

Development of a Software Engineering Process Improvement Game
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The goal of this project was to create a computer game that emphasizes best practices in software engineering process improvement while students create virtual engineering artifacts during game play. Our digital card game rewards players for using good software project management strategies within the Scrum framework to complete projects on time and within budget, while meeting required software quality standards.

The design team created the user stories and a paper prototype for the Process Improvement Game (PIG) card game in February 2016. The development team created the game infrastructure using Unity3D and exported WebGL and Windows versions of the feasibility game prototype in May 2016. A first playable game prototype containing the tutorial level was completed during June 2016. This prototype was deployed on the web and was play tested by a small number of software engineering students during July 2016. The software engineering students were asked to complete an online usability questionnaire (Purdue 2016) and a short quiz on Scrum concepts after playing the game prototype.

Player feedback from this game play test was used to refine game play and create the two additional levels containing new virtual software projects. The development team created an online user manual to provide background information on Scrum for players without software engineering backgrounds. A complete game prototype containing all three projects was made available for public review on the GAME Lab web page in August 2016.

The final game was exported from Unity3d for three platforms (Android, Windows, and WebGL) in September 2016 and made available on the GAME lab web site. During the Fall 2016 semester several software engineering students played this final game. They provided feedback by completing an online quiz and an online usability questionnaire created by the development team. The students gave the game high marks on most usability questions. The students liked the interface aesthetics, card mechanics, game balance, and challenges posed by the game. However, the students gave slightly lower marks on the user guidance within the game. They indicated that some of explanations on the effects cards were not adequate and suggested that a pop up help window that repeated the initial card play rules would be desirable.

The students were asked to complete a short true/false quiz on Scrum principles. It was satisfying to see that they players gave correct answers to the Scrum process and management questions. Their answers suggested that they recognized the importance of managing defects, budget, and time, as well as monitoring the velocity of code generation to provide effective project management.

The SIGCSE Special Project funds (\$3,200) awarded to this project were used to cover the salary of a part-time Graduate Student Research Assistant (GSRA). The GSRA helped to create a paper prototype for PIG, supervised the undergraduate student game developers from our Senior Design course, and built a web site to support game.

We are continuing to refine the usability issues uncovered by our assessment of the game and plan to submit a paper or poster to the 2018 SIGCSE Symposium in August 2017. We are making this WebGL game available as a free to play web game

hosted on the GAME Lab website (<http://gamelab.cis.umd.umich.edu/PIG-Web/>). We are allowing all versions of these games (Windows, WebGL, and Android) as free downloads from the same website.