A Reality Game to Cross Disciplines: Fostering Networks and Collaboration

Benjamin Stokes
University of Southern California
Annenberg School for Communication & Journalism
3502 Watt Way, #G-6, Los Angeles, CA 90089
bstokes@usc.edu

Jeff Watson
OCAD University
100 McCaul Street
Toronto, ON M5T 1W1, Canada
jwatson@faculty.ocadu.ca

Tracy Fullerton, Simon Wiscombe
University of Southern California
School of Cinematic Arts
3470 McClintock, SCI 201, Los Angeles CA 90089-2211
tfullerton@cinema.usc.edu, wiscombe@gmail.com

ABSTRACT
The rise of reality gaming introduces a new possibility: that games can directly shape real-world networks, even as they educate. Network relations and skills are associated with career growth, educational attainment and even civic participation.

Using methods of network analysis, this paper investigates the game "*Reality Ends Here*" over two years. The semester-long game is designed for freshmen university students, and is deliberately kept underground, which is rare in education. The game fosters multimedia production by small student groups, with hundreds of team submissions created each semester.

This paper seeks to advance the formative use of network analysis for games that address human capital in education. Findings confirm that a player's network centrality correlates with their game score. Team formation was biased by gender and academic discipline, but appears within acceptable levels. Implications are discussed for how game performance can be tied to various network indicators.

Keywords
network analysis, game, education reform, learning assessment, *Reality Ends Here*

Proceedings of DiGRA 2013: DeFragging Game Studies.

© 2013 Authors & Digital Games Research Association DiGRA. Personal and educational classroom use of this paper is allowed, commercial use requires specific permission from the author.

INTRODUCTION

Re-thinking Education around Networks

Can a University improve its undergraduate education through a game to catalyze the formation of interdisciplinary networks? Learning to build networks is an increasingly important skill for the 21st century student. In addition, the alumni network may itself hold value as an educational outcome. Strong networks are associated with increased life opportunities, including better jobs and greater civic participation (Levine 2007; Putnam 2000).

Unfortunately, most schools do relatively little to teach network-building skills or to actively shape network structure. In the United States, it is easy to blame this inaction on the current regime of standardized testing that holds schools narrowly accountable for the cognition of individuals (Shaffer and Gee 2012). But our interest is not in identifying where policy has fallen short; rather, we are interested in new solutions for learning environments that explicitly target network growth and quality.

The vision behind this case study did not begin with a game, but with a strategic overhaul of a prominent cinema and media school. A faculty "futures" committee called for increasing levels of collaboration, especially across disciplines.[1] They identified a problem: graduates of the university were not sufficiently connected across disciplines. Screenwriting students did not partner with animation students, interactive media students did not collaborate with production students.

In sum, there were less-than-optimal levels of creative cross-pollination and skill-sharing across the five divisions of the school (Watson 2012). The committee asserted that the professional success of their students would depend on forming interdisciplinary teams to tackle creative problems. In addition the committee recommended deeper connections to alumni, since alumni ties are an often-claimed benefit of attending elite schools.

Professional networking and collaboration rely on mechanisms that are often hidden. Communities of practice (Lave and Wenger 1991) are particularly known to rely on tacit learning and collaboration. For media-making, the collaborative standards are often implicitly set by the practitioner community, from film to independent games. Success depends on knowing when to bend the rules, and under what social contingencies. In other words, success depends on the mastery of cultural tools and "knowing how" rather than "knowing what" (per Herrenkohl and Wertsch (1999) in Bagley and Shaffer 2010).

A challenge was ultimately issued by the university "futures" committee: how can we encourage the development of networking skills and network capacity? In response, an ambitious extracurricular game was created[2] called *Reality Ends Here* (Watson, Wiscombe, and Fullerton 2009).

Why a Game

Human connection and mutual ties cannot be delivered to students in a textbook or lecture format – they only develop and manifest through human relations, activities and conversation.

Can games spur social structure? Games and play have long been studied by anthropologists for their ability to foster social ties, going back to the work of Brian Sutton-Smith in the early 20th century, which demonstrated the development of community, group identity, and a sense of belonging (Flanagan 2009). Psychologists like Piaget have long argued that games have their own social contract, describing how youth quickly learn that the space of games is fundamentally about collective negotiation (in Salen and Zimmerman 2004, 489). Even Putnam's landmark study of social capital (2000) focused on *bowling* leagues.

Most prior games research on *networks* has been digital-centric, focusing on virtual worlds and massively multiplayer games like *World of Warcraft* (Blizzard Entertainment 2004; for example, see Galarneau 2005; Zhu, Huang, and Contractor 2013). On one hand, such digital worlds are increasingly recognized as authentic and meaningful domains of human activity in their own right. They have social dynamics that are complex enough to constitute separate "third places" where social capital can be built (Steinkuehler and Williams 2006), and they may even be meaningful spaces for direct civic action (Thomas and Brown 2009). However, research on team formation in games is often inconclusive as to whether the mechanisms are the same as offline groups, such as street gangs (Ahmad et al. 2011).

Relatively little work has examined games that augment existing physical networks, especially in the post-secondary context. Educational games are traditionally preparatory, with skills and content to be applied later. Transfer is often assumed to be necessary for the success of such games, since the learning context is separate from the application. Yet the transfer model is less applicable when the learning context is collapsed into the context for future action (Thomas and Brown 2009). In other words, network games can go beyond training students for the future by directly building social capital that is immediately useful and persistent.

INTRODUCING THE CASE STUDY

In order to foster networks, the type of game matters enormously. *Reality Ends Here* is not a simulation, but rather directly integrates with the social and media-making lives of university students on a physical campus.

Design Overview

Reality Ends Here is played by incoming freshmen for 120 days in the fall semester of each school year. Students are drawn into the game via collectible cards, rumors, secret websites, and a mysterious black flag. Students compete to form small groups and submit collaborative media projects -- such as a movie script or a "30-second Short" video, among many possibilities. When a media project is submitted by a team, all contributors receive equal points based on the project's complexity.

Voluntary and Semi-Hidden

Although *Reality Ends Here* was covertly supported by the university administration, the designers fought to keep it hidden and separate from the formal power entrenched in course structures (Fullerton in press). Knowledge of the game spread via word of mouth and clues distributed by the designers in both digital and physical contexts. This approach made discovery of the game rewarding, and immediately set the tone that student agency is valued. Such tactics of deliberate obscurity are foreign to most school-based education programs, and run counter to the "gamification" of learning (Lee and Hammer 2011) that focuses on prescribed classroom tasks.

Blending In-Person with Online

Each player who discovers the game is given a packet of 10 printed game cards, selected from a pool of over 500. Students combine their cards with those of other players (see Figure 1) to create a unique creative prompt for a media project.

By producing these media artifacts and submitting them to the game's website, players earn points on a weekly leaderboard.

Winners each week (or at various point thresholds) unlock time-sensitive access to special experiences, such as meeting notable alumni and industry professionals in offbeat and unexpected locations.

Figure 1: Print cards for the game are creativity prompts that also determine point value for each collaborative production.

Specific network goals can be encoded in the card instructions.[3] Each card has a digital presence, and its use is tracked and celebrated online (Figure 2). Finished projects are visible to the Internet public.

For deep learning, reflection is vital -- especially in professional contexts (Schön 1983). Yet few networking activities in higher education are tied to learning goals, let alone reflection. In *Reality Ends Here*, reflection is structured partly by a "justification video" that is recorded by players when they submit a media project. This video is included with the finished project when it is published on the website. Such digital reinforcements amplify the ongoing face-to-face discussions about project quality and team strategy.

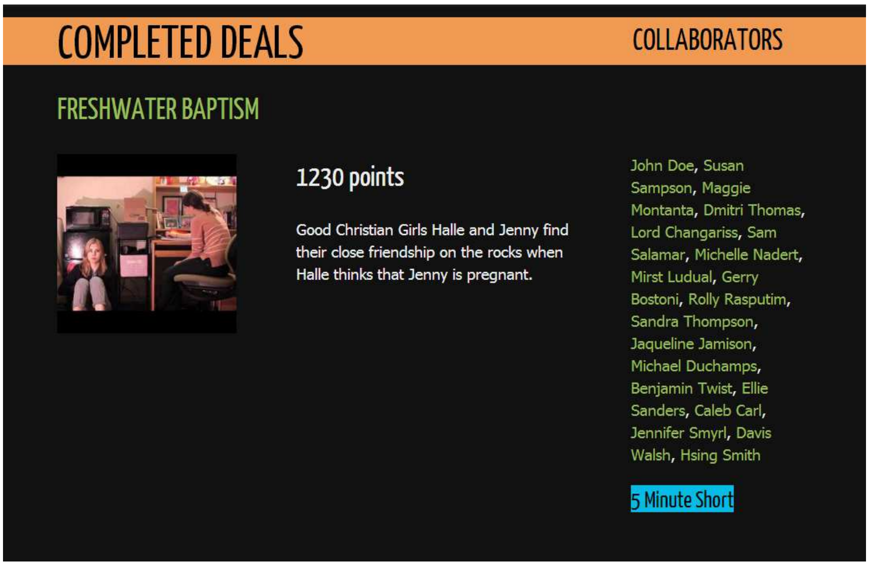


Figure 2: Online point tracking system, showing one completed creative project based on a card "Deal" (the names have been changed)

Anecdotally, participating faculty observed that student passion in the game was palpable. Despite the game's hidden nature, it seemed to be succeeding in generating heightened awareness in students about the school's media-making, in addition to fostering new forms of collaboration (Jenkins in Watson, Fullerton, and Wiscombe 2011). But what of the game's network structure?

ANALYSIS OF THE CASE

A case study approach was selected to investigate the dynamic complexity of collaboration networks in the game. The data primarily traced student collaboration tied to points in the online tracking system.[4] Network analysis was the primary analytic mode, including analyzing and visualizing participant relationships and overall group structure. Such methods are particularly well-suited to investigating self-assembling project teams that are tracked online (Zhu, Huang, and Contractor 2013).

Several research questions drove the analysis. Each will be introduced and discussed in turn. In brief, they address:

1. *How did teams form, and how did the network grow? Did game structures (like the point system) advance or hinder network formation and quality?*

2. *How might teachers and teaching be informed by network analysis? What decisions might network analysis help teachers to make?*

3. *Was the resulting network healthy? Was there a bias toward team formation by gender or academic discipline?*

Student Submissions

In the first year (or "season") a total of 119 projects were created by a total of 103 individuals, with a median group size of 8 participants (mean=11.9). In the second year, 41% of students played the game enough to complete one deal (80 students from the 194-person roster). Across two years, the participation rate was 47%. Note that a small number of participants were *not* students, since the game was deliberately left open.

To visualize the relationship in the first year, consider Figure 3. The players (red circles) are shown pointing to the projects they worked on (blue squares). Two patterns are highlighted by hand with pink circles.

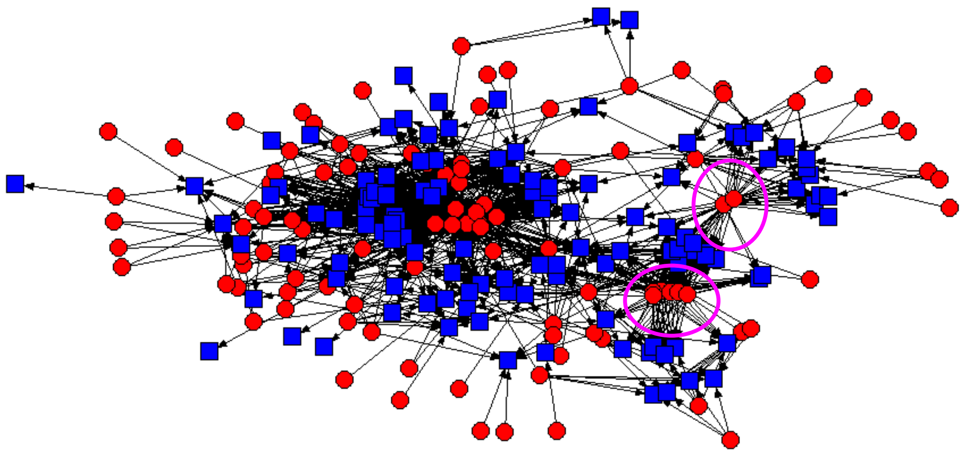


Figure 3: Contributors (red circles) and projects (blue squares) in the first year

First, the lower pink circle shows a group of at least five players who anchored a series of projects together. Second, the upper pink circle shows two students who collaborated on many projects with the first pink circle group. Note that these two students were also influential in drawing in many of the outlier students at top right, who only did one or two projects. In other words, these two circled students play an important role with peripheral members of the network. One implication: proactive teachers might respond by seeking these two as allies, asking how they found partners, and encouraging them. (Further discussion of teacher actions comes in a subsequent section.)

Curiously, some team sizes were strangely common – in particular, there was a spike for six-person and 24-person teams, as shown in Figure 4. The six-person group appears to be a natural size for media making collaboration, especially early in the semester. By contrast, the 24-person group size hints at a very different phenomenon that took place later in the semester. Specifically, the large number of 24-person projects points to a particularly successful and stable team. Stable teams work differently, and may even deserve terms like 'club.' At this scale, the organizing is *collective* – indeed, several large student groups did decide to form their own competitive alliances with exclusion agreements.

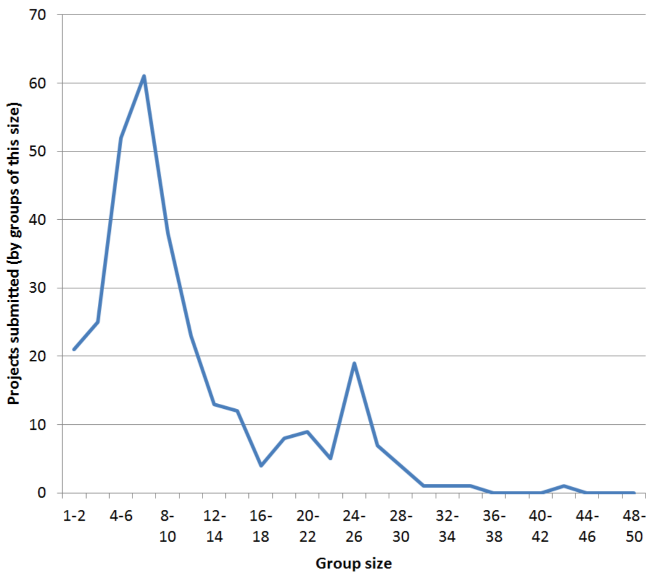


Figure 4: Team size frequency distribution (multi-year)

Points as Network Indicator

Points in the game are linked to network-based rewards based on the number of printed game cards used in a project. The more cards that are referenced in the project, the more points for all students involved. To keep the game dynamic, cards decline in value with each use.[5]

One way to optimize the game for network goals is to ensure that the players' score is tied to their network impact. To investigate, we graphed each player's score compared to their network centrality in Figure 5. (The specific kind of centrality is eigenvector centrality, which can be thought of as the "influence" of a participant according to the network, akin to Google's *PageRank*.)

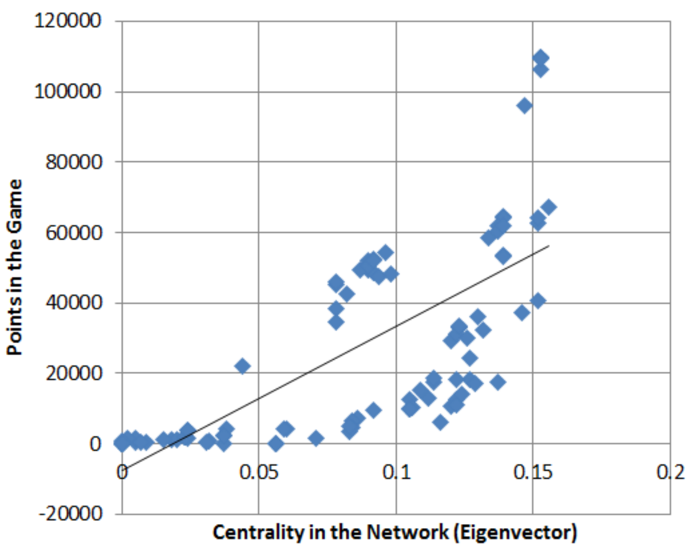


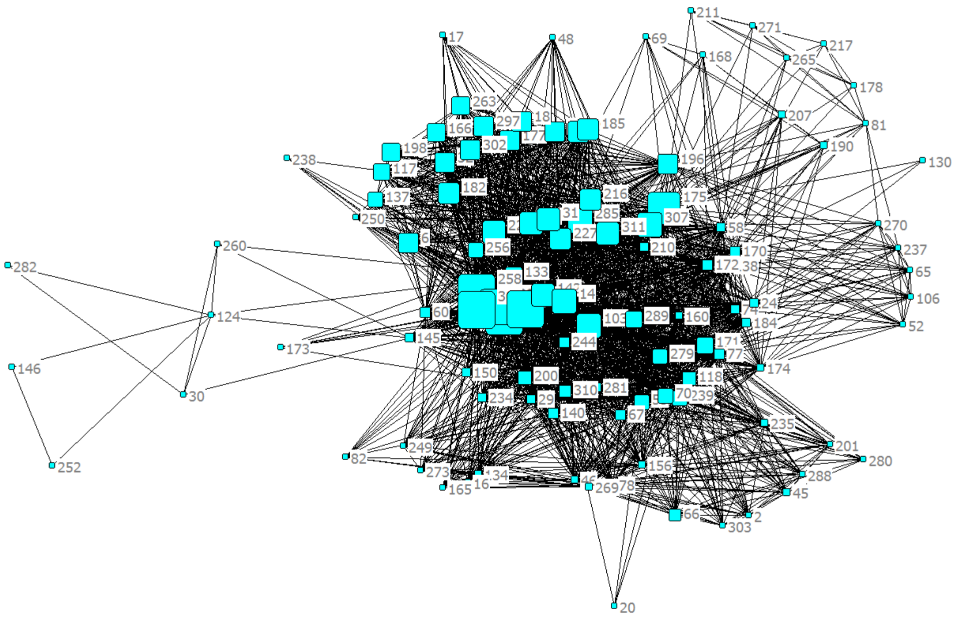
Figure 5: Players' scores as a function of their network position (year two)

We found a considerable connection between score and network influence. More than 50% of the variance in player score could be explained by that player's network role (as shown by a simple linear regression of score and centrality that yielded an R^2 of 0.522, significant at p<.001). In other words, we can quantitatively confirm that the game's point mechanics are substantially tied to the players' network position.

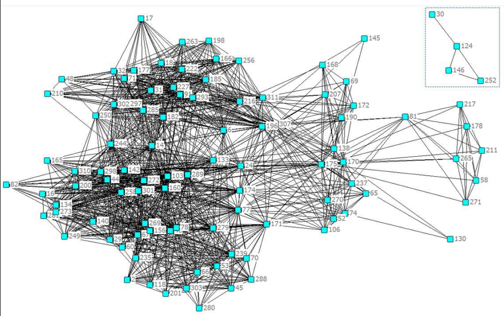
Network Growth

Some students chose to work with the same team for the entire duration of the game, while others moved from team to team. Network ties for a semester can be visualized (see Figure 6).

TOP: A full semester, drawn from 185 group projects submitted, which involved 110 students; node size is proportional to that student's score for the semester.

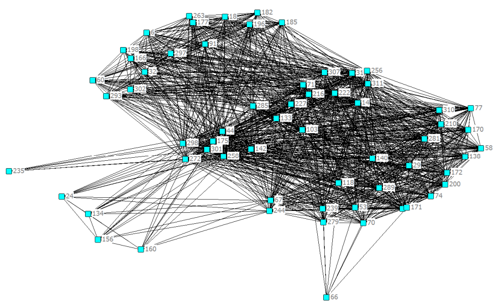


First half of the semester:



From the first 92 group projects, which involved 100 participants

Second half of the semester only:



From the last 92 group projects, with 74 participants (64 returning;10 new)

Figure 6: Network evolution over a semester: at top is the entire semester. If this semester's projects are split in

half, then the bottom left is the network visual for the first half of the year, and the bottom right is for the latter half.

Cohesion Over Time

Initial collaborations between students are often exploratory. As the network matures, structures typically shift and solidify.

Visually, differences are clear between halves of the semester, especially the growing density of connections. The semester midpoint was determined according to project submissions, so that each "half" includes an equal number of submissions (ninety two of them).The second half of projects appears much more tightly connected in the center, with the peripheral students appearing comparatively isolated. Appearances are valuable as a first glance at network data, but are rarely sufficient to make conclusive claims since the visuals represent just one solution to representing the data, and may hide overlaps and alternative solutions.

The density visuals can be backed with quantitative measures. The most intuitive measure is the typical number of teammates for a project, which increased from a simple average 10.5 participants per project in the first half the semester, to 12.0 participants in the second half. However, this measure of density does not consider the overall network size – and there were nearly 20% fewer players in the second half of the semester.

More substantively, the network 'density' measure indicates whether more individuals are well connected to one another (relative to a baseline where each participant is connected exactly once). Looking at the second year, the average density increases considerably, from 1.0 in the first half of the semester to 1.7 in the second half. (This difference in densities is unlikely to have occurred by chance, according to a bootstrap paired sample t-test at the $p<.01$ level. The densities were both calculated using the same baseline of 110 students who participated in one or more projects during the semester.) There is likely an attrition bias behind some of this density increase.[6]

To some extent densities can be compared across years. For the first year of the game, the average density was 1.78, while the second year had a higher average density of 2.7. However, the baseline number of participants also shifted across years, as did many game dynamics, so this cross-year comparison should be considered with caution; better inferences can be drawn once the game has stabilized in terms of participation and card content. In these early days, the primary benefit of 'density' for designers may be its well-established formula as a means to calculate points, and its use as a metaphor to optimize game mechanics.

Disciplinary Silos

To solve truly hard problems, a healthy network must be interdisciplinary (Page 2008). In the context of *Reality Ends Here*, students can collaborate across the five undergraduate departmental divisions in the school. As Table 1 illustrates, the participation rate for each division varied from 33-67 percent (that is, the percentage of students within the division who played the game). This represents modest success, in that all departments did participate. At the same time, the least participating departments (like Critical Studies and Animation/Digital Arts) had rates of participation as low as half the most active departments (like Interactive Media and Writing).

Department (both years)	Partici-pation	Submissions (per player)	Points Performance (v. Average)	Total Players
Interactive Media	67%	14	+6%	23
Writing (Screen and TV)	64%	20	-9%	37
Production (Film and TV)	44%	26	+3%	59
Animation and Digital Arts	37%	15	+17%	12
Critical Studies	33%	13	-6%	26
[Average] or Total	*[47%]*	*[20]*	---	*157*

Table 1: Participation by discipline (academic major)

The Table also includes a calculation of the overall ‘performance’ of each discipline or major, measured here as the point average compared to the overall game average. For better or worse, some of these trends conform to department-based stereotyping: production students are supposed to excel in networking and project management (see their high number of average submissions), while critical studies is a discipline that is perceived as being more isolated and independent. Yet it is also possible that some disciplines do their networking differently. Critical studies students may simply be avoiding networking *through media making*, preferring instead to network as part of discussing films. Additional research is needed to tease out a deeper picture for departmental affiliation, including their networking preferences and media making biases, and whether such differences are heightened at professional schools or after graduation. Regardless, since at least a third of students in each division participated (and at most about two-thirds), the game still had substantial penetration across departments.

Disciplines that Reach Out

Are disciplines partnering fairly, or with an internal bias? Consider the second year: across the five majors/disciplines, there was only evidence of homophily (the bias to partner with those similar) for the Production department students; this is unlikely to be a statistical fluke, since the bias measured was significant at the $p<.01$ level in a network autocorrelation using 5000 attributes. An overall model fit for homophily by discipline was significant, but with a R^2 that only explained 6.5% of the variance. In sum, there is some evidence for homophily among the Production students, but it is a mild factor. The cause remains hard to tease out at this early stage of research: is it that Production students self-identify based on personality traits to overcome differences, or is it a skill lacked by others, or simply a behavior rewarded in the Production department?

Guiding Teachers: Formative Assessment Strategy

We argue that network analysis may be especially valuable in a formative mode, providing learners and educators what game designers refer to as ‘state information’ about the health of a network. For learners, live feedback about network features can shift behavior (Gamberini et al. 2007; Gamberini et al. 2011); such feedback is already part of the game, and can be further optimized. For educators, real-time information can be integrated into daily decision-making, helping to shape targeted learning interventions.

By Measuring Centrality

Centrality is one way of understanding the importance of specific participants within the network structure. In the table below, we consider the top point earners in the game, and compare their performance with three network measures of centrality. This comparison is useful in understanding the network implications of the point system, and to identify unusual students.

We find that often the same player has quite different scores for different kinds of centrality (see Table 2). The three centrality measures used were: (a) **eigenvector** centrality, which as discussed above is akin to their influence, especially with peers who are highly networked; (b) **betweenness** centrality, which measures those who are most in the center, and useful for finding people who have might have the 'most control' over the communication of others; and, (c) **degree** centrality, which is a somewhat simplistic but intuitive measure defined as the number of links to others in the network.

Player Score *(and score rank)*	**Eigenvector Centrality** (rank)	**Betweenness Centrality** (rank)	**Degree Centrality** (rank)
21055 (1)	0.17 (4)	117.663 (11)	73 (5)
19150 (2)	0.169 (5)	347.691 (1)	77 (2)
18120 (3)	0.173 (1)	211.348 (5)	78 (1)
17660 (4)	0.163 (9)	104.289 (12)	69 (8)
17630 (5)	0.171 (2)	218.524 (4)	77 (3)
17620 (6)	0.163 (10)	84.322 (14)	68 (9)
16465 (7)	0.171 (3)	154.605 (7)	75 (4)
16445 (8)	0.165 (8)	67.367 (18)	68 (10)
16425 (9)	**0.079 (53)**	**269.026 (3)**	**45 (30)**
16340 (10)	0.16 (11)	69.948 (17)	66 (11)

Table 2: Highest scoring players, alongside their centrality rankings; yellow highlights a row with unusual contrasts

Disharmony can be particularly instructive. For example, consider the 9th row, representing the 9th ranked point earner. This student is relatively highly ranked (i.e., places in the top 10 of all points earners), but has low degree centrality – they simply do not have many links overall. Yet the links they do have are unusually powerful in connecting groups, since they are ranked #3 for "betweenness." In other words, they are a rare link between cliques.

For educators, a particular value of this perspective is to make timely interventions in game implementation during the course of the semester. In particular, educators can look past the usual leaderboards of the top point earners to identify "influential" players (such as with eigenvector or betweenness centrality). For game designers, this method can inform the game adaptation, especially across years to rebuild the scoring system and optimize for desired network goals.

By Identifying Student Groupings

To complement the instructors' intuition about student groups, clustering was analyzed. The approach partitions students into clusters based on their prior collaborations. Visually groups can be assigned to different colors (see Figure 7 for the first year network). The specific partitioning algorithm was a k-core analysis, a recursive pruning strategy to find local parts of a network (technically using 24 of 34 possible cores).

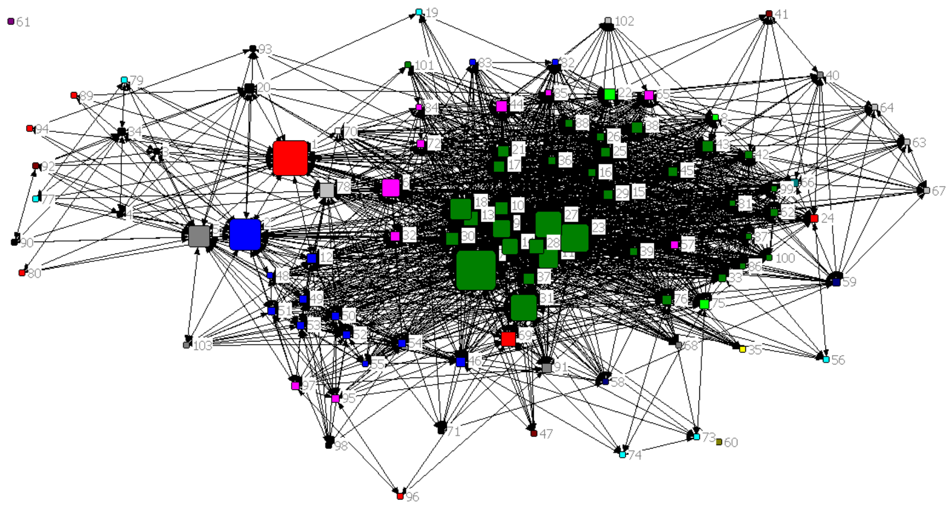


Figure 7: Group partitioning according to network analysis in the first year; color indicates the group, and size is proportionate to their bridging role (betweenness centrality)

When advising educators, we find that such visuals are most effective when coupled with additional indicators. In particular, it is useful to identify which students 'bridge' between clusters overall, as is done in Figure 7 by making student nodes larger when they have high bridging (as measured by betweenness centrality).

One application is to provide professors a printout of the different groups by name (omitted here for privacy reasons). Even more directly, the visual could be handed out to all students mid-semester to spur reflection and discussion about their own network habits and positioning.

A Visual Sense for Complexity

One benefit of network visualizations like Figure 7 is in how they synthesize very disparate types of data. Rarely do teachers have the time to parse rows of statistics, let alone seek out curious intersections in spreadsheet columns. To be realistic, the data must lure teachers into asking questions, especially about increasing student performance.

We found several attributes to be powerful, in addition to those mentioned previously:

- Gender of the student (men can be triangles, women circles)
- Media type submitted most frequently by the student (such as a 30-second short video, or a screenplay – give the dominant type a color)
- Typical number of collaborators the student works with on projects (this can be proportionate to their size)
- Attitudes like self-confidence and collective efficacy (which we collected via a separate survey)

The resulting visuals are colorful, and occasionally quite surprising. Beyond the educational use as formative assessment, researchers can also use the qualitative visuals to shape research questions. We might call this approach "mathematical ethnography," to borrow a term from Valente at al. (2004, 1702).

Sensitivity to Gender

Gender balance is a kind of network health that professors may wish to track in real-time. Consider the first year, when 67% of players appear to be male and 33% female based on an analysis of their names, profile pictures and internet searches – a slight skew toward the male beyond the school's usual level of 60% male. Do women bond disproportionately with women, men with men, or cross-gender? In other words, we might be concerned whether there is homophily for men and women within the network.

To test this concern, we investigated whether pairing by gender is happening more than expected by statistical chance during the first year. Using a method called QAP, we found two results. First, men are slightly more likely than random to have partnered on projects with other men (p=.044); and second, men are slightly less likely than random to have collaborated on a project with a woman (p=.038). The results are shown in Table 3; those in bold were significant (at the p<.05 level; the MD-QAP was conducted for a categorical auto-correlation with 10,000 permutations).

Node pairings by Gender	***p* >= Diff**	***p* <= Diff**	**Expected**	**Observed**	**Difference**
A. Male-male	**0.044**	0.957	752.078	871.000	118.922
B. Male-Female	0.963	**0.038**	752.078	682.000	-70.078
C. Female-Female	0.935	0.069	179.845	131.000	-48.845

Table 3: Gender homophily results in the first year

CONCLUSION AND DISCUSSION

This paper analyzes how peer-to-peer learning and community-building can be structured as a real-world game, rewarding the kinds of practices that are useful for collective organizing and meaningful participation. The educational reform goal is to help transform heavily-siloed academic divisions for college freshmen.

The immediate context is higher education, but the lessons are applicable to many contexts for informal learning with creative teams. Previously, the university approach to networks has centered on alumni events and internships, where there is rarely much structure for reflection and strategic learning. Can a game help universities to be more systematic in cultivating network value?

One contribution of this paper is to demonstrate the value of *formative* uses of network analysis in game deployments. With the network analysis provided, this paper offers a path toward more regular and comprehensive network analysis for educational games. For administrators, network tools can provide real-time feedback. For designers, the network perspective brings a different methodological frame: attention to state information based on network health, growth and roles.

There are risks with this kind of game strategy. If the game becomes a primary driver of small-group identity, then those who failed to join will become alienated from the network. Such a participation gap (Jenkins et al. 2007) can aggravate structural inequalities of class and ethnicity that existed long before the university experience for 18-year old students. Even the possibility of worsening inequality underscores the importance of careful facilitation – from monitoring the emerging game, to game mechanics that support recruiting at-risk students. Further research is needed to investigate how networking games in particular align with known participation gaps.

Another important warning is that these network methods emphasize collaboration *regardless of creative quality*. There is no attempt to reward aesthetics beyond the social dynamics of peer feedback. Once a student is over the basic threshold for "decently skilled," then the more important emphasis may be to cultivate the right network attitudes -- akin to the "grit" described by Duckworth et al. (2007).

How can network strategies be more deeply integrated into the design process, especially for games? Tuning game mechanics to network theories of learning may be the next step. Consider the bridging social capital described by Robert Putnam (2000), with its emphasis on mild relations social relations and weak ties (Granovetter 1973). If game designers want to follow Putnam's criteria, they should help players to *direct attention* outward beyond one's immediate group; to spur social *interaction*; to build group *identity*; and to foster the *reciprocity* that leads to trust. However, few (if any) games have been explicitly optimized for these criteria. Some are implicit in *Reality Ends Here*, but a more systematic review of the connection between design principles and network theory should further improve network outcomes.

ACKNOWLEDGMENTS

The support of the School of Cinematic Arts was essential for this research, which was conducted under the auspices of a program review. Thanks in particular to Tara

McPherson and Holly Willis. Thanks also to Microsoft Research and Donald Brinkman for his support of the research investigating the game.

ENDNOTES

[1] For example, the growth of online courses may increase the importance of a strong network strategy for elite universities, since content is becoming cheap online (relative to network formation, which often still is best face-to-face). Additionally, the innovation skills increasingly targeted by elite universities may rely on the generation of ideas at the edges of increasingly siloed academic disciplines.

[2] The design team included several authors of this paper, but not the first author. Specifically, the game was created by Jeff Watson as his doctoral research and design project, and was designed by Watson, Simon Wiscombe, and Tracy Fullerton.

[3] For example, each orange card has a random student's name printed on its face. Involving that student in a project where their "orange card" is a part of the Deal earns every collaborator on the project extra points. Initially, the names on orange cards were restricted to freshmen peers. However, in year two, the design goals evolved and the orange cards expanded to also include 25 sophomore students who had participated in the game the year before. The shift was designed to increase inter-cohort collaboration.

[4] Participants in the study were the incoming undergraduate classes at the USC School of Cinematic Arts in the fall of 2011 and 2012. According to the University, the overall undergraduate mix for undergraduates of all grades is approximately 60% male, with approximately 10,000 living alumni and 850 enrolled students ("Statistics-At-A-Glance (2010-2011): USC School of Cinematic Arts" 2012).

[5] Once a card has been used three times, it is no longer worth any points at all. Because cards are a limited resource in the game system, the more a player can connect with other players, the more cards they will have at their disposal.

[6] Attrition during the semester of play is disproportionately likely to leave behind the most motivated and active student teams. In the early weeks, some dabbling players may give the system a try, and not return or build up a larger network. Thus it is hard to tell how much of the shift is due to a loss of low-networked individuals (who might have undermined several projects), or an increase in the networking performance of those who stayed.

BIBLIOGRAPHY

Ahmad, Muhammad Aurangzeb, Zoheb Borbora, Cuihua Shen, Jaideep Srivastava, and Dmitri Williams. 2011. "Guild Play in MMOGs: Rethinking Common Group Dynamics Models." In *Social Informatics*, 145–152. Springer. http://link.springer.com/chapter/10.1007/978-3-642-24704-0_19.

Bagley, Elizabeth, and David Williamson Shaffer. 2010. "The Epistemography of Urban and Regional Planning 912: Appropriation in the Face of Resistance." In *Proceedings of the 9th International Conference of the Learning Sciences - Volume 1*, 81–88. ICLS '10. International Society of the Learning Sciences. http://dl.acm.org/citation.cfm?id=1854360.1854371.

Blizzard Entertainment. 2004. *World of Warcraft*. Personal computer.

Duckworth, Angela L., Christopher Peterson, Michael D. Matthews, and Dennis R. Kelly. 2007. “Grit: Perseverance and Passion for Long-term Goals.” *Journal of Personality and Social Psychology* 92 (6): 1087.

Flanagan, Mary. 2009. *Critical Play: Radical Game Design*. The MIT Press.

Fullerton, Tracy. in press. “What Games Do Well: Mastering Concepts in Play.” In *Postsecondary Play: The Role of Games and Social Media in Higher Education*, edited by William G Tierney, Zoe Corwin, and Gigi Ragusa. Baltimore, MD: John Hopkins University Press.

Galarneau, Lisa. 2005. “Spontaneous Communities of Learning: A Social Analysis of Learning Ecosystems in Massively Multiplayer Online Gaming (MMOG) Environments.” In *Changing Views: Worlds in Play*. Vancouver, British Columbia, Canada. http://summit.sfu.ca/item/287.

Gamberini, Luciano, Francesco Martino, Fabiola Scarpetta, Andrea Spoto, and Anna Spagnolli. 2007. “Unveiling the Structure: Effects of Social Feedback on Communication Activity in Online Multiplayer Videogames.” In *Online Communities and Social Computing*, 334–341. Springer. http://link.springer.com/chapter/10.1007/978-3-540-73257-0_37.

Gamberini, Luciano, Francesco Martino, Anna Spagnolli, Roberto Baù, and Michela Ferron. 2011. “‘Your Team Cohesion Is Low’: A Systematic Study of the Effects of Social Network Feedback on Mediated Activity.” In *Online Communities and Social Computing*, 172–181. Springer. http://link.springer.com/chapter/10.1007/978-3-642-21796-8_18.

Granovetter, Mark S. 1973. “The Strength of Weak Ties.” *American Journal of Sociology*: 1360–1380.

Jenkins, Henry, Katie Clinton, Ravi Purushotma, Alice Robison, and Margaret Weigel. 2007. *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*. MIT Press.

Lave, Jean, and Etienne Wenger. 1991. *Situated Learning: Legitimate Peripheral Participation*. Cambridge Univ Pr.

Lee, J. J., and J. Hammer. 2011. “Gamification in Education: What, How, Why Bother?” *Academic Exchange Quarterly* 15 (2): 2.

Levine, Peter. 2007. *The Future of Democracy: Developing the Next Generation of American Citizens*. Lebanon, New Hampshire: Tufts University Press.

Page, S. E. 2008. *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*. Princeton Univ Pr.

Putnam, Robert D. 2000. *Bowling Alone: The Collapse and Revival of American Community*. New York, NY: Simon & Schuster.

Salen, Katie, and Eric Zimmerman. 2004. *Rules of Play: Game Design Fundamentals*. The MIT Press.

Schön, Donald A. 1983. *The Reflective Practitioner: How Professionals Think in Action*. Basic books.

Shaffer, David Williamson, and James Paul Gee. 2012. “The Right Kind of GATE: Computer Games and the Future of Assessment.” In *Technology-based Assessments for 21st Century Skills: Theoretical and Practical Implications from Modern Research*, edited by Michael C. Mayrath, Jody Clarke-Midura, Daniel H. Robinson, and Gregory Schraw. Charlotte, NC: Information Age. http://epistemicgames.org/eg/wp-content/uploads/Comp-Games-and-Future-of-Assess-Chapter1.pdf.

“Statistics-At-A-Glance (2010-2011): USC School of Cinematic Arts.” 2012. *University of Southern California*. Accessed April 28. http://cinema.usc.edu/admissions/statistics/index.cfm.

Steinkuehler, Constance, and Dmitri Williams. 2006. “Where Everybody Knows Your (screen) Name: Online Games as ‘Third Places’.” *Journal of Computer-Mediated Communication* 11 (4): 885–909.
Thomas, Douglas, and John Seely Brown. 2009. “Why Virtual Worlds Can Matter.” *International Journal of Learning* 1 (1): 37–49.
Valente, Thomas W., Peggy Gallaher, and Michele Mouttapa. 2004. “Using Social Networks to Understand and Prevent Substance Use: A Transdisciplinary Perspective.” *Substance Use & Misuse* 39 (10-12): 1685–1712.
Watson, Jeff. 2012. “Reality Ends Here: Environmental Game Design and Participatory Spectacle”. Dissertation. USC School of Cinematic Arts.
Watson, Jeff, Tracy Fullerton, and Simon Wiscombe. 2011. “A Virtual Bullpen?: How the USC Cinema School Has Embraced ARGs To Shape The Experience of Entering Students” Interview by Henry Jenkins. http://henryjenkins.org/2011/10/a_virtual_bullpen_how_the_usc.html.
Watson, Jeff, Simon Wiscombe, and Tracy Fullerton. 2009. *Reality Ends Here*. Pervasive/card/web.
Zhu, Mengxiao, Yun Huang, and Noshir S. Contractor. 2013. “Motivations for Self-assembling into Project Teams.” *Social Networks* (in press/avail online). doi:10.1016/j.socnet.2013.03.001.
http://www.sciencedirect.com/science/article/pii/S0378873313000166.