Using Games in Software Engineering Education to Increase Student Success and Retention

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Abstract

Software Engineering (SE) and Systems Engineering (Sys) are knowledge intensive, specialized, rapidly changing disciplines; their educational infrastructure faces significant challenges including the need to rapidly, widely, and cost effectively introduce new or revised course material; encourage the broad participation of students; address changing student motivations and attitudes; support undergraduate, graduate and lifelong learning; and incorporate the skills needed by industry. Games have a reputation for being fun and engaging; more importantly, they are immersive, requiring deep thinking and complex problem solving. We believe educational games are essential in the next generation of e-learning tools. An extensible, web-enabled, freely available, engaging, problem-based game platform that provides students with an interactive simulated experience closely resembling the activities performed in a (real) industry development project would transform the SE/Sys education infrastructure.

1. Summary

Creating a game for students creates an interactive student-centered environment rather than a passive content-centered environment. This allows students to create a personalized learning experience, progressively incorporating new knowledge and scaffolding it into what they already know. The variability within this interactive environment permits students to work on lower-level tasks repeatedly as they begin to develop broader analytical skills and make progress towards completing the game objectives. Because each student is able to engage course-based material at his or her own pace, underprepared or at-risk students can focus on needed skills at their convenience. Feedback is frequent and immediate, thereby reinforcing mastery of fundamental skills required for advancing further into the game.

A game is task-oriented rather than content focused; it encourages practice and mastery rather than rote memorization. Games stress strategic learning allowing students to practice further transference of their knowledge to more complex scenarios. Creating a game environment for the SE curriculum creates a highly motivating environment. A real-time strategy game appeals to a student’s sense of fantasy and amusement; it is self-directed, appealing to a student’s curiosity; and it is a continuous challenge where existing tasks or knowledge appear incomplete, inconsistent or incorrect, thereby challenging a student to continue and foster deeper levels of learning.

The creation of a real-time strategy game has a better chance of increasing the efficacy of attaining SE student learning outcomes. The rules of the game are designed to mimic the rhetoric and practices of SE as a discipline, thereby engaging players to develop mindsets they can use in professional contexts. The paradigm shift gaming creates will augment faculty resources and will help students become life-long learners, practice deeper problem-solving skills, and enhance their ability to communicate about SE in a professional context. Because the game environment will better motivate students to repeatedly practice outside of class time and challenges them to improve where they specifically have a need, under-represented and higher-risk students will have better chances of success in SE courses.