

Pilot Study and Survey to Increase Adoption and Sustained Utilization of Simulations Using Role-Play Course Content

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Abstract— Role-playing (RP) has been used in psychology, medicine, and education because of the rich learning experiences it provide to students and the dialog that they open between faculty and student. Despite these benefits, it has not been widely adopted. A pilot study generating classroom STEM RP simulations to meet course learning objectives was also conducted to gain deeper insight into the barriers to both adoption and sustained utilization of RP course content from several areas of engineering problem solving. Eleven engineering faculty at an undergraduate-focused engineering college were interviewed about adoption of RP for the most challenging course objectives. Six of the eleven were willing to consider RP simulations. RP content was designed for those six and deployed for classroom use. Using an RBIS barriers to adoption survey as a template, a survey was created and distributed to 125 faculty members in engineering to determine if the barriers to adoption were the same for RP and RBIS or if RP had unique barriers.

Keywords—role-playing, simulation, role-playing game based learning, RBIS, Research-Based Instructional Strategies

I. INTRODUCTION

Simulations using role-playing have been long been used in military training [1] and have also been used in medical training [2], psychotherapy [3], K-12 education [4] and in higher education [5]. In higher education they have been used to help college students consider the many perspectives involved in making historically significant decisions [5] or chemistry students as they learn analytical chemistry techniques [6] among other applications. They have been shown to improve student self-efficacy [7], reduce stereotype threat [7], and even improve creativity [8]. Despite these benefits, they have not been widely adopted in college classrooms.

Research-based instructional strategies (RBIS) that have been proven to be effective in enhancing both student engagement and learning have not been widely adopted in higher education for a number of reasons [9]. The primary barriers have been identified as the amount of time to prepare the content and the amount of class time that it would require [10]. As a member of

the Reacting to the Past Consortium (RTTP: <https://reactingconsortium.org>), these are the primary reasons that I have heard voiced by instructors considering role-playing (RP) for their classrooms along with additional concerns, such as possible student and administration perceptions about the seriousness of the role-playing pedagogy. This work was begun as an effort to explore the barriers to adoption of role-playing game based learning (RPGBL) and identify approaches that might ease concerns and facilitate faculty acceptance.

The author met with engineering faculty colleagues about RPGBL to gauge their perceptions and interest as well as their willingness to adopt the approach in their courses. The author offered to design and run RPGBL content for their course to remove time-related barriers to adoption and to gain insight into designing instructor-friendly course content.

A survey was created and disseminated to STEM educators to identify the primary barriers to RPGBL. The survey was designed to determine the respondent's knowledge about the pedagogy as well as identify the barriers to its adoption.

II. STEM PILOT STUDY

A. RPGBL Design Philosophy

The RPGBL content used in this study were designed with the following criteria:

1. Game design that fits the physical and time constraints available and fits with the tone of the course and the instructor's style
2. Simple game mechanics
3. Game mechanics that reinforce the learning objectives

Note that "game mechanics" is anything that establishes or reinforces the game world. It is anything that sets and defines the boundary conditions of the game world and how the world within it works.

Criterion 1 is designed to increase the likelihood that the instructor would adopt and continue to use the content after the trial period [11]. The course content created in this study was designed in collaboration with the instructor and anything presented to students in class or in an online forum was reworded by the instructor to fit the authorial voice used in class to integrate the RPGBL content.

Criterion 2 requires simple mechanics to make the games easy to learn for the students and easy to remember and run for the instructor [12]. This reduces the time required to teach the game and reduces the in-class requirements on the instructor; it was first used in Prussian war games (kriegspiele). It was a response to increased complexity as war games evolved that increased the time required to play and difficulty of the games without increasing their verisimilitude. It is a design philosophy, called FKR for Free Kriegspiele Revolution, in current RPG design and play. It is utilized here via the simplicity of the response requirements, i.e. responses to online or in-person prompts without requiring learning any game mechanics.

Criterion 3 is to make sure that the game is in service of the course learning objectives and not just a game. The conceptual foundation was Fink's taxonomy [13] – which lists role-playing as a way to integrate all of the Significant Learning categories. Here Fink's taxonomy is used to design game mechanics that reinforce the learning objectives and connect to the course content [14]. Each of the games developed in this study directly addressed learning objectives in the courses they were deployed in, as discussed below.

B. Pilot Study Phases

Aligned with the propagation paradigm of Froyd et. al. [11], a four-phase study was designed to explore faculty willingness to consider RPGBL and obtain insight into how best to ease the implementation. Eleven engineering faculty were approached to determine their interest in using RPGBL in their courses. They were given a paper highlighting the benefits to students' self-efficacy and a reduction in stereotype threat [7] as they were told of its merits; they were then asked if they had any courses that they might be willing to consider for the approach. The four phases and the number of faculty who participated in each phase as listed in Table II.

Table I

Phase	Description	Faculty
0	Consideration of RPGBL content	9
1	Planning RPGBL content	5
2	RPGBL content implementation	3
3	Continued use of RPGBL content	2

C. Phase 0: Consideration of RPGBL content

The nine faculty willing to consider RPGBL were engaged in a discussion about the possibilities of implementation in their future courses. Four of the nine expressed general interest but

did not identify a specific course and asked to discuss the specifics in a future term. Two of the nine identified a course they would teach during the next academic year and asked to resume discussion later. The remaining three were willing to go to Phase 1.

D. Phase 1: Planning RPGBL content

Planning commenced in the fall with the three Phase 1 faculty to plan the timing within their course and align the RPGBL content and outcomes with their course learning goals using a version of Fink's taxonomy modified for RPGBL [14]; from these, two possible approaches were identified for each instructor. These were then discussed and a mutual conclusion determined the trial candidate for each instructor for Phase 2. One of the three did not continue to Phase 2 at this time as the target course is to be taught during the next academic year.

E. Phase 2: Continued use of RPGBL content

RPGBL content was created for two quarter-long courses: a design for manufacturing course in a mechanical engineering curriculum and a human-centered design course in a biomedical engineering curriculum. The mechanical engineering course was performed completely online and the biomedical engineering course and lab were taught by the course instructor and the author.

RPGBL was created for an injection molding project in four week-long online forum exercises in a design for manufacturing course that covered manufacturing basics, comparative analysis of processes, and manufacturing fitness for design. Criterion 1 was achieved via several cycles of interviews and concepts to tailor the online role-playing exercises to the course content and instructor approach. The exercises were conducted online to avoid consuming course time and conducted in Moodle Learning Management System forums to use the simplest RP mechanics (forum discussion) to match the learning objectives of the course, exploration of manufacturing concepts and constraints; this satisfied Criteria 2 & 3. For the simulation, students were formed into groups representing assembly, customer satisfaction, marketing, and purchasing to develop design requirements for an imaginary customer in week one; the groups were chosen to meet the course learning objectives, considering the impact of design choices on others involved in the manufacturing process. It also served to acclimate students to their group's role and to train them in the role-playing process. Teams were then formed with representatives of each group to develop new, combined design requirements in week two. The team requirements were used by the team to create a design to present to their "customer" in week three and to evaluate the other teams' designs in week four. All communication between the groups and teams were in an online discussion forum and coded for their breadth and depth with respect to the course learning objectives. The course content and results of the forum response coding were published by White and McCormack [15]; the RP resulted in strong participation and over 80% of online interactions having depth

of thought in their comments that went to 100% during the last two weeks of the study. The majority of these later interactions also considered other groups' perspectives and needs in their discussions.

The human-centered design course utilized RPGBL in a one-hour class session and a three-hour lab to explore empathy with users, one of the course learning objectives, by taking on the role of care-giver and patients to achieve the learning objectives of exploring patient empathy and understanding patient needs. Criterion 1 was achieved via an initial meeting to understand learning objectives, instructor style, and course tone followed by a follow-up meeting to discuss prototype approaches. The rounds of improvement and refinement lead to the in-class RP approach with an initial short RP using famous movie characters as emergency room patients followed by the longer RP discussed below to meet Criterion 3. Criterion 2 was met by directing the in-class RP with character information sheets (containing background and motivation) and information about the setting in which the RP takes place.

The class session divided students into teams of three or four to decide how an emergency room doctor might best deal with the ailments and concerns of a *Lord of the Rings* (LotR) character that was in their care that was then discussed as a class; this was to acclimate them to role-playing by playing the ER doctor and the instructors playing the LotR characters. In lab, students were in three person teams and took turns playing a caregiver, an alien, and an observer in an imaginary scenario where an alien vessel has crashed near campus and the biomedical engineering class has been asked to do triage for the injured aliens. Aliens were chosen as it allowed exploration of complications for the caregiver's diagnosis of their actual ailment without associating the complication to a person with a gender and race. The list of alien roles and their associated symptoms, complications, and actual ailments are listed in Table III.

Table II

Alien	Description	Symptoms	Complication	Actual Ailment
1	Squat alien – kind of a disk with two legs	- Holding knees and saying it hurts - Speech is inaudible to you but translator is recording speech	The frequency of the lights is audible to it and painful to its hearing	Minor contusion on leg
2	Humanoid with a viscous fluid that is slowly flowing along its abdomen	- Flowing liquid and stooped posture	The fluid absorbs oxygen and is how it breathes in our environment	Sprained ankle/wrist
3	Humanoid, smiling, pleasant,	- None obvious	Smile is a grimace – pain is	Bleeding internally

	limbs held close		indicated by lack of limb motion. Their culture emphasizes courtesy above all else.	
4	Humanoid – frantic, complain of lighting, barometric pressure, taste of the water	- Hard to tell with all of the complaining. - Left hand has been resting on same place in leg for some time.	The emotion is from shock – the patient has a significant wound	In shock, holding significant wound that is stopping bleeding
5	Humanoid, slumped over, head down, doesn't look up when you enter	- Barely responds to any questions and only gives short answers	The environment is overwhelming to this patient. Too bright, too loud,	No injuries
6	Humanoid slumped very focused on using a small device with a cracked screen. They are moving their mouth but not speaking and moving their hands (maybe 2 different aliens)	- Lost, quiet, and non responsive - Answer with repeated "I don't know how I'm feeling" - They say their walking is "not right"	They have a condition their species get that caused the loss of all nerve signals. The device connects to sensors that inform them of their physical status was damaged in the crash	They have a broken leg but they can't tell because they have no info from their nervous system
7	Humanoid with one prosthetic leg	- Their gate is off, they are limping when they walk	Their prosthetic is ill fitting	They have no injuries from the crash

The third course was to be presented during the following quarter. The complexity level and learning objectives of the course content to be reinforced by the RPGBL required a game with more complex mechanics than the other two in this study, requiring more time to train both the students and the instructor with preliminary game play. Unfortunately, the time available for the RPGBL would not allow for an in-class training session. The author is currently developing online content to allow for game mechanics training without consuming class time.

F. Phase 3 and Debrief

A post-RPGBL debriefing session was held with each instructor. The questions asked of each instructor and their responses are summarized in Table IV below.

Table III

Question	Design for manufacturing	Human centered design
How do you think the RPGBL content went?	Well	Very well
Would you be willing to do it again?	Yes	Yes
Did you notice a change in class after the RPGBL content?	Yes	Yes
Did it bring up any questions or discussion?	Yes	Yes
Did it make later parts of class richer or better?	Yes	Yes

Each instructor had additional comments:

Design for Manufacturing

- There was some difficulty with the process and requirements – training needs to be better
- Challenged their social-side skills
- Good team-building activity
- Online content only required about 20 minutes of class time over four weeks
- It would have made discussions richer and opened up more possibilities had it appeared earlier in the term

Human Centered Design

- It was rewarding to watch students' dawning realization as to why we chose aliens for the patients as the lab period unfolded (because it allowed us to talk about possible patient biases and concerns without talking about race or gender)
- Students reached back to the alien concerns but also their roles later in the course and referred to the alien roles, e.g. "you're that alien." The alien roles allowed a common language to refer to patient needs and concerns.
- The role-play created a safe space to explore performing and controlling interviews and real-time problem-solving skills that proved useful in customer interviews later in the quarter and built a common foundation for subsequent class discussions
- Increased the class participation comfort of the more introverted students

III. SURVEY

A survey was created to determine barriers to adoption that exist for RPGBL, specifically those that might be unique to RPGBL. The results will be utilized to aid in designing course content that is more easily implemented. The results will also be used to formulate instructor approach strategies about RPGBL techniques that address concerns and biases that might exist among STEM instructors.

The survey design was based on a survey to identify barriers to adoption of RBIS by over 200 electrical and chemical engineering faculty [10]. The survey was designed to be taken in a few minutes and consisted of four questions. A draft of the survey was submitted to the RTTP Facebook page with responses from 24 faculty that informed the final survey.

The first two questions determined knowledge of and interest in RPGBL on a three and five point Likert scale, respectively. The third question determined their current disposition toward RPGBL and branched to one of four possible additional questions based on that response. The fourth question was designed to either identify the source of the respondent's knowledge about RPGBL or the barrier to their use of it. The third question and the possible fourth questions from each response are listed in Table IV.

Table IV

Question 3: Have you used role-play in your classroom?		
Question 3 Response	Question 4 (based on Q3 response)	Q4 Choices
I currently use it or plan to use it in the future	Where did you learn about role-play in the classroom?	Professional society, Conference, Article/Book, Colleague, Used it when I was a student, Other
I have never used it.	What is the primary barrier to your use of role-play in the classroom?	Lack of information or familiarity, Lack of evidence of efficacy/utility, Lack of resources from administration, Not valued by the administration, Colleague skepticism/concerns, Concerned about perception of role-playing, Anticipated student response, Too much prep time, Too much class time
I am not willing to use it.	What is the primary reason you are not willing to use role-playing in the classroom?	- Same as above -
I have used it in the past but do not plan to use it again.	What is the primary reason you stopped using role-play in the classroom?	Same as above plus: Doesn't fit my teaching style

The survey was sent to 104 members of a STEM qualitative research incubator – part of the ProQual Institute for Research Methods, an NSF funded qualitative research initiative – and 24 completed the survey. Their feedback is summarized below.

Question 1 asked respondents to rate their agreement with the statement "I am willing to use role-play/simulation in my classroom"; 5/24 Strongly Agreed, 11/24 Agreed, 7/24 were Neutral, and 1/24 Disagreed. Question 2 Asked their experience with RPGBL; 9/24 said they were using it or had used it, 10/24 said they were aware of it, and 5/24 were not aware of it. In response to Question 3 (see Table IV above) 8/24 currently used it or plan to, 14/24 have never used it, 2/24 used

it and do not plan to again. Question 4 branched from question 3, as shown in Table IV; the results from question 4 are shown in Table V.

The results indicate that the majority of the respondents were willing to use RPGBL; the primary reason for not using it was lack of information/familiarity. The small number of the responses and the general positive disposition toward RPGBL suggest caution in drawing definitive conclusions. Nonetheless, the majority (10/24) of those who are interested in using RPGBL would benefit from the Propagation Approach suggested by [11]. This, even if only in a small way, validates the approach used here.

Question 3: Have you used role-play in your classroom?		
Question 3 Response	Question 4 (based on Q3 response)	Q4 Responses
8/24: I currently use it or plan to use it in the future	Where did you learn about role-play in the classroom?	2/8 Colleague, 2/8 Used it when I was a student, 3/8 Other
14/24: I have never used it.	What is the primary barrier to your use of role-play in the classroom?	9/14 Lack of information or familiarity, 1/14 Lack of evidence of efficacy/utility, 1/14 Concerned about perception of role-playing, 2/14 Anticipated student response,
0/24 I am not willing to use it.	What is the primary reason you are not willing to use role-playing in the classroom?	NA
2/24 I have used it in the past but do not plan to use it again.	What is the primary reason you stopped using role-play in the classroom?	1/2 Lack of evidence of efficacy/utility, 1/2 Doesn't fit my teaching style

IV. CONCLUSIONS AND FUTURE WORK

The willingness to consider RPGBL was unexpected and reinforced the findings of Froyd et. al. [11], i.e. the best way to propagate an idea is to help colleagues to implement it. I encourage anyone who has an education innovation to pursue their Propagation paradigm by working with willing colleagues to start a community who use that innovation in practice.

The successful deployment of the RPGBL in the Human Centered Design course was partially due to the fitness of the approach for the course learning objectives but also due to the short "training" role-play before the bigger exercise; my participation in those exercises may have also been a factor. The Design for Manufacturing instructor recommended a short training course. An online version of this training approach is being created to allow asynchronous training for in-person classes or introductory content for online RPGBL content. It is hoped that this asynchronous training module will broaden the potential applications of the RPGBL by reducing the required class time for a trial.

In both applications, RPGBL resulted in a richness of in-class discussion and facilitated additional content in a way that traditional lectures could not have. This indicates that RPGBL might be well suited for courses with higher Bloom's taxonomy content or facilitating the exploration of higher Bloom's content in a course.

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