring that the Scrum Team adheres to Scrum framework, practices, and rules. The Scrum Master acts as a facilitator and is responsible for helping the team with any problems they might encounter during the implementation. The Development Teams consists of a group of cross-functional professionals, with all of the skills necessary to create a potentially releasable product at the end of each Sprint.

This paper is organized as follows: in Section II, different types of project management games are discussed; Scrum-X is presented in Section III; in Section IV, the results of the pilot run are discussed; and Section V concludes the paper and suggests directions for further research.

II. LITERATURE REVIEW

Research has shown that the content-centric approach may not be adequate for adult learning, since adults prefer experiential-based learning or problem-based learning approaches. It is widely accepted that experienced project managers perform better than inexperienced managers, suggesting that project management is inherently an experiential learning process. With experiential learning, learners can enhance their management skills and their ability to make decisions, by analyzing different scenarios and paths that the project could have taken, if specific decisions were made during the project.

The case study approach, developed early in the 20th century, increased the possibility of inductive learning, but was

not designed to address the dynamism and complexity of the real world problems, which simulation can offer. With the paradigm shift towards participant-centered learning, use of simulation to support project management education has been steadily gaining ground in recent years. The main type of simulation would be role-playing ones, where the emphasis is on interpersonal skills of the player. SCRUMIA [9] is a role playing game that aims to strengthen players' knowledge and proficiency at application of Scrum concepts. After playing the game, a player should be able to easily differentiate Scrum roles, events and artefacts, eventually being able to apply them in real life situations. The targeted audience of the game is undergraduate students with basic knowledge of project management and Scrum, but generally have no past practical knowledge in the field.

Gloger [10] created a Ballpoint game that involves getting participants to pass as many tennis balls as possible between them within a stipulated time. This exercise covers the basics of Scrum principles; Product Owner setting the objectives and goals, team planning and estimation process, and conducting retrospective sessions. Krivitsky [11] designed a game which was made up of paper, pencils and LEGO Bricks. The players were to construct LEGO houses and vehicles from user stories. Another game, Agile Hour [12], also uses LEGO bricks, and players are to construct a product using LEGO bricks based on a set of project requirements. This game targets computer science students and IT professionals. The XPGame [13], another paper, pencil and props game, was created with the aim to acquaint players with the more complex concepts of velocity and user story estimation. Prior knowledge of agile methods and principle of XP programming is required to play the game.

Many games in the field of project management have shunned computers, in favor of cards or board games, often involving dice. Zapata [14] introduces a card game that involves tossing a dice to determine which questions the team should answer in order to get a chance to estimate the size of a project component to score points. This game relies more on chance, rather than on skill. Chance also plays a key role in PlayScrum [15], a game where students assume the role of Scrum Master in a software development project. Players roll the dice to determine what resources they can accumulate and what problems they may encounter. Simsoft [16] was developed to evaluate what contribution it could make to the education of software engineers and software project managers.

Gkritsi [17] created a web-based game called Scrum Game, which is a virtual run through of a Scrum lifecycle, giving insight on the various stages of Scrum, and the manner in which the different Scrum roles interact with each other. Lee [18,19] developed a spreadsheet-based project management simulation game designed as a teaching tool to facilitate the training of project management in a classroom setting. This allowed participants to encounter firsthand what real project management entails. In the game, participants learn to respond to unforeseen events and make sound decisions to resolve problems, while minimizing any compromise to project schedule, cost, quality or scope. SimSE [20] is an educational, interactive, fully graphical computer game that simulates software engineering processes, and is designed specifically to train students in situations that require an understanding and handling of software process issues.

The literature survey shows the variety of educational games for teaching conventional project management and Scrum, ranges from role playing games [10], to kinesthetic games [10,11,12,13], to card or board games [14,15,16], to computer-based simulation games [17,18,19,20]. Some of these games simulate the Scrum process, and students typically take the role of the Scrum Master and makes decisions about scope, activities and resources in order to see how these affect project success. However, the challenges with using these games in university courses is that firstly, they need large amounts of props (e.g. LEGO bricks), which is impractical, or the games take several hours to play, which cannot fit into typical class time. Furthermore, most of these games are more suited for professional training courses, and lack a clear specification on how they are incorporated within an instructional context following a systematic instructional design [9].

In this context, Scrum-X was deliberately designed to complement the learning of Scrum as an important part of a post-graduate IT project management course at the Singapore Management University (SMU). The duration of the game has to be within a typical three hour class time at SMU. Microsoft Excel was chosen to develop Scrum-X because of its flexibility, general availability, and relative ease of use. Complex algorithms, functions, and routine can be coded in VBA programming language. To avoid system incompatibility issues, only standard Excel functions were used in the simulation game.

III. DESCRIPTION OF THE GAME: SCRUM-X

Scrum-X is a simulation platform to help students strengthen their understanding of Scrum methodology through experiential learning. Although the game was initially intended as an in class exercise, it can also be used as a take-home assignment. It is meant principally for students with little or no prior knowledge of the Scrum framework. The game is developed in Microsoft Excel with embedded VBA programming. As a standalone application, no software installation is required. It does not need an internet connection to run. The game file can be shared easily with students, and they only need to have Excel 2010 or 2013 to run it. A similar approach was taken by Lee [18] who used Excel to build a project management simulation game based on the waterfall approach. That simulation game has been used by hundreds of students at SMU and several universities globally. An instructional video of that game can be found on YouTube at this link:

<http://www.youtube.com/watch?v=Rn2f76LVIdY>

Scrum-X simulates a software development project to build a website for selling books. It involves the entire Scrum process from sprint planning, to sprint execution, and final sprint review and retrospective. The game is most effective when played with three members, each member playing different roles at different stages of the game. Although Scrum is slowly but steadily gaining popularity in many industries, it originates in the software industry, but surprisingly, many IT students have little or no knowledge of Scrum methodology. Scrum is fundamentally different from conventional project management methodology, which focuses on performing detailed upfront planning, with emphasis on fixing the scope, cost and schedule. Scrum, on the other hand, encourages iterative development, in which the primary focus is on delivering products that satisfy

customer requirements. It is important for students to first understand that the Scrum framework consists of Scrum Teams and their associated roles, events, artifacts, and rules. By clicking on the different characters or list of questions on the home page shown in Fig 1, students can learn about the basic elements of the Scrum framework that will aid them in playing the game.

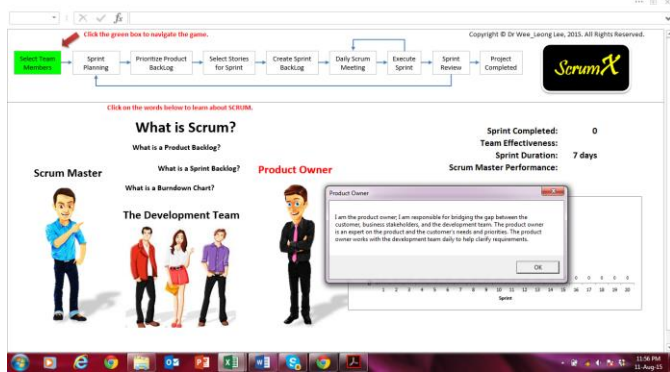


Fig. 1. Home Page

At the top of the home page, a process flow illustrates the Scrum process flow sequence. Players can navigate the game by clicking on the green box in the process flow, which acts as a directional button to progress to the next stage of the game. Clicking on the green button may trigger a series of issues that will require the player to make a decision by making a selection from a list of options as shown in Fig 2.

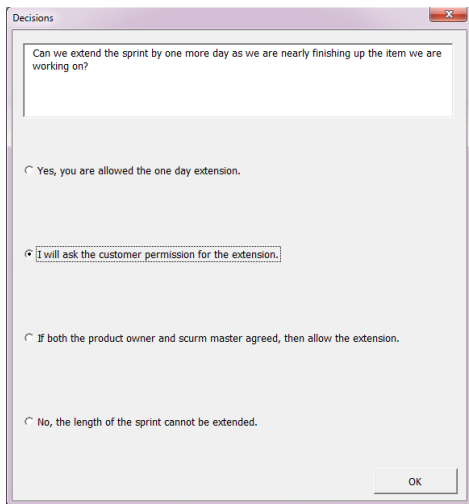


Fig. 2. Issues Requiring a Decision

In the event that players are lost, they can click the green box in the process flow diagram and instructions will be given. Audio instructions and pop up message boxes are used to help players navigate the game.

A. Select Team Members

To make the game more interesting and interactive, fictitious characters are introduced. The game starts with participants playing the role of the Scrum Master, and the first task is to form a Development Team. For simplicity, only three roles are created in the game, architect, developer, and quality assurance. There are three members in each role. The Scrum Master

(participants) has to select one member from each role to form the Development Team. To help participants form their dream team, a brief background of each character is given as shown in Fig 3. The selected team member will stay with the team throughout the sprint, and changing of team members can only happen between sprints, just before the sprint planning process.

Throughout the game, events or issues, in the form of a pop up dialog box with multiple choice questions (Fig 2), may arise that will require players to make decisions. The results of these decisions will impact the effectiveness of the Development Team, and thus the outcome of the game.

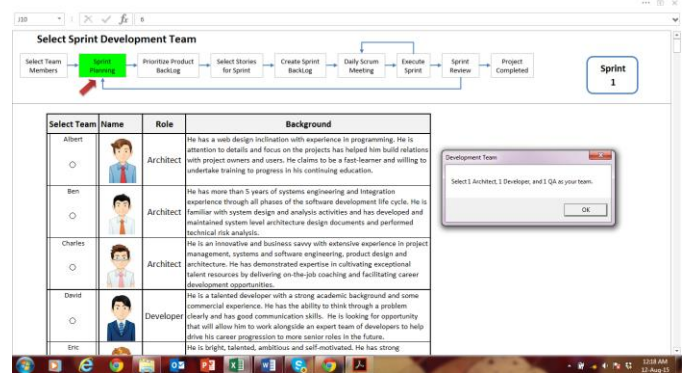


Fig. 3. Select Development Team Members

B. Estimate User Story Points and Select Story for Sprint

A user story is a description of a user requirement, containing just enough information for the Development Team to reasonably estimate the effort required to implement it. In short, the user story describes the type of user, what they want and why. An example of a user story is:

“A Customer can search for books by entering values in any combination of author, title, ISBN number, word or phase in the title fields.”

Story points are quantitative indications of the size and complexity of user story. One of the critical success factors in implementing Scrum is the ability of the Development Team to estimate user story points accurately.

In this stage of the game, the participants take on the role of the Development Team and play the planning poker game. Planning poker is a consensus-based technique for estimating effort of user story. Each member makes their own estimates without showing it to others, and when everyone is ready, reveal and discuss their estimate. By hiding the estimate initially, the group cognitive bias of anchoring can be avoided. The process can be repeated until the team agrees on a single estimate. All user story points must be estimated before they are allowed to progress into the next stage.

Next, the Product Owner will prioritize the user story. The prioritization process is performed by the internal game engine following a uniform random distribution, that ignores story dependencies. Now participants will play the role of Development Team to select the amount of work (a number of user stories) they believe they can complete within the sprint (Fig 4). If too many stories are selected, there is a risk of having some partially completed stories at the end of the sprint. Any

partially completed stories will go back to the Product Backlog to be reprioritized for the next sprint. In the game, user story going back to the Product Backlog will not be treated as a partially completed story in subsequent sprints. At the other extreme, selecting too few stories may result in completing the stories before the end of the sprint, which is also undesirable because this will result in requiring more sprints to complete the project. The game rules dictate that within a sprint, the amount of work (user stories) chosen cannot be changed, and no stories can be taken out or inserted. Throughout the game, new user stories are constantly being added to the Product Backlog. The new story (aka new user requirements) will appear during Sprint planning.

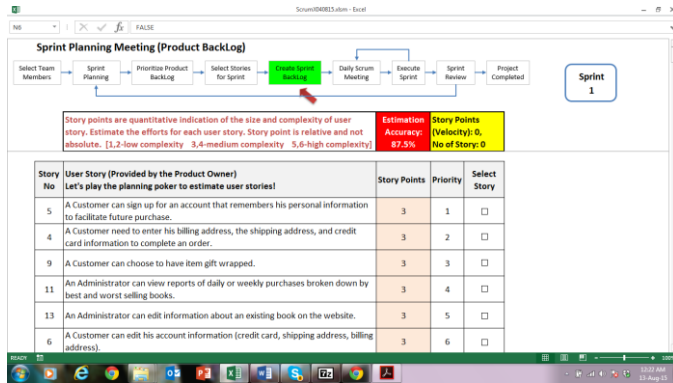


Fig. 4. Story Point Estimation and Selection

C. Sprint Backlog

Once the user stories have been selected, the game engine will automatically generate the Sprint Backlog. The Sprint Backlog consists of the set of user stories selected for the Sprint, and a work schedule for delivering the product at the end of the Sprint. In the game, user stories are broken down into smaller chunks (tasks) and assigned to individual Development Team members to form the Sprint Backlog (Fig 5). User story with higher story points will be decomposed into a larger number of tasks than those with lower story points. In Scrum framework, the Development Team is responsible for creating the Sprint Backlog, and neither the Scrum Master or Product Owner has control over how the Sprint Backlog is formed. With the Sprint Backlog prepared, the game moves into the Sprint execution stage.

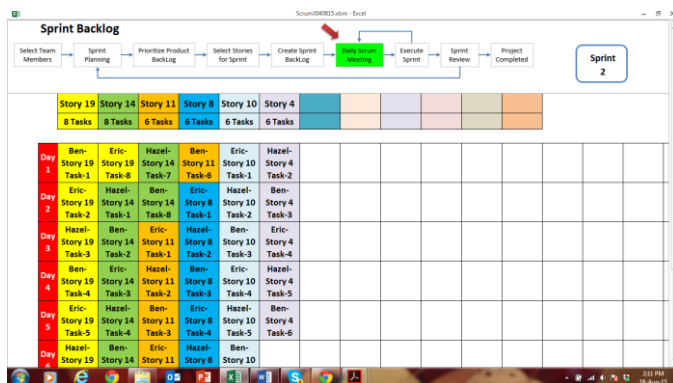


Fig. 5. Sprint Backlog

D. Sprint Execution

In the Scrum framework, Sprint duration is typically between two to four weeks. It is not necessary for the game to have such a long duration, thus it was decided that each Sprint will last for 7 days. Weekends and holidays are disregarded to avoid adding unnecessary complexity to the design and construction of the application. There is a simulated 15 minutes daily Scrum meeting. During this meeting, each member of the Development Team will ask three questions:

1. What did you do yesterday?
2. What will you do today?
3. Are there any impediments in your way?

If there is an impediment, it will trigger a pop-up dialog box which describes an issue that needs to be addressed (similar to Fig 2) before the game can proceed further.

Fig 6 shows a screen shot of the Sprint execution stage. There are three columns on the left of the screen, the first column shows the stories in the Product Backlog, the second column shows the stories that are selected for that sprint (work-in-progress), and the third column shows the stories that are completed. The table in the middle of the screen shows the respond to the three questions asked during the daily Scrum meeting. On the right of the screen, there is a Sprint Burndown chart. The Sprint Burndown chart shows the total amount of work (in man hours) to be completed in the Sprint. A diagonal dotted blue line shows the ideal progress if the Sprint is to be completed on time. If progress is lagging behind schedule, the work remaining (indicated by the solid green line) will be above the diagonal line. If progress is going faster than scheduled, the work remaining will be below the diagonal dotted blue line.

Players have to repeatedly click the execute Sprint button to progress to the next day. After seven days, the Sprint is completed and the game moves on to the Sprint review and retrospective stage, where the result of the Sprint execution is evaluated.

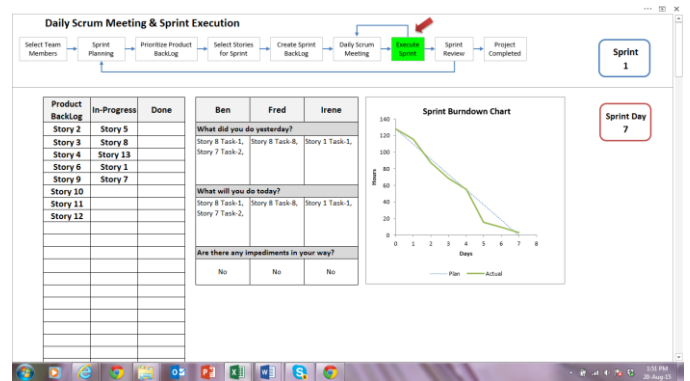


Fig. 6. Sprint Execution and Burndown Chart

E. Sprint Review & Retrospective

In the Sprint review screen shot shown in Fig 7, there is a product Burndown chart which depicts the completion of requirements over time. Here, it shows the number of stories left in the Product Backlog after each sprint. In the initial few Sprints, the number of user stories left in the Product Backlog is

expected to increase, despite the fact that user stories have been completed. This is because new stories are added to the Product Backlog along the way, akin to customers requesting for new requirements as the project progresses.

The clustered column chart in Fig 7, below the product Burndown chart, compares the number of stories selected (blue bar) to the number of stories completed (red bar) in each sprint. The velocity, which is the sum of the total number of story points selected for each sprint, is indicated by the green line. Velocity can be defined as how fast the Development Team is working. Measuring velocity without taking into consideration yield (defined as the ratio of number of stories selected to the number of stories completed) is meaningless. A high velocity with low yield suggests that the team is taking on more work than it can handle. A low velocity with high yield, on the other hand, infers that the team is taking on too little work, and fails to maximize the utilization of the Sprint. One of the key challenges of the game is for the players to determine what is the maximum velocity of the Development Team that gives a 100% yield.

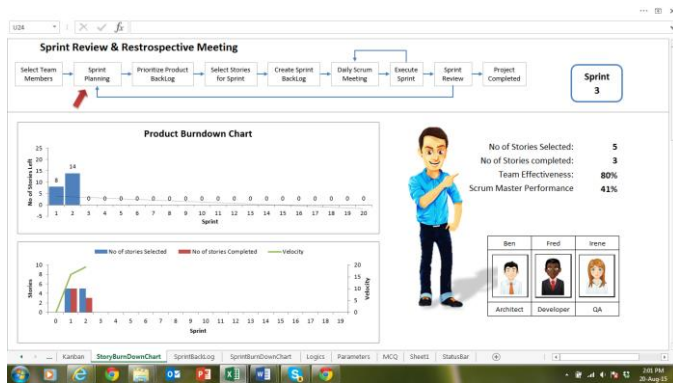


Fig. 7. Sprint Review and Retrospective

Clicking on the Scrum Master figure in Fig 7 will bring forth a dialog box showing the questions that were asked during that Sprint cycle, the players' answers and whether they were answered correctly, as well as the correct answers with an explanation (Fig 8). This is to simulate the retrospective meeting, whereby the Scrum team analyzes the good practices and lessons learnt. The Sprint Retrospective is an integral part of the Scrum process, without which the team would be unable to improve their overall output and team performance.

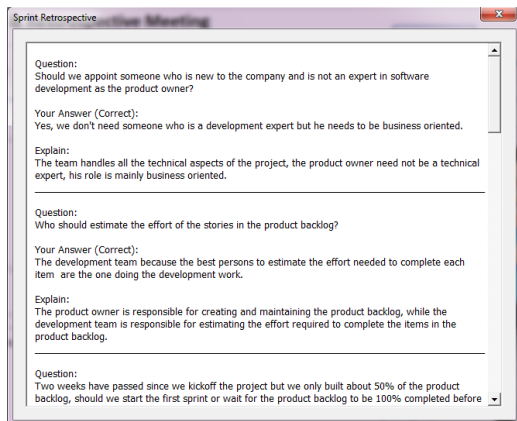


Fig. 8. Retrospective Review of Decision Made

At this juncture, the players would have completed one full cycle of the game for one Sprint. Next, players have the option of either going back to re-select their Development Team members, or directly proceeding to Sprint planning to start the next Sprint cycle.

The game ends when all the user stories are completed, which typically requires several Sprints. If the game is played in class with teams of three members each, the team with the least number of Sprints needed to complete the game is the winner.

IV. PILOT STUDY AND EVALUATION

A pilot run was conducted in a professional program with 15 participants, playing in groups of three people. This was a three day project management course covering the fundamentals of project management, and half a day was devoted to teaching Scrum methodology, including playing Scrum-X. Majority of the participants had some background in project management but few had in-depth theoretical or practical knowledge of Scrum methodology. Participants were first introduced to Scrum framework and shown how to navigate the game. They were given two hours to play the game. At the end of the session, participants completed an evaluation questionnaire to provide feedback on Scrum-X.

The questionnaire was designed to assess the effectiveness of the game in teaching the principles of Scrum. Below are the list of ten questions, and for each question, participants were to indicate on a five points scale that measured along one dimension from "very little" to "very much".

- Q1. How familiar are you with Scrum methodology?
- Q2. Did you think that prior knowledge of Scrum was required to play this game?
- Q3. Did you find the user interaction of the game easy and smooth?
- Q4. Did you find the game enjoyable to play?
- Q5. Did the game provide you with a good overview of Scrum?
- Q6. Did the game contribute to your project management knowledge?
- Q7. Did you find the game interesting?
- Q8. Did you find the game challenging?
- Q9. Did you think the game was useful for this course?
- Q10. Did you encounter any technical problems whilst playing the game?

The results from the pilot test were very encouraging, as can be seen from Fig 9, which summarizes the questionnaire results. Majority of the participants felt that the game provided a good overview of Scrum (4.5/5), which is the key objective of the game, despite the fact that most of them were unfamiliar with Scrum (3.3/5). The participants also felt that prior knowledge of Scrum was not necessary to play this game (3.7/5), which was the one of the considerations when designing the game.

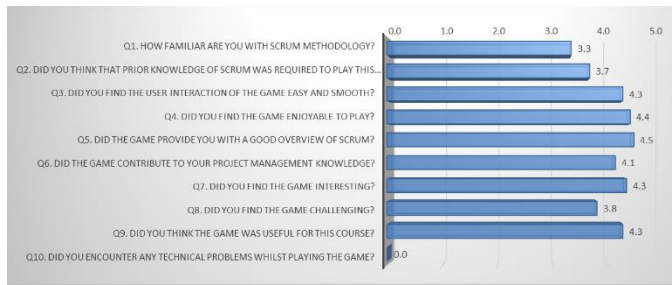


Fig. 9. Results of Pilot Run

Although the participants found the game to be interesting (4.3/5), they did not find the game challenging enough (3.8/5), which is valuable feedback for future enhancement of the game. Most participants did find the game enjoyable to play (4.4/5) and easy to navigate (4.3/5), although the game involved multiple stages and Sprint cycles that they were required to clear. Overall, no one encountered any technical problems whilst playing the game (0/5).

V. CONCLUSION

Computer-based simulation games seem well suited for adult learners, particularly in the field of project management. They get the opportunity to experiment with the consequences of executing or neglecting important project management decisions, and to test out different approaches and solutions, as well as learning by observing the consequences of their actions.

In this article, a spreadsheet-based experiential learning platform, Scrum-X, was introduced. The aim of this simulation game is to allow learners to experience and discover the Scrum processes and roles, and how they apply to software development. In the game, learners get to estimate user story, plan, execute and monitor a sprint and the respective meetings, assume different Scrum roles, as well as learn to make decisions that will impact the outcome of the game.

Results of the pilot run demonstrate the potential of the game to contribute positively to the learning objective. It has also been recognized that the game can have a positive impact on the student's motivation to learn, while at the same time providing an engaging and enjoyable learning experience.

The beta release of this game has exhibited much potential, and feedback gathered from the pilot run suggested several areas of improvement. Making the game more challenging and improving the Sprint execution process are key priorities for future releases.

REFERENCES

[1] D. Michael, & S. Chen, "Serious Games: Games That Educate, Train, and Inform", Boston: Thomson Course Technology PTR, 2005.

[2] M. Prensky, "Digital Game-Based Learning" St. Paul, Minnesota: Paragon House Publishers, 2007.

[3] M. Savin-Baden, and C. H. Major, "Foundations of Problem-Based Learning, Maidenhead", The Society for Research into Higher Learning & Open University Press, 2004.

[4] E. Kaynak, J. Wolfe, J. B. Keys, "Business Simulations, Games, and Experiential Learning in International Business Education", Routledge, 2013.

[5] E. Oh, and H. A. Van der, "Towards game-Based Simulation as a Method of Teaching Software Engineering" Proceedings of The Frontiers in Education. 2002. FIE 2002. 32nd Annual, 6-9 Nov. 2002.

[6] J. Torrente, P. Moreno-Ger, I. Martínez-Ortiz, and B. Fernandez-Manjon, "Integration and Deployment of Educational Games in e-Learning Environments: The Learning Object Model Meets Educational Gaming", Educational Technology & Society, 12 (4), 359-371, 2009.

[7] A. Amory, and R. Seagram, "Educational game models: conceptualization and evaluation", South African Journal of Higher Education 17(2), 206 - 217, 2003.

[8] K. Schwaber, "Agile Project Management with Scrum", USA: Microsoft Press, 2004.

[9] G. W. Christiane, S. Rafael, F. B. Andriano, 'SCRUMIA-An educational game for teaching SCRUM in computing courses', The Journal of Systems and Software, 86, 2013, pp 2675-2687.

[10] B. Gloger, "Ballpoint Game", Available at: <https://www.box.com/shared/mg9kq3d17e>, 2008.

[11] A. Krivitsky, "A Multi-Team, Full-Cycle, Product-Oriented Scrum Simulation with LEGO Bricks", Accessed via lego4scrum.com, 2011.

[12] D. Lubke, K. Schneider, "Agile Hour: Teaching XP Skills to Students and IT Professionals, Product Focused Software Process Improvement", 6th International Conference, PROFES 2005, Oulu, Finland, June 13-15, 2005, Proceedings.

[13] V. Peeters, P. V. Cauwenbergh, "XP Planning Game", 2010, Available at: <http://www.xp.be/xpgame.html>

[14] C. M. Zapata, and G. Awad-Aubad, "Requirements Game: Teaching Software Project Management", CLEI Electronic Journal, 10(1), 2007.

[15] J. M. Fernandes, S. M. Sousa, "PlayScrum - a card game to learn the scrum agile method", In: Proc. of Second International Conference on Games and Virtual Worlds for Serious Applications, Braga, Portugal, 2010.

[16] C. W. Caulfield, D. Veal, and S. P. Maj, "Teaching Software Engineering Project Management-A Novel Approach for Software Engineering Programs", Modern Applied Science, 5(5), 2011.

[17] A. Gkritsi, 2011. "Scrum Game: An Agile Software Management Game", Master Thesis, University of Southampton, Electronics and Computer Science, Great Britain, 2011.

[18] W. L. Lee, "Spreadsheet Based Experiential Learning Environment for Project Management", Proceedings of the 2011 Winter Simulation Conference, Phoenix, Arizona.

[19] W. L. Lee, "An Integrated Model of Team Motivation and Worker Skills for a Computer-based Project Management Simulation", Proceedings of the 2013 Winter Simulation Conference, Washington D.C.

[20] E. O. Navarro, "SIMSE: An Interactive Simulation Game for Software Engineering Education", Conference: Proceedings of the 7th IASTED International Conference on Computers and Advanced Technology in Education, August 16-18, 2004, Kauai, Hawaii, USA