

Making In-Class Competitions Desirable For Marginalized Groups

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Abstract—Inspired by research that indicates that direct competition is not always comfortable for female students, we redesigned an existing class competition to permit students to choose whether they wished to participate in either direct or indirect competition. We pilot tested it in the Spring of 2013 in a undergraduate/graduate class on introductory artificial intelligence at the University of Oklahoma. Although the results for female students are inconclusive due to their small number, we observed that international students embraced the indirect competitions. This suggests that allowing the option of indirect competition may also appeal other groups of students who can be marginalized in engineering. Our results indicate the international students prefer the less risky option of indirect competition.

I. INTRODUCTION AND MOTIVATION

We have previously successfully introduced a game-based environment used to motivate students to learn about artificial intelligence and to create a significant learning experience [1], [2]. With our previous experience in games and literature that demonstrates the games are motivating for students [3], we wanted to continue to use games to motivate students but to adjust the type of competition to make it more appealing for all students. Based on existing literature that demonstrated the first person shooter games were not motivating for women [4], we designed our game to not to contain any first-person shooting or blood. The game that we designed is called Spacewar and it is based on the classic game of Asteroids [5]. In the original version of our game, the students competed to have their spaceships survive as long as possible while being controlled by programs they wrote using artificial intelligence techniques.

In order to encourage creativity and early completion of projects and to promote active engagement in the subject matter, our previous work used a game ladder where all groups of students competed against each other. The competition was run each night by having all combinations of three students and three professor created agents play simultaneously. Scores from all runs were averaged to determine the winners. This competition provided extra credit for students who performed in the top three positions of the game ladder. Although the students who competed in the ladder enjoyed the competition, there were a number of students who chose not to participate. We hypothesized that this is based on the type of competition that was required to participate in the ladder.

Direct competition occurs when competitors are permitted to interact with and hinder other opponents (e.g. a stock car

race or boxing match). Students using Spacewar were competing directly since damaging or destroying other spaceships was permitted and encouraged in the game ladder. Indirect competition occurs when competitors are judged independently against a single standard (e.g. a beauty pageant or golf)[6]. We were concerned that using direct competition in the class might be uncomfortable for the women students, so we redesigned the projects and simulation system to allow students to choose either direct or indirect competition.

This work in progress paper focuses on our pilot test in the artificial intelligence class in Spring 2013. We provide two separate but equal tracks for projects. Our hypothesis was that students who are members of marginalized groups (e.g., traditionally underrepresented groups and international students) will choose indirect competition over direct competition.

II. RELATED WORK

Many computer games are focused on direct competition. The computer gaming industry has extensively studied girls' response to competition in games. Much of this research is proprietary but one company released some of their research results without peer review [7]. Their study shows that girls tend to be horizontal competitors with covert competition and a desire to establish relationships and friendships. Their social status tends to be determined by affiliation and exclusions. Boys are hierarchical competitors (also supported by [8]) and tend to favor overt competition with a desire to establish physical superiority and power. Often their social status is determined by achievement and physical domination. Gendered competition preferences of Germans in games were studied by Hartmann and Klimmt [4]. They demonstrated that more than women prefer competitive games and identified first person shooter games as particularly unappealing to women.

The literature on how other groups, such as racial and ethnic minorities or non-native speakers of English, might prefer to compete in games is thin. Amory and Molomo [9] have compared video game playing by South Africans by gender but did not consider race in their analysis. Similarly, Joyner and TerKeurst [10] found differences between British and Japanese gaming preferences. This data supports the well-established idea that gaming and competition preferences are culturally situated; an idea also established using a gender lens [11].

The role of gaming self-efficacy and feelings of competence was discussed as a factor related to girls' enjoyment

of computer games [12]. Kiesler, Sproull and Eccles discuss gender differences in poker playing behavior, where women prefer video poker and men prefer to play face to face. While both forms of poker risk money, face to face poker also requires deceit and assertiveness. Playing poker face to face requires direct confrontation with more experienced (usually male) players [11], which may require more self-efficacy and tolerance of risk taking. The link between gender and risk taking behavior was shown to be different in all female groups than in mixed gender groups. Female students in an all-female context were shown to exhibit patterns of risk taking behavior that were similar to males, where females in a mixed gender environment exhibited less tolerance for risk taking [13].

Joyner and TerKeurst created a model that considers interactions between motivating needs, interpersonal motivations, and entertainment preferences[10]. It is not unreasonable to hypothesize, that just as stereotype threat [14] can be demonstrated in many marginalized groups, marginalization could impact self-actualization, self-esteem, and a sense of belonging of a variety of marginalized groups in similar ways.

Competitive structures have been used previously in artificial intelligence [15] and other CS classes [16] although these efforts have not examined whether the competitive aspects had a differential impact on marginalized groups. [3] discusses the use of games in computer science classes but does not study the effect of competition on marginalized groups.

III. METHOD AND CURRENT RESULTS

A. *Spacewar2: The New Design*

In order to accomplish our goal of having the two tracks be separate yet equal, we had to redesign Spacewar. The version that we pilot tested in Spring 2013 began with the goal of having the ships collect resources. Spacewar2 still has the students controlling spaceships in an asteroid filled environment. In the new version, the resources come in two forms: energy beacons and mineable asteroids. The energy beacons provide energy to the ships necessary for their navigation and survival. The mineable asteroids provide money.

At the beginning of the semester, the goal was to collect monetary resources. We introduced the question of what the students would like to buy with their monetary resources in a class discussion. After a passionate discussion, teams were given the power to buy additional ships, bases, and a variety of power ups to the ships and the bases. We included a balance of power ups that were offensive and defensive.

B. *Competition ladder*

Both the indirect and direct competition ladders rank the teams based on the amount of money brought back to the base. In the direct track, students compete against each other. The top three teams receive extra credit every day that the student remains at the top of the ladder (2 points for first place, 1.5 points for second, and 1 point for third). In the indirect track, students compete against known heuristics. Any student who can outperform the heuristic consistently can receive up to one point of extra credit per day. Student groups choose one of these two tracks on a project by project basis. Each competition is available for 10 to 14 days before the project is

Groups participating in the competitions by type		Indirect	Direct
Project 1	International	5	4
	Female	3	2
	Non-URM	7	1
Project 2	International	8	1
	Female	4	1
	Non-URM	5	3
Project 3	International	9	0
	Female	2	2
	Non-URM	7	2
Project 4	International	7	2
	Female	2	1
	Non-URM	8	1

TABLE I. NUMBER OF GROUPS PARTICIPATING IN EACH COMPETITION. ‘INTERNATIONAL’ HAS AT LEAST ONE INTERNATIONAL STUDENT, ‘FEMALE’ HAS AT LEAST ONE FEMALE, AND NON-URM GROUPS HAVE NO UNDER-REPRESENTED MINORITIES (URM) OR INTERNATIONAL STUDENTS.

due, with extra credit being awarded daily. In either track, the student must outperform a specific heuristic that is provided ahead of time in order to receive extra credit.

C. *Student Choices*

The pilot test for this project was in Spring 2013. We had four class projects. For each project, we tracked which type of competition the students choose (indirect or direct), how early each group entered the competition (intermediate or final), and their success in the competitions and in earning extra credit. The competition ladders are published daily. This enables students to see the results of their work quickly.

The majority of students worked in pairs, which influenced their competition choices. At the start of the semester, we had 42 students enrolled. This included ten members of underrepresented groups (including women and members of racial and ethnic groups that attended high school in the U.S. and are underrepresented in engineering). This number was obtained through observation with discreet questions in case of ambiguity and likely under-estimates the true number of members of underrepresented groups due to group memberships which may not be physically identifiable (specifically biracial and Native American students). We had 13 international students. Most pairs stayed together for the semester but a few changed due to compatibility issues, affecting the counts very slightly.

Table I summarizes the choices of the student groups in the projects. Overall, more students are choosing the indirect competition over the direct competition. Although the numbers were small for the groups of international students or female students, there is a pattern. The international students primarily preferred the indirect competition. In project one, it was almost an equal split, but the remaining projects demonstrated that the international students chose indirect competition instead. Groups with female students had a more mixed picture, with their choices being approximately equal in projects one and three. Most of the females are grouped with White male students and most of the females are also not international students. This likely affected their views on risk taking. Although there are female international students, the numbers are too small to analyze separately.

Beginning with project 2, we asked them to explain their choice of competition in their write-up. Many of the groups

Student persistence in choice of competition			
	International	Female	Non-URM
Project 1 to Project 2			
Indirect persistence	5	2	3
Indirect to direct	0	1	2
Direct to indirect	3	1	0
Direct persistence	1	0	1
Project 1 through Project 4			
Indirect persistence	4	0	2
Direct persistence	0	0	0

TABLE II. STUDENT GROUP PERSISTENCE: CHOICES WERE ONLY RECORDED FOR TEAMS PARTICIPATING IN AT LEAST 2 COMPETITIONS.

who chose the indirect competition stated that they knew how well they would perform there because the heuristic was provided. The direct competition involved risk of not knowing if they would win. Although the payoff was higher for the direct competition, the risk was also higher. In informal discussions with groups of mixed underrepresented minorities and non-underrepresented minorities, this risk was a big factor in their decision making. In project 4, we changed the extra credit structure for the direct competition to address the risk factor (3 points for top place, trickling down to 1/2 point for the 4th place) but nothing changed in the student choices.

During this study, an interesting aside developed. The results of each competition are available publicly on the primary author's website. Students were asked to choose a name for their teams. We asked them to include some part of their name in the team name to make it more efficient to assign the extra credit. Two of the groups containing underrepresented minorities did not want to put part of their personal names into their team name. This may be a response to the additional visibility that can come from being a member of an underrepresented group (called spotlighting [17]) or it may be related to the risk-avoidance behavior also observed in the international students.

Student groups are permitted to change their competition preferences for each project. Table II examines the trajectory of the student groups' competition choices across projects. Interestingly, no group persisted in the direct competition for all four projects yet four international groups persisted in indirect competition. We also measured choices from project 1 to project 2 and there the choices of the underrepresented groups can be seen more clearly. They chose indirect or moved from direct to indirect at a higher frequency than the groups with no URM students.

IV. DISCUSSION AND FUTURE WORK

Although this change in classroom practice was designed to support women students, the primary beneficiaries appear to be the international students. While we don't typically consider international students within the framework of underrepresentation in engineering, these are students that can be marginalized in the classroom by lack of fluency with English (real or perceived) and social customs. The U.S. higher education system also places these students under more pressure since their ability to remain in the U.S. is dependent upon their academic success. International students may be strategically choosing to avoid an outcome with a high penalty (failing a course) by taking the less risky indirect competition route.

While international students may have benefitted most from this innovative practice, two groups of White male students also chose to persist in the indirect competition. As is often the case, this shows that course design changes that are made to support specific groups can be beneficial across the board.

Future work in this area should include a deeper and more comprehensive analysis of: student motivation, choices in competition selection, and direct queries of students to determine group membership and identity and decision making patterns. An analysis of choices made by marginalized students if teams are allowed to display or conceal their individual identities could also be fruitful.

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