‘Achievement Systems’ to Boost ‘Achievement Motivation’

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Abstract: If games are to be used to reform educational practice then there needs to be a better understanding of how they motivate learners. Previous research on the classic intrinsic vs. extrinsic model of motivation is reviewed. Achievement Goal theory is suggested as a way to further unpack how games can affect motivations to learn, particularly in the use of badge or achievement systems. The Fostering Innovation through Robotics Exploration (FIRE) project is offered as an example of how research studies can use Achievement Goal theory to investigate and inform the design of educational games and gamification.

Introduction

Amongst the seemingly never-ending calls for reforming our public education system, a core problem can be distilled: low motivation of students to learn. Motivational issues are cited as a pre-cursor to general drops in school performance amongst all adolescents (Eccles, Midgley, & Adler, 1984) as well as for our nation’s declining populations of native-born engineers and scientists (Kuenzi, Mathews, & Mangan, 2006). While low motivation may have a limited impact on any one educational metric, every education environment potentially suffers from low student engagement and persistence at least some of the time with some of the intended learners. Thus, improving student motivation is a prime target for meaningful educational reform, independent of learning objectives.

A growing number of reformers are looking to computer and video games to improve motivation in educational settings. There are several leading theories that declare the modern video and computer game as the next great educational tool, seemingly originating from the conventional wisdom that games can be educational but also fun (Kafai, 2006; Kiili, 2005; Shaffer, Squire, Halverson, & Gee, 2005; Squire & Jenkins, 2003; Steinkuehler, 2004). Only a relatively low number of research findings support the use of games for traditional learning, but many researchers continue to try and unpack how learning in games can transfer to other settings.

While a better understanding of how learning occurs in games will benefit at least some traditional educational settings, this framing may be too narrow in focus. If improving learner motivation is a key element of educational reform, then education researchers and practitioners must also investigate ways in which games and game-like elements influence learner motivation. If we truly believe that games are attractive tools for reforming education because of their motivational qualities (i.e. playing games is fun) then we need to verify and unpack how they increase motivation to learn.

In this paper we argue that if increasing learner motivation is a key benefit when using games in educational settings, then researchers must specifically investigate why and how game-based learning increases motivation. In order to do so, we will suggest that education researchers must update their views of the motivational potential of games and revisit avenues of research that can test whether the inclusion of gaming in educational practice increases the kind of motivation that leads to high-academic performance.

Research on Motivation in Games

Well-designed games are thought to be motivating to players regardless of the game context. People seek games in order to have fun (Lazzaro, 2004). Even if the fun they experience

becomes intertwined with other emotions (Yee, 2006b) the overarching drive for playing games is a sense of enjoyment.

In the 1980s, Thomas Malone and Mark Lepper investigated the motivational qualities of games, looking to identify the inherent intrinsic motivations of players under the pretense that games are learning opportunities. Their goal was to create a taxonomy of what makes learning fun and suggest a framework for applying it to learning contexts. Their work involved experimentation that altered features of games (i.e. goals, fantasy elements, effects, and later cooperation) in order to isolate specific motivating characteristics (Malone, 1981; Malone & Lepper, 1987). The taxonomy they created classifies learning motivations in games as either individual or interpersonal. Individual motivations are classified as solely intrinsic, generated from within oneself, but interpersonal motivations are considered a blend of both intrinsic and extrinsic, generated from outside oneself, classifications. While this taxonomy has proven useful to researchers, we noted that the intrinsic/extrinsic classification failed to completely categorize distinctions in game motivations.

Surprisingly, and despite the advancement of both games and motivation research, there has been no other seminal research using other motivation theories to unpack the motivational potential for learning in games. While almost all game research and theory, including all of the research listed previously, cite the importance of motivation as why games are effective for learning, very few studies expand on the concept.

Those few studies that have looked at how motivation manifests in educational games have continued to use the context of intrinsic motivation as established by Malone and Lepper. Cordova and Lepper (1996) investigated how the addition of context, personalization, and choice in games alters intrinsic motivations of players. Amory, Naicker, Vincent, and Adams (1999) looked at how game fidelity and sophistication improve intrinsic motivation. Garris, Ahlers, and Driskell (2002) acknowledge the existence of extrinsic factors within games but still refer to the Malone and Lepper model of using games to increase intrinsic motivation. Dickey (2007) used the Malone and Lepper model to investigate how massively multiple online role-playing games foster motivation. Even the military's research on this topic relies on the Malone and Lepper model (Belanich, Sibley, & Orvis, 2004).

We are not suggesting that the use of the Malone and Lepper model prevents good investigation. Tu□zu□n, Yilmaz-Soylu, Karakus, Inal, and KizIlkaya (2009) were able to show some evidence of increase in intrinsic motivation in primary school students based on their interaction with a geography game. Habgood and Ainsworth (Habgood & Ainsworth, 2011) have altered the model to better assess how intrinsic motivation is integrated with gameplay. What we are suggesting is that current research on motivation in educational games is to narrowly focused on a single theory.

It is also worth noting that there are attempts to understand motivation in games outside of education research. Yee (2006c) has identified a motivation inventory that can be used to analyze player motivations in multi-player games. It has resulted in an instrument that can identity player motivations in massive multiplayer online role playing games (Yee, 2006a). However, the connection between this research and education has not yet manifested. Kebritchi, Hirumi, and Bai (2010) used a model of motivation based on instructional design theory to show evidence of gains in motivation in school settings. Unfortunately the connections between instructional design and K-12 education are not well established.

Call for New Game Motivation Research

Research on the motivation to learn has itself progressed beyond the dichotomous viewpoint of intrinsic versus extrinsic. Investigators have created more nuanced theories that have shown evidence of potentially large learning effects resulting from manipulations of learners' motivation.

Some educational games promote epistemic framing, an understanding of how a community of practice thinks (Shaffer, et al., 2005). Student generation of an epistemology through a game would seem naturally compatible with recent motivation research given that motivation is directly tied to epistemological beliefs (Hofer & Pintrich, 1997). It is possible that games that allow for epistemic development do so because of integration with motivation.

But to date the vast majority of educational game research has not shown compelling evidence that games increase motivation more than other educational interventions (Clark, 2007). Barab, Arici, and Jackson (2005) credit Malone and Lepper for their work but suggest that more motivational theories will allow for further advancement of educational games. As games become more complex, identifying motivation requires more nuance. For example, if a player helps their classmates learn a skill in a game then it is unclear whether they are motivated intrinsically by a desire to use their knowledge or extrinsically by a desire to receive thanks or praise.

Choosing a Motivation Theory

Educational game researchers who wish to consider more modern theories of motivation face an embarrassment of riches: the recent proliferation of motivation theories reported by the field (Pintrich, 2003) opens up a staggering number of new options. To highlight just a few, researchers can now choose from theories of self-determination, needs approach, and achievement motives, among many others.

Each major theory subdivides further, forcing researchers to make assumptions regarding, for instance, conscious or unconscious operation, whether different but related motivations are occurring simultaneously, or about the strength of different motivations. Efforts to unify various theories have resulted in still-complex models that bear out complicated analyses when applied to complex learning goals (Clark, Howard, & Early, 2006).

Nevertheless, in order to investigate how games affect learner motivation, we need a valid theory of motivation that would still allow for discovery and potential manipulation of motivational effects. Within the limited context of educational games, we believe that current Achievement Goal Theory provides an excellent starting point for investigation.

Achievement Goal Theory

Recent developments in Achievement Goal theory frame achievement goals into a 2x2 matrix of (mastery or performance) x (approach or avoidance) (Elliot, 1999). *Mastery approach* motivation is the desire to master something out of one's own interest in improving. *Performance approach* motivation is the desire to perform demonstrably better, while *performance avoidance* is the desire to avoid the appearance of underperforming. *Mastery avoidance* does not manifest itself in most real-world contexts.

Research evidence shows a positive correlation between mastery learning and academic performance outcomes and a negative correlation between performance avoidance and academic performance outcomes (Elliot, Cury, Fryer, & Huguet, 2006). Performance approach goals have had both positive and negative correlations with academic performance, depending on other variables (Elliott, Shell, Henry, & Maier, 2005). Overall, achievement goal orientation has proven to be a good predictor of academic performance in various academic subjects (Pajares, Britner, & Valiante, 2000).

Achievement goal theory is attractive for investigating games in education for three reasons. One is that it is easily applied to both educational settings and games. For games, goals are often the dominant structure for telling the player how to proceed. In educational settings, goals are easily compared to classic learning targets such as grades or the gaining of a new skill.

A second reason is that by using goals as the basis of a motivation theory there is a reasonable assumption of the potential for learning impacts. Much research has established goals as either supporting or having a symbiotic relationship with motivation in learners (Locke & Latham, 2002). By focusing research on motivational goals, research findings can be adapted to the various goals of different educational opportunities while avoiding the labor of trying to align general motivations between disparate educational opportunities.

Lastly, achievement goal theory is compatible with various other motivation theories; discovery of associated achievement goal theories associated with an emerging technology does not preclude the existence of other types of motivation and in fact might support it. For example, Pekrun, Elliot, and Maier (2009) were able to find connections between achievement goals and achievement emotions. Research that utilizes achievement goal theory could be used to support investigations into emerging technology that eventually implement other motivation theories.

There is also some precedence for using to achievement goal theory to better understand learner motivation when using educational technology. Moos and Azevedo (2006) used

achievement goal theory to examine student motivation in a hypermedia-based learning task. Surprisingly, they found little interaction between the hypermedia tasks and different achievement goal orientation. And although it was not their primary research focus, Day, Espejo, Kowollik, Boatman, and McEntire (2007) used achievement goal orientation to tease apart subject performance in a computer game.

Applying Achievement Goals to Badges

There are numerous ways Achievement Goal theory can be applied to educational game research. We present the following study that we are currently implementing as one example. Our hope is that it serves as inspiration to other researchers considering similar approaches.

A recent but growing feature of commercial games is the inclusion of a badge or achievement system. These systems are essentially meta-games providing additional goals to players, independent of the key goals of the game. For example, if the goal of a game is to rescue a princess then a player could earn additional badges or achievements by rescuing the princess under a certain time, without making a mistake, or other choices not directly related to game goal of rescuing the princess. Rather than letting these goals go unnoticed, badge systems reward players for accomplishing these unique achievements with a graphic or points, usually of no discernible value.

Because these badge/achievement systems are games that can be layered on top of educational settings, developers have theorized that meta-games might be a valuable tool for increasing learner's motivation without sacrificing learning goals. An example of the process frequently referred to as *gamification*, applying a badge or achievement system could be a way to isolate the motivational aspects of games and apply them to learning opportunities in order to increase learner motivation without having to severely restructure the learning opportunity. Some current examples include the badge system being implemented by the Khan Academy or Mozilla's Open Badge project.

Using a validated measure of achievement goal theory, our research aim is to generate quantitative measures of learner motivation in order to understand the impact of badge systems on learner motivation. Consequently we are implementing a study to test the following hypotheses:

1. The inclusion of badges (achievements) will result in an increase in performance approach goals for the subject being learned.
2. The inclusion of badges (achievements) will have no effect on mastery approach motivation or performance avoidance motivation for the subject being learned or the learning environment.
3. The inclusion of badges (achievements) will result in increased student learning

We have already conducted a pilot study where we designed a set of achievements for a single instructional unit for a high-school engineering class. For the one-month time frame of the study we used the PALS measurement tool (Midgley, et al., 2000), prior and post to quantify student's levels of achievement motivation. Additionally, we also used traditional measures of performance (i.e. homework, projects, class participation).

Our next step will be the application of badges to a web-based architecture for teaching programming and mathematics. The Fostering Innovation through Robotics Exploration (FIRE) project is a DARPA-funded initiative to promote student interest in science, technology, mathematics, and engineering. The project includes a number of applications developed with a pure focus on educational outcomes, selected to accommodate a wide range of learner stances, and thus have a wide variety of learning goals, intended audiences, and technology bases – they include web-based cognitive math tutors, programmable virtual robot simulations, and an Alice Animation Festival. To these, we are adding an achievement/badge tracking system layer whose elements are chosen entirely with a motivational focus. Some achievements in the system may align with learning milestones, but they are not required to. We will measure the effectiveness of the badge system through the PALS measurement tool, learner performance metrics, and qualitative observation and alter the design of our system based on learner performance and feedback.

Conclusion

The aim of this paper is not to say that we must use achievement goal theory to unpack motivation to learn within games. There are several good theories of motivation that would be appropriately applied to games in education besides achievement goal theory. Ryan and Deci (2000) update the classic extrinsic verses intrinsic distinction into self-determination theory which could be an excellent framework for understanding games given the work by Malone and Lepper. A sociocultural view of achievement motivation, as described by Hickey (2003), could also allow for interesting discoveries, particularly in multiplayer games.

We are, however, suggesting that if educational games are to be used successfully, then practitioners cannot simply assume that motivation will occur automatically and in line with the classic models. As a result of recent motivation research, we know that maintaining learner motivation is both complicated and necessary for good learning. Games are uniquely situated to meet both learning and motivational needs but much more research needs to be done. If gamification can be used to support learning opportunities then more evidence needs to be generated to support this position. We believe that applying achievement goal theory to educational games will allow for a deeper understanding of motivation and its contribution to the learning power of games.

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