Abstract

Agile Project Management methods and processes that emphasize action and feedback over planning continue to gain prominence for Information Systems development and implementation projects. This topic is an ideal candidate to lead the evolution of project management instruction from teaching “about” to learning “how to”. This paper describes a roleplay simulation to instruct students in Agile project methods. This simulation called “Scrummy Agile” is inspired by the Scrum Software Development Process and has as its goal to teach key Agile project management competencies using first hand experiences. A study of efficacy across three cohorts of students is presented to contrast the roleplay instructional method with traditional reading and lecture.

1.0 Introduction

This paper describes a roleplay simulation to instruct students in Agile project methods. This simulation called “Scrummy Agile” is inspired by the Scrum Software Development Process (Rubin 2013) and has as its’ goal to teach key Agile project management competencies using first hand experiences. Agile approaches such as Scrum, XP, and Lean are increasingly common processes to deliver software and information systems.

Common project management books teach “about” Agile, including definitions, concepts, tutorials (Devedzoc and Milenkovic 2011) and anecdotes (Schwaber 2004). These resources support lecture guided presentation of technical skills described as a passive learning of explicit knowledge (Geist and Myers 2007). A variant of lecture and teaching cases involves guest speakers from industry who relay a variety of historical experiences and anecdotes to breathe life to otherwise static concepts (Poston and Richardson 2011). However, students are easily distracted by the vision of flexibility and individual autonomy emphasized by evangelists of Agile approaches, and lose site of the importance of the structure provided by specific Agile project management practices. For those who have not participated first hand in Agile projects, the apparent contradiction can be difficult to resolve. The duality of structure and flexibility is more easily assimilated as a dialectic by novices experiencing these practices first hand.

While Agile project methods have been prescribed for extended duration student projects (Mahnic 2012), undergraduate capstone courses (Baird and Riggins 2012) and student consulting projects (Heroit et al. 2008; Pollard 2012), these settings are best suited for integrating multiple competencies established earlier in the curriculum. An introductory primer is needed to establish a foundation that prepares all team members to participate fully from the onset of either academic or real world projects.

In an attempt to guide students to a tacit appreciation of the duality, we adopt roleplay, whereby students experience Agile project management practices in the context of a real-time storyline in which they are participants. The roleplay instructional method emphasizes competency development and concept understanding through the act of doing. Roleplay simulations use a participatory learning model to improve learning outcomes (Vold et al. 2010). In addition, roleplay scenarios provide a setting for peer learning where students actively consult among other students to clarify ideas and solve problems (Boud 2001). This method is a particularly good match for the Agile project management that values tacit knowledge over explicit knowledge.
This roleplay simulation was designed for a cohort of Health Informatics students in an interdisciplinary program run jointly between a School of Nursing and College of Business at a major metropolitan university. Many of the students have either clinical training or clinical experience. Coincidently, simulation is regarded as an effective instructional method for procedural skills within the health sciences (Nestel et al. 2011). Simulation instructional methods are also gaining traction among STEM disciplines (Chen et al. 2011; Streicher et al. 2005), including architecture design (Cleland-Huang et al. 2014), collaborative programming (Auer et al. 2011), specific refactoring strategies (Foster and Ruiz 2010), and some plan-driven project management techniques (Sullivan 1993; Tachikawa et al. 2013; Nakamura and Tachikawa 2014). However, many STEM simulations are staged within a technology mediated environment, while Agile is rooted in a value system that emphasizes face-to-face interactions. As a result, face-to-face roleplay simulations that include rich communication and interaction experiences (Andersson and Andersson 2010) align nicely with the philosophical views that inspire Agile methods.

This paper is organized as follows. Section two describes instructional preparation, including a summary of the Scrum Software Development process. Section three presents the Scrummy Agile roleplay activity. Section four identifies target learning objectives for both undergraduate and variants for graduate students who are often ready to analyze teaming and leadership dynamics. Section five presents a study of efficacy demonstrated through multiple cohorts using Scrummy Agile. The final section provides discussion and conclusion.

2.0 Preparation
The Scrummy Agile roleplay is an instructional aid used one week during a semester long IT Project Management class in a university setting. This roleplay is best performed after the class has been introduced to several other concepts such as project charters and requirements. The class for which this simulation was developed has already practiced writing a project charter and explored requirements, including preparation of use cases, user stories, conditions of satisfaction and estimating (estimating using planning poker can be an engaging classroom activity on its own.)

Once this foundation has been established, the iterative Agile project management approach can be introduced as a risk management strategy to manage the inevitability of scope creep and requirements change. Approximately 30 minutes of class time should be allocated to summarizing the Scrum Software Development process (Rubin 2013) and its key roles as a prototypical Agile process (VersionOne 2016).
Figure 1 is displayed (or circulated in printed form) to the class as a visual aid accompanied by a step-by-step summary of the generalized Scrum process including this information:

2.1 Scrum Roles:
The Product Owner is responsible for a vision of what s/he wants to create. During the project the product owner will prioritize features and capabilities (often collected in a Product Backlog), provide clarifying information (e.g., elaborating on use cases), serve as a conduit for authoritative product feedback, and determine when the product is complete. The product owner is also a liaison to project sponsors, other project stakeholders and isolated user communities.

The ScrumMaster is responsible for the mechanics of the Agile process. This includes: serving as a time-keeper; scheduling and facilitating key meetings such as the sprint planning, daily standup, sprint review and sprint retrospective; coordinating the product delivery and collecting user feedback; acquiring team space that supports project work and interaction; and managing the product backlog, sprint backlog, issues lists and project specific deliverables to provide visibility to backlog and various progress metrics. The ScrumMaster often generates certain reports such as a burndown chart to communicate progress. Following each sprint the Scrum Master may re-calculate velocity to forecast project duration.

Team Members are responsible for performing the tasks that create the project’s product. Members select tasks based on skills, confidence and interest. Team members often form sub-teams to collaborate on specific tasks as appropriate.

2.2 Scrum Process:
After a project charter is approved, the Product Owner’s vision is decomposed, refined and ordered through a processed called grooming into a set of discrete user stories that become Product Backlog
Items (PBIs). A Sprint Planning Meeting provides estimates for product items to establish relative size in terms of effort and time. The Sprint Planning Meeting also selects specific backlog items to be part of the next sprint, thus creating a Sprint Backlog. High level planning and just-in-time design of these items is performed as team members select activities they will perform during the next sprint.

Following the Sprint Planning meeting the team beings a time boxed development sprint, typically lasting two weeks (alternate duration “time boxes” are appropriate for some projects). During the fixed duration sprint, teams perform the activities to create, develop and otherwise enable the product features associated with user stories identified in the sprint backlog. A short Daily Standup Meeting (often 15 minutes) takes place at the start of every workday with all project participants. This meeting highlights progress, difficulties and provides information relevant to the whole team. While not itself a problem solving meeting, the daily standup will expose issues that may subsequently lead to problem solving activities. At the end of each sprint, an instance of the product suitable for use and examination by the user community is assembled. This instance of the product is employed to educate the product owner and users, trigger feedback, and where appropriate, perform useful organization work.

Following each sprint, a series of meetings take place. A Sprint Review meeting focuses on product feedback to influence refinement and evolution of the product during future sprints. The Sprint Review may lead to new or altered product backlog items as feedback is translated into new user stories. A Sprint Retrospective meeting focuses on project and process improvement. The Sprint Retrospective may lead to alternate resource assignments, different sequencing of tasks, changes to tools, or other process related adjustments to improve the team’s performance in subsequent sprints. Finally a new sprint begins with its Sprint Planning Meeting and the process restarts with a new sprint.

A key role for the product owner is to assess and accept the overall product. This assessment includes liaison with other stakeholders to assure ongoing alignment with organization objectives, including allocation of resources (time, people, money, facilities, etc.). The project concludes when the product owner either accepts a final product or disbands the project.

3.0 “Scrummy” Roleplay Exercise

The “Scrummy” roleplay exercise adapts the Scrum Software Development process in an abbreviated form to allow students to experience the roles and process mechanics within the time constraints of a classroom setting. After providing summary of the Scrum Software Development process as noted in the previous section, The Scrummy roles and Scummy process should be described.

3.1 Scrummy Roles

Team sizes may vary from four to six individuals, with five being ideal. This roleplay exercise involves three roles: (1) one Product Owner, (2) one Scrum Master, (3) two to four team members.

3.2 Scrummy Process

Teams will perform the project in a series of 30 minute “sprints” to deliver a solution/product. Each sprint will unfold in a predictable/repeatable set of timed increments:

A. **Sprint Planning**: 5 minutes to identify the goal and activities for the upcoming sprint (what to deliver). Individuals should select their own tasks from among those identified (there is no dictator running Agile projects).
B. **Execution**: 10 minutes to do work (this may be individual or in sub-teams if multiple people are collaborating).

C. **Product Build**: 5 minutes to consolidate your product.

D. **Delivery & Feedback**: 5 minutes to present your product and get feedback.

E. **Retrospective & Review**: 5 minutes to identify (at least) 1 thing you need to improve in your process (sprint retrospective) for the next sprint and to assimilate feedback from product presentation and Product Owner as you continue to build your product (sprint review).

### 3.3 Running the Srummy Roleplay

Teams are formed with self-assigned roles. The following instructions guide students to organize and launch the simulation.

- Teams are composed of four to six students (five is ideal).
- Adjust seating so students within a team are adjacent.
- This activity will use PowerPoint or some other presentation tool as well as Internet access. Now is the time to get multiple computing devices up and running.
- Each student will need a few pages of blank paper and a pen/pencil (for taking notes and organizing ideas during the course of the activity).
- As a team, select roles for each individual. Each student will maintain the same role throughout the full simulation.
- This is a “roleplaying game”. Pretend you are that person and act (fictitiously if needed) so that the game plays out smoothly.
- Send the Product Owner on behalf of the team to the instructor for additional instructions and information.

Once product owners are assembled they are provided a package of information for each team member. The package includes a one page summary of the Scrummy process (Appendix A.1), a one page project charter (Appendix A.2) and a description of their role with guidelines for their participation (Appendix B.1, B.2 and B.3). After dealing with questions, product owners return to their team, distribute the packages of information and the first sprint begins.

To facilitate a timely progression through each step of the Scrummy process the instructor should maintain and display a countdown timer. For the first sprint this can be done in increments for each stage of the Srummy process with an announcement for each transition. In subsequent sprints the classroom countdown timer measures the full sprint duration (30 minutes), and Scrum Masters have the responsibility for managing transitions for their individual project team.

At the conclusion of each sprint one team will present their product. The full class participates in question and answer to generate feedback for that team, and vicariously for all teams. The instructor may also participate to help guide the product. This serves as a collective **Sprint Review**. Following the classroom-wide presentation and feedback session Product Owners are again collected to receive supplemental instruction (Appendix B.4). After dealing with questions, product owners return to their team to continue with a team-specific sprint review where product adaptation is discussed to integrate feedback. A Sprint Retrospective allows teams to discuss process improvements. A new sprint begins as the team transitions to a Sprint Planning meeting.
3.4 Sample Project and situational adaptation

3.4.1 Sample Project Charter and alternate charters
The charter (Appendix A.2) is delivered as completed and approved (the subject of this roleplay is not project initiation). Following the Agile philosophy, the charter is a very brief document with a clearly stated vision, mission and benefits. In addition, a set of objectives helps guide the early stages of product development.

The project charter used for this simulation leads teams to develop a PowerPoint presentation to train other students to measure and understand their own blood pressure. This topic is aligned with the healthcare theme that underlies the target student’s Health Informatics curriculum. The selection of this topic is intentional to achieve emotional interest by the participants in the project mission.

The Scrummy simulation is adaptable to different educational domains beyond health informatics. When preparing to use this simulation for students in alternate degree programs carefully select a topic to quickly engage the students. Negotiating what product to create may be an interesting topic for another class session, but does not advance the learning objectives of this simulation.

3.4.2 Simulation Phases and requirements change
The simulation takes place in four phases. Phase 1 is 30 minutes of preparation. This includes introduction of generalized scrum, the Scrummy process, the simulation project charter, and forming of teams. Phase 2 is the first sprint and one team’s product presentation. Allowing 5 minutes for presentation followed by 5 minutes of questions and feedback, this phase will consume about 40 minutes. Phase 3 includes introduction of minor requirements changes (Appendix B.4). This phase will take about 30 minutes. Phase 4 includes additional requirements refinements, including some that contradict earlier feedback (Appendix B.5). By the end of phase 4 teams should be approaching a completed product. An optional Phase 5 involves a significant new requirement (determining a student’s temperature) that constitutes scope creep not aligned with the charter (Appendix B.6).

The requirements change provided in product owner instructions of Appendix B can be mixed and reordered. This allows introduction of the scope creep requirement (temperature) earlier and withdrawal in subsequent sprints. By manipulating user feedback, the instructor can simulate the back and forth nature of requirement change during a project. This leads students to experience how the iterative approach generates and responds to user and stakeholder feedback.

3.4.3 Adapt to alternate class duration
The Scrummy simulation was developed for a class which meets once a week for two hours and thirty minutes. This time frame allows ample time to present the generalized Scrum process, introduce the simulation and project charter, have teams select roles, distribute information packets and run three sprints. This activity can be easily split into two sessions where the preparation and role assignment occurs in one session and performing sprints occurs in a second. Adaptation for a class with three fifty minute sessions is a bit more challenging as some sprints are separated by one or more days in which some students/teams may be tempted to complete the project offline (and thereby circumventing effective practice of Scrummy time boxing and interaction dynamics).
4.0 Learning Objectives

4.1 Undergraduate students
This simulation was developed for an undergraduate class in IT project management for students pursuing a degree in health informatics. The healthcare field is highly regulated, leading to a culture that encourages a verification and validation methodology commonly implemented in plan-driven project management approaches such as V-model. However, even in the life-sciences and healthcare domain many organizations are opportunistically using Agile project methods. As a result, students need familiarity and understanding of Agile methods. This roleplay simulation seeks to accomplish the following learning objectives:

1) Understand key agile project concepts including: backlog, iterative development, sprint, and time boxing,
2) Understand the common roles in agile projects including product owner and scrum master.
3) Explain the purpose of agile processes including Sprint Planning Meetings, Sprint Reviews and Sprint Retrospectives.

4.2 Graduate students
This simulation is applicable for a graduate class in IT project management for students pursuing a Masters of Science in Information Systems. These students typically have work experience in IT project teams. During the course of a classroom simulation, graduate students with some Agile project experience quickly educate their peers on the learning objectives targeted for undergraduate students. In this setting, the simulation becomes as first person case study to explore these alternate learning objectives:

1) Explain how iterative project processes help expose requirements and manage risk associated with changing requirements.
2) Identify and categorize new project, product and organization risks that Agile projects are susceptible.
3) Describe the characteristics of leadership required in an Agile project.
4) Illustrate the Emotional Intelligence (Mersino 2013) dynamic of “Social Awareness” by capturing an example of Empathy exhibited by one team member during the simulation.
5) Estimate the duration of the project based on velocity measured after the first and second sprints (this learning objective may require additional preparation to carefully build the product backlog and estimate use-cases).

5.0 Measuring Results and Discussion
Following the roleplay with a reflective assignment allows students to synthesize and interpret the function of Agile project management structures that support both flexibility and alignment with the project’s purpose and mission. A formative assessment is provided to all students as an electronic web based questionnaire (see Table 1). Responses were coded with numeric values of 1 for Definitely-not, 2 for Probably-not, 3 for Probably-yes and 4 for Definitely-yes. The result is an ordered scale with higher values reflecting greater student confidence in their understanding and command of the associated concepts.
A Three Cohort Study of Roleplay Instruction for Agile Project Management

Schmitz, K

Data was collected from three cohorts of students participating in an IT project management class as part of their university degree program. The first group involved 41 undergraduate students in a cohort Health Informatics program. Data for the first group was limited to post-roleplay confidence. The second group involved 60 graduate students in a cohort MS-IS program. Data for the second group included both a pre- and post-roleplay confidence providing some comparative evidence of instructional effectiveness. The third group involved 46 undergraduate students in a cohort Health Informatics program. Data for the third group included pre- and post-roleplay confidence as well as aligned test questions from an exam. All data is anonymous and none of the responses are matched, except to their respective cohort.

5.1 Cohort 1: Undergraduate course in IT Project Management

The first cohort to participate in the Scrummy roleplay involved a class of 41 students. Table 1 identifies the anonymous formative assessment questions presented to students following the roleplay exercise and provides descriptive statistics for each. Actual participation in this optional questionnaire is reported in the table as N=29.

Table 1: Cohort 1 (undergraduate Health-Informatics students)

<table>
<thead>
<tr>
<th>Statement of Knowledge</th>
<th>Method</th>
<th>Post roleplay Mean (N=29)</th>
<th>Post roleplay St.Dev (N=29)</th>
<th>Post roleplay Variance (N=29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 Do you know what a Sprint is?</td>
<td>roleplay</td>
<td>3.55</td>
<td>0.632</td>
<td>0.399</td>
</tr>
<tr>
<td>Q2 Do you know what a Planning Meeting is?</td>
<td>roleplay</td>
<td>3.59</td>
<td>0.733</td>
<td>0.537</td>
</tr>
<tr>
<td>Q3 Do you know what a Product Owner is?</td>
<td>roleplay</td>
<td>3.62</td>
<td>0.561</td>
<td>0.315</td>
</tr>
<tr>
<td>Q4 Do you know what a Scrum Master is?</td>
<td>roleplay</td>
<td>3.66</td>
<td>0.614</td>
<td>0.377</td>
</tr>
<tr>
<td>Q5 Do you know what time-boxing is?</td>
<td>roleplay</td>
<td>3.59</td>
<td>0.568</td>
<td>0.323</td>
</tr>
<tr>
<td>Q6 Do you know what a project retrospective is?</td>
<td>roleplay</td>
<td>3.24</td>
<td>0.830</td>
<td>0.690</td>
</tr>
<tr>
<td>Q7 Do you know the difference between an end of sprint project review and an end of sprint project retrospective?</td>
<td>roleplay</td>
<td>3.17</td>
<td>0.848</td>
<td>0.719</td>
</tr>
<tr>
<td>Q8 Do you know the difference between Planning Poker and a sprint Planning Meeting?</td>
<td>lecture</td>
<td>2.90</td>
<td>0.860</td>
<td>0.739</td>
</tr>
<tr>
<td>Q9 Do you know what a Daily Standup meeting is?</td>
<td>lecture</td>
<td>3.34</td>
<td>0.769</td>
<td>0.591</td>
</tr>
<tr>
<td>Q10 Do you know what an Epic/Theme is?</td>
<td>lecture</td>
<td>3.52</td>
<td>0.634</td>
<td>0.401</td>
</tr>
<tr>
<td>Q11 Do you know what a Burn-down Chart is?</td>
<td>lecture</td>
<td>2.76</td>
<td>0.912</td>
<td>0.833</td>
</tr>
<tr>
<td>Q12 Do you know what velocity is?</td>
<td>lecture</td>
<td>3.31</td>
<td>0.660</td>
<td>0.436</td>
</tr>
</tbody>
</table>

The first seven questions involve topics addressed by the roleplay exercise, while the last five involve Agile related topics covered only in the textbook and standard lecture. Students expressed the highest confidence in their command of role related concepts addressed in questions 3 and 4. Confidence scores are also relatively high the remaining knowledge level concepts addressed in questions 1, 2 and 5. Confidence was somewhat weaker for the concept of “project retrospective” addressed in question 6. It
appears some students are not differentiating the similar concepts of “project retrospective” and “project review” (confirmed by question 7).

Knowledge level concepts covered in the textbook and lecture are addressed in questions 9, 10, 11 and 12. Students confidence for these concepts is more variable. The lowest confidence is reported for “the concept of burn-down charts, which may be attributed to a lack of a-priori context. In the case of Question 9 (daily standup meeting), students may infer from the label sufficient context clues to guide rapid assimilation of this concept. Similarly, the label “velocity” in question 12 allows students to appropriate pre-existing ideas to the project management domain. In contrast, pre-existing knowledge is less helpful for the idea of a burn-down chart (question 11), making this concept somewhat more difficult to assimilate. The outlier for this cohort is the concept of Epic/Theme (question 10). This concept was covered using a conventional textbook and lecture approach at least a week prior to the roleplay. Student confidence for this concept is surprising and may be explained by multiple clarification questions asked by students at the time this material was presented. (The resiliency of student comprehension is explored more effectively in data collected in cohort 3, reported below.)

Questions 7 and 8 involve more nuanced comprehension that requires comparing and contrasting certain concepts. In particular these relate to the purpose and function of certain recurring meetings used in Agile projects. Interestingly Students report markedly higher confidence for Question 7 that involves concepts covered in the simulation than for Question 8 which involves concepts covered only in the text and in traditional lecture.

After reviewing student feedback from the first cohort, the overall impression of success inspired the primary investigator enhance the roleplay activity with a pre-course questionnaire, employ the simulation as a first-person case study for graduate students (cohort #2). In addition, a small set of exam questions for undergraduates has been introduced (cohort #3) to provide additional insight regarding effectiveness as an instructional method.

5.2 Cohort 2: Graduate course IT Project Management

A cohort of 60 graduate students taking a master level course in IT Project Leadership participated in the Scrummy roleplay simulation. In addition to reinforcing Agile and Scrum process competencies, the simulation provided a somewhat controlled first person team experience from which the students examined additional leadership phenomenon related to emotional intelligence and strategic risk management. This paper focuses on the Agile/Scrum process related learning objectives which are common across both the undergraduate and graduate classes.

Before and After confidence scores were collected from this cohort using the same survey instrument as cohort 1. As with the undergraduates, all answers were anonymous, and responses were not matched to the informant. Table 2 provides the mean confidence scores both prior (N=52) to the Scrummy roleplay exercise and after (N=59). In addition, a two-sample t-test for unpaired data samples with unequal variances was calculated (Stata 2013) to provide a statistical test of the hypothesis that the students gain confidence related to their command of these concepts during the simulation. In all cases, statistically significant evidence suggests that self-reported knowledge and comprehension improves.
Three Cohort Study of Roleplay Instruction for Agile Project Management

<table>
<thead>
<tr>
<th>Statement of Knowledge</th>
<th>Method</th>
<th>Pre Sim Mean (N=52)</th>
<th>Post Sim Mean (N=59)</th>
<th>H: post - pre &gt; 0 t-score (pvalue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 Do you know what a Sprint is?</td>
<td>roleplay</td>
<td>3.25</td>
<td>3.97</td>
<td>5.607 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q2 Do you know what a Planning Meeting is?</td>
<td>roleplay</td>
<td>3.21</td>
<td>3.86</td>
<td>5.213 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q3 Do you know what a Product Owner is?</td>
<td>roleplay</td>
<td>3.33</td>
<td>3.97</td>
<td>6.342 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q4 Do you know what a Scrum Master is?</td>
<td>roleplay</td>
<td>3.04</td>
<td>3.92</td>
<td>5.855 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q5 Do you know what time-boxing is?</td>
<td>roleplay</td>
<td>2.90</td>
<td>3.83</td>
<td>6.464 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q6 Do you know what a project retrospective is?</td>
<td>roleplay</td>
<td>2.54</td>
<td>3.90</td>
<td>9.267 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q7 Do you know the difference between an end of sprint project review and an end of sprint project retrospective?</td>
<td>roleplay</td>
<td>2.12</td>
<td>3.78</td>
<td>10.862 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q8 Do you know the difference between Planning Poker and a Sprint Planning Meeting?</td>
<td>lecture</td>
<td>2.23</td>
<td>3.56</td>
<td>7.518 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q9 Do you know what a Daily Standup meeting is?</td>
<td>lecture</td>
<td>3.60</td>
<td>3.93</td>
<td>3.577 (0.0003)</td>
</tr>
<tr>
<td>Q10 Do you know what an Epic/Theme is?</td>
<td>lecture</td>
<td>2.35</td>
<td>3.49</td>
<td>7.515 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q11 Do you know what a Burn-down Chart is?</td>
<td>lecture</td>
<td>2.12</td>
<td>3.39</td>
<td>7.352 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q12 Do you know what velocity is?</td>
<td>lecture</td>
<td>2.44</td>
<td>3.50</td>
<td>5.959 (&lt;0.0000)</td>
</tr>
</tbody>
</table>

Two sample t-test of unpaired samples with unequal variances (one-tailed test of significance).

The pre-simulation confidence scores are relatively high for the knowledge level concepts associated with questions 1, 2, 3, 4 and 5. Confidence increases and approaches the top of the scale after the roleplay activity. Students report a lower level of initial understanding of project retrospective and project review (questions 6 and 7), yet in both cases the post roleplay confidence approaches the top of the scale.

Concepts delivered through reading and lectures are associated with questions 8 through 12. With the exception of daily standup meetings (question 9), a priori confidence is equivocal. While the confidence grows with reading and lecture, students do not report confidence levels as high as those experienced during the roleplay. The one interesting exception is “daily standup meetings” associated with question 9. Self-reported understanding of this concept starts relatively high and increases. One explanation may be the highly descriptive label assigned to this practice, which is largely self-evident.

5.3 Cohort 3: Undergraduate course in IT Project Management

A cohort of 46 undergraduate health informatics students taking a course in IT Project Leadership are the third group to participated in the Scrummy roleplay simulation. In addition to collecting self-report data before and after the roleplay exercise, a small set of exam questions were administered to this cohort as test of knowledge and comprehension.
Table 3 provide the mean confidence scores both prior (N=42) to the Srummy roleplay exercise and after (N=39). In addition, a two-sample t-test for unpaired data samples with unequal variances provides a statistical test of the hypothesis that the students gain confidence related to their command of these concepts during the simulation. The data provides strong statistical evidence (p<0.000) that self-reported knowledge and comprehension improves with the simulation.

<table>
<thead>
<tr>
<th>Statement of Knowledge</th>
<th>Method</th>
<th>Pre Sim Mean (N=42)</th>
<th>Post Sim Mean (N=39)</th>
<th>H: post - pre &gt; 0 t-score (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 Do you know what a Sprint is?</td>
<td>roleplay</td>
<td>2.50</td>
<td>3.69</td>
<td>7.232 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q2 Do you know what a Planning Meeting is?</td>
<td>roleplay</td>
<td>3.14</td>
<td>3.62</td>
<td>3.455 (0.0004)</td>
</tr>
<tr>
<td>Q3 Do you know what a Product Owner is?</td>
<td>roleplay</td>
<td>3.19</td>
<td>3.72</td>
<td>3.522 (0.0004)</td>
</tr>
<tr>
<td>Q4 Do you know what a Scrum Master is?</td>
<td>roleplay</td>
<td>2.33</td>
<td>3.67</td>
<td>6.913 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q5 Do you know what time-boxing is?</td>
<td>roleplay</td>
<td>3.24</td>
<td>3.69</td>
<td>3.465 (0.0004)</td>
</tr>
<tr>
<td>Q6 Do you know what a project retrospective is?</td>
<td>roleplay</td>
<td>2.76</td>
<td>3.62</td>
<td>5.148 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q7 Do you know the difference between an end of sprint project review and an end of sprint project retrospective?</td>
<td>roleplay</td>
<td>2.17</td>
<td>3.23</td>
<td>5.429 (&lt;0.0000)</td>
</tr>
<tr>
<td>Q8 Do you know the difference between Planning Poker and a Sprint Planning Meeting?</td>
<td>lecture</td>
<td>2.71</td>
<td>3.41</td>
<td>3.745 (0.0002)</td>
</tr>
<tr>
<td>Q9 Do you know what a Daily Standup meeting is?</td>
<td>lecture</td>
<td>2.69</td>
<td>3.28</td>
<td>3.158 (0.0011)</td>
</tr>
<tr>
<td>Q10 Do you know what an Epic/Theme is?</td>
<td>lecture</td>
<td>2.81</td>
<td>3.10</td>
<td>1.502 (0.0686)</td>
</tr>
<tr>
<td>Q11 Do you know what a Burn-down Chart is?</td>
<td>lecture</td>
<td>2.98</td>
<td>2.97</td>
<td>-0.0088 (0.5035)</td>
</tr>
<tr>
<td>Q12 Do you know what velocity is?</td>
<td>lecture</td>
<td>2.93</td>
<td>2.92</td>
<td>-0.0312 (0.5124)</td>
</tr>
</tbody>
</table>

Two sample t-test with unequal variances of unpaired samples (one-tailed test of significance).

Undergraduate student confidence both before and after the roleplay exercise is lower than their peers in the graduate student cohort. For the roleplay activity, the compare and contrast comprehension concepts (question 7) remain the most difficult for students to master. Yet even with the relatively low starting point, self-reported confidence for these concepts is higher than most of the concepts communicated through reading and lecture. The exception is the concept of “daily standup meetings” where the highly descriptive label assigned to this practice, appears to make this concept self-evident.

Several weeks after the roleplay activity a multiple-choice exam was administered to this cohort testing their knowledge on many project management topics. Table 4 identifies questions specific to Agile project management. Some of the questions were multiple choice with one correct answer (X3 and X5, incorrect answers are noted with strike-through font), while others were multiple-select/multiple-answer questions (X1, X2, and X4). Each of these questions was graded on a 4 point scale, with multiple-select/multiple-answer questions qualifying for partial credit, while the questions with only one correct choice either received full credit of 4 points or zero.
Table 4: Agile PM Exam Questions

X1: Identify all the formal roles within the typical Agile project (select all that apply)
   a) Burn-Down Reporter
   b) Scrum Master
   c) Senior Supplier
   d) Development Team Member
   e) Product Owner
   f) Time Keeper

X2: Select the items below that are valued in the Agile systems development philosophy (select all that apply)
   a) Working Software
   b) Comprehensive Documentation
   c) User Collaboration
   d) Following a Plan

X3: Which of the following is not an accurate characterization for Agile project requirements
   a) A user story includes a brief description of how to test the requirement to verify it has been achieved/completed
   b) A user story may encompass multiple use cases
   c) A user story includes benefits achieved by the requirement so that different requirements can be prioritized relative to each other
   d) A use case is a collection of project epics

X4: Which of the following are common practices for Agile projects? (select all that apply)
   a) Risk Poker
   b) Time-boxing
   c) Sprint Retrospectives
   d) Daily Standup meetings
   e) Approved design specifications

X5: In Agile projects the ____________ help forecast when a project will end.
   a) CMM-I
   b) BAC index
   c) Cost Performance index
   d) velocity and burn-down charts
   e) Pareto charts

Table 5 provides cohort wide summary scores for each of the exam questions and shows the alignment to self-report confidence scores. The pre/post roleplay questionnaires were collected anonymously, so there is no matching of samples to the exam scores. However, the aggregate exam scores support the self-report learning levels, particularly for the concepts covered in the roleplay simulation. Students performed less well for exam questions of concepts delivered through reading and lecture than they did for concepts delivered within the roleplay.

It is worth noting that the high confidence reported for the concept of Epic/Theme did not translate to retained knowledge in the exam. The same can be said for the concepts associated with Agile vision and philosophy (commonly identified with the Agile Manifesto), which were not part of the self-report questionnaire.
### Table 5: Cohort 3 Post-Sim and Grades

<table>
<thead>
<tr>
<th>Statement of Knowledge</th>
<th>Method</th>
<th>Post Sim Mean (N=39)</th>
<th>Mean Exam Score for specific questions (N=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you know what a <strong>Sprint</strong> is?</td>
<td>simulation</td>
<td>3.69</td>
<td></td>
</tr>
<tr>
<td>Do you know what a <strong>Planning Meeting</strong> is?</td>
<td>simulation</td>
<td>3.62</td>
<td></td>
</tr>
<tr>
<td>Do you know what a <strong>Product Owner</strong> is?</td>
<td>simulation</td>
<td>3.72</td>
<td>3.41</td>
</tr>
<tr>
<td>Do you know what a <strong>Scrum Master</strong> is?</td>
<td>simulation</td>
<td>3.67</td>
<td></td>
</tr>
<tr>
<td>Do you know what <strong>time-boxing</strong> is?</td>
<td>simulation</td>
<td>3.69</td>
<td></td>
</tr>
<tr>
<td>Do you know what a <strong>project retrospective</strong> is?</td>
<td>simulation</td>
<td>3.62</td>
<td></td>
</tr>
<tr>
<td>Do you know the difference between an end of sprint <strong>project review</strong> and an end of <strong>project retrospective</strong>?</td>
<td>simulation</td>
<td>3.23</td>
<td>3.34</td>
</tr>
<tr>
<td>Do you know the difference between Planning <strong>Poker</strong> and a <strong>Sprint Planning Meeting</strong>?</td>
<td>lecture</td>
<td>3.41</td>
<td></td>
</tr>
<tr>
<td>Do you know what a <strong>Daily Standup meeting</strong> is?</td>
<td>lecture</td>
<td>3.28</td>
<td></td>
</tr>
<tr>
<td>Do you know what an <strong>Epic/Theme</strong> is?</td>
<td>lecture</td>
<td>3.10</td>
<td>1.45</td>
</tr>
<tr>
<td>Do you know what a <strong>Burn-down Chart</strong> is?</td>
<td>lecture</td>
<td>2.97</td>
<td></td>
</tr>
<tr>
<td>Do you know what a <strong>velocity</strong> is?</td>
<td>lecture</td>
<td>2.92</td>
<td></td>
</tr>
<tr>
<td>Agile values &amp; philosophy (test question not in pre/post questionnaire)</td>
<td>lecture</td>
<td>2.23</td>
<td></td>
</tr>
</tbody>
</table>

### 6.0 Conclusions

This paper describes a roleplay simulation as an instructional method to develop knowledge and comprehension of Agile project management ideas and processes. The roleplay requires only common office supplies and internet access. The exercise can be run in a single two-hour thirty minute meeting session, or in two sessions of half that duration. With these time constraints the simulation intentionally excludes certain concepts such as daily standup meetings. In addition, without a decomposed product backlog the simulation lacks reliable artifacts to experience Epics and Burn-down charts. With a bit of creativity and preparation, future structures added to the simulation may allow students to build competencies around these concepts as well.

This study comparing two instructional methods does not describe a protocol for the reading and lecture method. The reading and lecture treatment is uneven across cohorts. As a result, comparison and interpretation of lecture related concepts across cohorts should be done with caution (particularly between undergraduate and graduate which involve different texts and lecture focus). With that in mind, the culture of stand-and-deliver lectures is well established in the United States. Criticisms of the lecture method are common in the literature and often treat lecture as a homogeneous method. The lecture related results presented here can be interpreted as part of that tradition.

The use of this roleplay exercise with three student cohorts has been studied and demonstrates the comparative efficacy of roleplay over traditional reading and lecture for the concepts of Agile project management.
References


Appendix A: Scrummy Project

A.1 Scrummy Process

**Preparation:**
- Teams are composed of four to six students (five is ideal).
- Adjust seating so students within a team are adjacent.
- This activity will use PowerPoint or some other presentation tool as well as Internet access. Now is the time to get multiple computing devices up and running.
- Each student will need a few pages of blank paper and a pen/pencil (for taking notes and organizing ideas during the course of the activity).
- As a team, select roles for each individual. Each student will maintain the same role throughout the full simulation.
- This is a “roleplaying game”. Pretend you are that person and act (fictitiously if needed) so that the game plays out smoothly.
- Send the Product Owner on behalf of the team to the instructor for additional instructions and information.

**Roles:** (Play your role through communication and action and other team members do the same.)
- Product Owner
- Scrum Master
- Team member (two or more)

**The Scrummy process is as follows:**
You will have a series of 30 minute “sprints” to deliver your solution. Each sprint will unfold in a predictable/repeatable set of timed increments:

A. **Sprint Planning**: 5 minutes to identify the goal and activities for the upcoming sprint (what to deliver). Individuals should select their own tasks from among those identified (there is no dictator running Agile projects).

B. **Execution**: 10 minutes to do work (this may be individual or in sub-teams if multiple people are collaborating).

C. **Product Build**: 5 minutes to consolidate your product.

D. **Delivery & Feedback**: 5 minutes to present your product and get feedback.

E. **Retrospective & Review**: 5 minutes to identify (at least) 1 thing you need to improve in your process (sprint retrospective) for the next sprint and to assimilate feedback from product presentation and Product Owner as you continue to build your product (sprint review).
A.2 Blood Pressure Project Charter

Blood Pressure Project Charter

**Project Charter**

**Vision:** Our students can be the healthiest student population in the world.

**Mission:** Teach all students how to measure blood pressure and know what a healthy range is and why this matters.

**Benefits:** By equipping students to measure each other’s blood pressure and understand what this means, students will pursue a more healthy lifestyle, live 10% longer, make 30% more money and donate 10% more money to the alumni association.

You will use a series of 30 minutes “sprints” to build a PowerPoint to train students how to determine a patient’s blood pressure. Identify tools needed to accomplish the training and very precisely document the process.

**Objectives:**

1. Create a PowerPoint presentation (the PowerPoint file is your “product”) that can be provided to students to achieve the benefit statement.
2. Primary objective: PowerPoint will be used by students to learn how to measure blood pressure.
3. Secondary objective: PowerPoint will help students understand blood pressure and their health.
4. Create the “product” using the Agile process “Scrummy”.

Appendix B: Role Instructions

B.1 Scrum Master

<table>
<thead>
<tr>
<th>Scrum Master</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform these tasks through verbal communication and influence and participation. Your job is to guide your team to accomplish the task using elements of our Scrummy process.</td>
</tr>
<tr>
<td>• Enforce the timed increments.</td>
</tr>
<tr>
<td>• Make sure team members are volunteering to take on tasks they choose themselves.</td>
</tr>
<tr>
<td>• Try to encourage the overall activity to be subdivided into task units that can be worked on individually or in small subteams when possible.</td>
</tr>
<tr>
<td>• Have the product owner help choose which activities should be completed first.</td>
</tr>
<tr>
<td>• You cannot tell team members how to do their tasks – it is up to them to figure it out.</td>
</tr>
<tr>
<td>• Make sure there is something to present at the end of the time sprint. Partial work is fine, but you must have something to show the stakeholders/users!</td>
</tr>
<tr>
<td>• Expectations for sprint 1: Document tools needed to measure blood pressure. If you have time identify three or four things that need to be covered in the instructions.</td>
</tr>
<tr>
<td>• Expectations for the second and subsequent sprints: Gradually through a series of sprints you will build a product to meet the project objectives &amp; requirements.</td>
</tr>
</tbody>
</table>

Be aware that the Product Owner should provide guidance on what your stakeholders/customers/users want. This means the product owner can set priorities and has the final say in the team about what the requirements really mean.
B.2 Team Member

**Team Member**

Your job is to contribute ideas and work units that can be assembled into the finished product. Don’t let anyone assign you a task, but you should volunteer for at least one task each sprint. Pick the tasks you want to work on that you believe will advance the project the most in the current sprint.

If you cannot complete a task you signed up for in the current sprint, provide partial work. Remember, each sprint must have something to present to your stakeholders/users at the end.

If you don’t have specific expertise in the tasks, consider pairing up with another team member work jointly and help them work faster. You may also use your judgement - make something up that you think may be correct. Document what you think is correct then allow the feedback session to identify problems and guide correction.

- Expectations for sprint 1: Document tools needed to measure blood pressure. If you have time identify three or four things that need to be covered in the instructions.
- Expectations for the second and subsequent sprints: Gradually through a series of sprints you will build a product to meet the project objectives & requirements.

You may use the internet to obtain information you do not know personally. Remember you have very little time to create your deliverable, so don’t spend all your time searching. YOU MUST ADD SOMETHING TO THE PRODUCT EACH SPRINT!
B.3 Product Owner – Sprint 1 supplemental instructions

Product Owner

Communicate everything verbally. The team documents & writes things down NOT YOU!

Avoid volunteering to do tasks. You can talk and conduct research, but other team members should be doing work to deliver components of the product.

Your role includes prioritizing tasks. When the team is struggling to decide where to start or what to work on first, you need to provide guidance. Make a decision, pick something and say the team should start with the item you identify as the most important. Even if you are unsure, you must provide clear decisions for the team (don’t worry about being wrong, do worry about taking too long to make a decision). Be careful, your role is to prioritize, but do not dictate. Don’t force the team to do it your way. Allow for the possibility that doing one less important task first may indeed help create the more important task faster.

- Expectations for sprint 1: Document tools needed to measure blood pressure. If you have time identify three or four things that need to be covered in the instructions.
- Expectations for the second and subsequent sprints: Gradually through a series of sprints you will build a product to meet the project objectives & requirements.

You have some information that the rest of the team does not have. The quality of your team’s product will be evaluated on how effectively the product incorporates these ideas.

- The presentation must identify the tools needed (e.g., stethoscope, watch, etc.).
- The presentation should identify the process as a series of steps (step 1: have the patient sit down, step 2: remove clothes from students left arm, etc....)
- Your team is assigned students in music history department as your customer – they know NOTHING about healthcare. It is your job as the product owner to represent the needs of these students so the final product will work for them.
- You will have new requirements at the end of each sprint. Only you have these requirements and you must communicate them to the team so they deliver the correct product in the end. *Come visit the instructor while the project team is in stage C (Product Build) of each sprint.*
B.4 Product Owner – Sprint 2 supplemental instructions

**Product Owner**
Here are some requirement clarifications that you did not previously tell the team. You should do so during the Sprint Review (product feedback session).

- The Powerpoint “product” should be 3 slides in length (no more, no less). (Put contributor names in the notes portion of the powerpoint slide, or in small print at the end – the team is creating a product not a classroom assignment.)
- The presentation must be very specific about the steps to take. Instructions like “use stethoscope” are not good enough. How do you hold it? How firm should it be pressed into the patient’s flesh? Where on the patient’s body do you put it? When you are counting, beware that your music student will want to know if this is ¾ time, or 4:4 time, or something else that has no meaning for measuring blood pressure. Your instructions must make sense in the language and background that these customers already have. Your music student customers knows NOTHING about this new process and it is your job to make sure the product works for them.

B.5 Product Owner – Sprint 3 supplemental instructions

**Product Owner**
Here are some requirement clarifications that you did not previously tell the team. You should do so now.

- The PowerPoint product may actually be 4 slides long:
  - 1 slide to document materials needed
  - 1 slide to document the health implications of blood pressure
  - 2 slides to document in very precise detail the steps needed to measure someone’s blood pressure using the tools identified.

B.6 Product Owner – Sprint 4 supplemental instructions

**Product Owner**
Here are some requirements clarifications that you did not previously tell the team. You should do so now.

- Add 1 slide to document the process for measuring patient body temperature.

Note: A fourth sprint is optional and depending on the time available may not be practical. By the end of the third sprint teams should be approaching a completed product. This change represents a significant change in scope and serves as an example for classroom discussion regarding recognizing scope-creep that may diverge from the spirit of the project charter.
Appendix C: Glossary

**Benefits** – Benefits describe a measurable outcome of value expected from this project. Benefits should be objectively measurable and establish criteria to determine project success. Benefits are typically documented in terms of the organization’s benefits and concisely capture the sponsor’s justification for allocating resources to the project. Benefits should move the organization closer to accomplishing the vision identified for the project.

**Burndown Chart** – A graph that shows the quantity of work on the vertical axis and the remaining time on the horizontal axis. As backlog items are completed a trend line forms with a negative slope.

**Daily Standup Meeting** – A meeting involving all scrum participants to inspect and adaptively plan activities underway during the current sprint. This meeting is traditionally conducted with all members standing and is timeboxed to 15 minutes.

**Grooming** – The activity of writing and refining, estimating and ordering product backlog items.

**Mission** – What an organization or team does to provide benefits that lead toward an identified vision.

**Objectives** – Near-term targets for a team or organization aligned with the mission and lead toward an identified vision.

**Product Backlog** – An ordered (prioritized) inventory of product backlog items that are not yet fully integrated into the project’s product.

**Product Backlog Item (PBI)** – An item such as a feature, capability, defect or technical work that is valuable from the product owner’s perspective.

**Product Owner** – An individual providing the central point of product leadership. This individual provides the authoritative voice of the stakeholder community to the scrum team. The product owner defines what to do and in what order to do it.

**Scrum Master** – A coach, facilitator, impediment remover, and servant leader of the Scrum team. This individual provides process leadership without assigning responsibilities and tasks.

**Scrum** – An iterative and incremental framework for managing complex product and service development efforts.

**Sprint** – A short duration, timeboxed iteration of team activities to build components of a target product. Multiple sprints incrementally add capabilities until a completed product/service is accepted by project sponsors.

**Sprint Backlog** – A list of product backlog items pulled into a sprint and an associated plan for how to achieve them. The Sprint backlog forms a contract that the team works to deliver in the current sprint.

**Sprint Planning Meeting** – A time when the Scrum team gathers to agree on a sprint goal and select the sprint backlog for the forthcoming sprint.
**Sprint Retrospective Meeting** – An inspect-and-adapt activity performed at the end of a sprint. During this meeting the Scrum team reviews its processes and methods to identify opportunities for improvement.

**Sprint Review Meeting** – An inspect-and-adapt activity performed at the end of a sprint. During this meeting the Scrum team shows the product in its current state to interested parties to collect feedback that will guide product adjustments in future sprints.

**Time Boxing** – A time management technique that uses fixed-length periods of time to perform activities. Daily standups are commonly timeboxed to 15 minutes. Sprints are commonly timeboxed to two weeks (though durations from one week to 4 weeks are sometimes chosen as appropriate).

**Use case** – A list of actions or steps that a specific actor (an individual with a known role) follows when interacting with a work system to achieve a goal. Often actors with different roles interact with a portion of a system in very different ways to accomplish different goals. Identifying multiple use cases for a single system capability facilitates delivering systems that meet all user needs.

**User story** – A format to capture product requirements in a way that is understandable to both business and technical people. The format structure is: “As *user role* I want to achieve *goal* so that I get *benefit*.” User stories can be written on index cards (or captured electronically) where the back of the card contains acceptance criteria.

**Velocity** – A measure of the rate at which work is completed. Velocity is typically reported as the sum of completed backlog item units (normalized to a standard size estimate) per sprint. Velocity measures output (the size of what was delivered), not outcome (the value of what was delivered).

**Vision** – An aspirational statement of what the world might be like if anticipated projects are delivered successfully.