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THE USE OF VIDEO GAME ACHIEVEMENTS TO ENHANCE PLAYER PERFORMANCE, SELF-EFFICACY, AND MOTIVATION

by
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ABSTRACT

A taxonomy of achievement design features that exist currently in video game systems was created in order to evaluate the current the state of the art in achievement design. From the taxonomy of design features multiple mechanisms of action that influence player behavior were identified. These mechanisms lead to a predictive model that can guide the designs of achievements in order to improve performance, self-efficacy and motivation in players.

Expected, unexpected, and incremental achievements were tested. Notifications occurring before and after earning an achievement were also tested. In addition to testing individual mechanisms of action a “combined achievement” was created with multiple mechanisms added that were hand-picked. For testing purposes the model was applied to achievements that were inserted into an instructional game. The results of the study revealed that individual mechanisms of action had little effect on players while multiple mechanisms in a combined achievement caused significant improvements in several categories. The limitations of the current study, as well as, plans for future study are also discussed.

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LIST OF ACRONYMS

MMO	Massively Multi-player Online game
FPS	First Person Shooter
CET	Cognitive Evaluation Theory
VGSES	Video Game Self-Efficacy Scale
GSE	Generalized Self-Efficacy Scale
GEQ	Game Engagement Questionnaire
IMI	Intrinsic Motivation Inventory
TPLKATS	Structural Knowledge Assessment Tool
ANOVA	Analysis of Variance

CHAPTER 1: INTRODUCTION

"*A soldier will fight long and hard for a bit of colored ribbon.*" - Napoleon Bonaparte

An achievement in a video game is a reward or recognition earned by players for an in-game accomplishment. Achievements are often used in video games to extend play time by adding additional goals or by serving as extrinsic motivators added to those incumbent in the game. The concept of achievements has been in video games since Space Invaders (Midway, 1978), which allowed players to earn a "hi-score" and post their initials for other players to see. The terminology was not introduced however until 2005, when Microsoft introduced the "Gamerscore" system for the Xbox 360 platform. The Gamerscore system coined the term "achievement" and made their use in games mainstream. The entertainment gaming industry's use of achievements today is pervasive. A game cannot be on Xbox Live or the PlayStation Network (Sony), two popular gaming consoles, without having achievements in it. World of Warcraft (Blizzard Entertainment), currently the world's largest pay-to-play Massively Multi-player Online game (MMO) in terms of subscribers (12 million), has 1,320 achievements and Farmville (Zynga), the most-popular game on the social networking site Facebook, has 132 ribbon achievements.

The entertainment gaming industry’s quick adoption of achievements without proper study of their effects has lead to backlash among some designers. They fear achievements are a threat to the inherent value of games, the main focus of which is to have fun. Achievements, in their minds, could become an exercise in behaviorism that will trick players into playing "bad games" to earn more achievements (Hecker, 2010). With little existing research to back-up concerns about any negative consequences associated with achievement use, critics have been relegated to speculation and oversimplification of studies on rewards and motivation. A common argument made by opponents of achievements is as follows: Rewards are bad

because they decrease motivation. Achievements are rewards, therefore achievements must decrease motivation. An understanding of the elements that comprise achievements will help alleviate concerns about use of achievements and guide future designs.

The serious games industry, which creates games that enhance performance and learning, has been much slower in their adoption of achievement systems. This new form of feedback and reward could be beneficial to an industry that often struggles with making games entertaining and educational. Because time-on-task contributes to the effectiveness of a serious game, the use of achievements to affect play time might be beneficial to learning (Cannon-Bowers & Bowers 2010). The achievements add incentive for performing a task to a certain degree or simply spending more time on a given task trying to complete it. Both increased effort and increased time on task are the true goals of including achievements in serious games, as both are shown to increase the learning value of an experience (Fisher & Ford, 1998). However, there is no empirical evidence to suggest that achievements are effective in creating these outcomes. Because a serious game's entertainment value is subordinate to its instructional value, the effect that achievements have on learning should be investigated before they are put into use. An understanding of the elements that comprise achievements will enable the creation of achievements tailored to meet specific needs, in order to optimize player performance and increase learning in serious games.

Purpose of study

The purpose of the proposed work is to develop an understanding of the role of achievements in game-based learning. This will be achieved by creating a taxonomy to describe the components of achievements that currently exist in games. The taxonomy will facilitate the creation of a predictive model that will define what achievement design features are likely to elicit a desired behavior that leads to increased learning. The model will then be used to add

achievements to an existing serious game. An experiment will be performed to evaluate the changes in learning outcomes, motivation, and self-efficacy when comparing games with and without achievements.

CHAPTER 2: LITERATURE REVIEW OF ACHIEVEMENT DESIGN ATTRIBUTES

The motivation for players to earn achievements is described by Expectancy Theory (Vroom, 1964; Porter & Lawler, 1968; Lawler 1970), which states that performance on a task is a function of motivation and ability. In this theory motivation is broken down into three subsets: valence, instrumentality, and expectancy. Valence is the perceived value of an outcome, instrumentality is the belief that certain actions will lead to the desired outcome, and expectancy is perceived capability for performing the actions (Heneman & Schwab, 1972). These factors are an amalgamation of player perceptions and design influences. How a player perceives an achievement or the task(s) associated with it influences whether or not they will choose to engage in it (Komarraju & Karau, 2008) and their reaction to earning it. Consequently, understanding the factors that influence player perception may allow designers to preempt biases to help ensure achievements increase motivation. As the interest in achievements has increased in industry, designers have created a number of specific elements that presumably improve their games and increase value to the player. This section will review the process of achievement design with the goal of creating a taxonomy of achievement design features. The taxonomy features will be extracted from the current library of popular entertainment games that utilize achievement systems to enhance the game play experience. The features will then be analyzed based on psychological theories that focus on motivation, performance, and learning.

Difficulty of achievement

The difficultly level of achievements is addressed twice by designers. First, the actual difficulty of the achievements needs to be on a level that is attainable but challenging to the players. This can be accomplished by manipulating features like the win expectancy of game events and with scaffolding that provides players with assistance when it is needed. Second,

player's self-efficacy for the task(s) associated with the achievement must be high enough that they feel confident in attempting it. Otherwise, players will not set achievements as goals for themselves as they play the game.

The term “win expectancy” is used in game design to describe what percent of the time players will be successful. This percentage is usually tied to a level of skill. For example, if expert level players have an 80% win expectancy for an in-game task, beginning players will have a much lower rate of success and they will be easily discouraged. These levels and rates of success are usually defined through play testing. Each achievement must be designed so that players don't get discouraged through multiple attempts (Game Developer, May 2010). Achievements that are too difficult will not be attempted by the players and those that are too easy will be completed quickly and will not provide adequate challenge. Proper calibration of achievement difficulty to match with player ability can keep the task challenging but not threatening in the player's mind (Drach-Zahavy & Erez, 2002). Achievements should be challenging goals for players, because difficult goals lead to greater gains in performance (Campbell, 1982). In addition to ensuring players of lower skill levels are not overburdened, designers also use achievements to challenge expert players. For instance the achievement "The Undying" in World of Warcraft requires players to defeat every boss in a difficult dungeon without any group member dying. Using achievements to provide alternative objectives for players who have reached a mastery level of performance can make mastered tasks interesting again.

Player self-efficacy is another important factor that game designers must consider. The term self-efficacy refers to a person's perception about their ability to produce a desired result or effect for a specific task (Bandura 1999). If players do not "believe they can produce desired results and forestall detrimental ones by their actions, they have little incentive to act or to

persevere in the face of difficulties" (Bandura, 2001, p. 11). High self-efficacy has been linked to increased goal commitment, increased strategy creation and use, and a more positive response to negative feedback (Seijts et al. 2004). There are four major factors identified by Bandura (1994) that influence self-efficacy. The first factor that will affect a player's self-efficacy is their level of expertise on the subject matter. Seeing others succeed and fail, or vicarious experience, is the second factor that influences self-efficacy. This effect is likely to be particularly powerful if the person being observed appears to be at the same ability level of the observer. Examples of utilizing this in games are leader boards for online games or the "brags" system in the game streaming system Onlive. Social persuasion, such as the act of giving someone a verbal boost, is the third method of influencing self-efficacy. This can be as simple as telling someone "good job" after a performance or the "50 NOTE STREAK!" messages that appear in Guitar Hero (Activision). How a person feels is the fourth factor that influences self-efficacy. This includes their level of stress, emotional condition, and perceived physical state. Learners made to believe their skill sets could benefit with practice showed improved levels of anxiety and self-efficacy (Martocchio, 1994).

Negative achievements

Achievements can be earned for positive or negative performances in a game. Positive achievements, like killing 10 enemies without dying or scoring a triple kill with the sword in Halo 3 (Microsoft), are much more abundant in games than negative achievements. Although less common than their positive counterparts, negative achievements can have drastic effects on players. Negative achievements are earned for a poor performance in a game. Examples of negative achievements are the Command & Conquer 3 (EA) achievement given for losing to someone "Ranked 20 places below you in a Multi-player Ranked Game" and the "Getting my ass kicked" trophy on PS3's God of War (Sony Computer Entertainment). Players choosing to

pursue a negative achievement should not a be of concern, but players legitimately earning them, especially in a string, could have a detrimental effect. Negative achievements may decrease the player's sense of competence and self determination, making the activity less rewarding (Deci & Cascio, 1972). Negative achievements, like those on Xbox Live that do not contribute any points to the player's overall "Gamerscore," offer no incentive to earn a negative achievement. Instead of offering incentive to pursue a goal, the players are instead encouraged to avoid a goal. Avoidance goals create an environment of "constant monitoring of negative possibilities which is draining" to players and makes the experience unenjoyable (Elliot, 2006, p. 115).

In some circumstances like pilot training, error avoidance may be appropriate for advanced learners who are being trained for tasks in which errors are extremely detrimental. Negative achievements could represent the errors that are to be avoided and earning a negative achievement would signify a shortcoming in the player's training. Negative achievements could also give the player the opportunity to correct their own errors.

Boring vs. Interesting tasks

Achievements are earned for the completion of a task or series of tasks. These required actions will fall on a spectrum ranging from boring to exciting from the player's perspective. If a task is boring, the reward structure associated with it has to be different from tasks that are inherently interesting to player.

Fortunately for designers, intrinsic motivation is unaffected by rewards given for the completion of dull or boring tasks (Deci, Koestner, & Ryan, 1999). Because of this, designers can use rewards or other design features to entice players into engaging in boring game tasks. There are two common strategies employed to make students engage in unpleasant task that have benefits outside of the task itself. "Engagement in a boring or unpleasant task is achieved

by emphasizing the instrumental value of the activity in producing desirable outcomes that are extrinsic to the activity itself" (Lepper & Gilovich, 1982, p. 249). Achievements can be themed to reflect real world outcomes of learning the material or stress the importance of the knowledge the player is gaining. Making the player think the subject matter is relevant to them in this way will improve engagement and learning (Shernoff et al., 2003). An example of this would be an achievement that gives the player the title "Life Saver" for completing firefighting training in a game. A second method is to re-imagine the dull task by adding rules, fantasy, or game elements to make it more enjoyable (cf. Bruner, 1962, 1966; Csikszentmihalyi, 1975; deCharms, 1968; Moore & Anderson, 1969) as cited in (Lepper & Gilovich, 1982). This method was shown by Lepper and Gilovich (1982) to increase compliance and rated enjoyment in children. Achievements can add a level of challenge, play, fantasy, and reward to activities that are otherwise boring. In games this has been implemented for boring tasks like mining, blacksmithing, and fishing in Massively Multi-player Online Role Playing Games (MMORPGs).

For tasks that are inherently interesting for the player, achievements should be employed with a different strategy. Instead of trying to create artificial interest in the task, the achievements should be attentional in that they focus the player's attention on important lessons or strategies for the task. This could improve player's performance and learning on the task by scaffolding "hints" about what the most effective strategy is. An example of this would be the achievement “The Flying Heal Bus” in Starcraft 2, which leads players to utilize a specific unit, or the achievement “Can't Touch This!”, which encourages players to dodge a specific enemy attack.

Goal orientation of achievement

Goal orientation must be considered when designing achievements, because a player's orientation will alter how they experience a game. Elliott and Dweck (1988) and Ames and Archer (1987) described the two types of goal orientation as either performance orientation or

learning orientation. Individuals in a performance-oriented state "seek to gain favorable judgments of their competence or avoid negative judgments" while learning oriented "individuals seek to increase their competence" (Elliott & Dweck, 1988).

Players with a high performance orientation will take fewer risks and experience less of whatever they are participating in because their fear of failure makes them avoid experimentation that could affect their "score" (Dormann & Frese, 1994). They would rather choose tasks that enable them to demonstrate their competence at the expense of their learning something new (Seijts et al., 2004). Players who have a learning goal orientation will accept errors and seek challenging tasks that provide them the opportunity to develop their competencies (Seijts et al., 2004). Attitudes and motivation are not the only things affected by goal orientation. In some studies, performance was directly tied to a participant's orientation. Winters and Latham (1996) found that trainees who were given performance-oriented goals performed better on simple tasks while trainees given mastery-oriented goals performed better on complex tasks. In addition to the performance differences, trainees who were given mastery goals also had higher self-efficacy and utilized more effective task strategies.

Some research (Kozlowski et al., 2001; Button, Mathieu, & Zajac, 1996) indicates that learning orientation and performance orientation are not two sides of a coin but are instead two distinct states. Viewing goal orientation as less of an inherent trait and more of something that can be influenced through design (Kozlowski et al., 2001) will change how achievements are made. Achievements can influence a player's state of goal orientation depending on several design features. Achievements should not simply list the metrics for success in a game. Instead they should provide reasons why the experience is important and focus on skill development as much as performance evaluation (VandeWalle et al., 1999). Telling a player they can succeed through persistence will foster mastery orientation (Thompson & Musket,

2005). Design that focuses on "learning, effort, challenge, and errors as diagnostic feedback induce a learning or mastery orientation" (Kozlowski et al., 2001). The names of achievements are very important when trying to effectively communicate this. The wording for the trophy "So Close..." in the game Heavy Rain (Sony Computer Entertainment) that is given to players for reaching the end of a difficult task, but still failing, could be seen as encouragement and recognition of effort. As opposed to the achievement “Blowing It” in Guitar Hero III (Activision), which is given for the same type of last minute failure, but is worded in such a way that it could be discouraging. Because it "emphasizes the achievement of high grades and minimization of mistakes" (Kozlowski et al., 2001), players could be driven closer to a performance orientation.

Measurement achievement

Measurement achievements are earned because a player meets a certain degree of "performance relative to some normative information or standard" (Deci & Ryan, 1985, p. 74 cited in Eisenberger & Cameron 1996). These rewards are quality dependent (Eisenberger & Cameron, 1996) as opposed to completion achievements which are given for the completion of a task without a measure being applied to it. The standard can be measured against the user's own performance (beating your old high score), the community performance (having the highest score in the community), or an value determined by the game designer. An example of this type of achievement would be the 1-3 star rating in Angry Birds (Rovio) for completing the same task to different degrees.

Measurement achievements should be thought of as a type of feedback for performance in a game. Feedback allows players to reflect on their performance in relation to performance goals they have set for themselves (Locke & Latham, 2002). A player who has set a goal for themselves in a game will earn achievements periodically that reveal their progress toward that end. When structured properly, feedback in a game can affect the player’s perception of

competence, which will lead to an increase in intrinsic motivation (Deci, 1975). Perceived competence may also mediate the negative effects on player's intrinsic motivation (Lepper & Gilovich, 1982) caused by other factors like competition (Reeve & Deci, 1996). Providing feedback is one of the nine events of learning (Gagne, 1965) and when combined with clearly defined goals, feedback can enhance performance (Earley et al., 1990; Stajkovic & Luthans, 2003) and learning retention (Epstein et al., 2002). Also unlike the completion achievements discussed in the next section, which are closer to true rewards, measurement achievements "do not necessarily reduce intrinsic motivation" (Deci & Ryan, 1985, p. 74 cited in Eisenberger & Cameron, 1996) because like verbal feedback, they are purely informational (Deci, Koestner, & Ryan, 2001). Measurement achievements in serious games can be given to learners in place of or in addition to performance feedback. Players could earn achievements in serious games for completing learning content perfectly or for beating their own previous high score.

Completion achievement

Completion achievements are best described as task-contingent rewards (Deci & Ryan, 1985). The achievement does not tell the player how well they performed the task; instead, it is offered as a reward after an activity or task is completed. These types of achievements are binary; they are either completed, or not. Completion achievements can be split into two subcategories: performance contingent achievements and non-performance contingent achievements. Performance contingent achievements or completion-dependent rewards (Eisenberger & Cameron, 1996) require skill to complete. Capturing a flag for the first time in a multi-player first-person shooter (FPS) or completing a training event in a serious game are examples of this. For serious games, this could not only be used as recognition for the players ,but also as a way for managers to track completion of necessary training. Non-performance contingent achievements, also refered to as performance-independent rewards, (Eisenberger &

Cameron, 1996), can be completed without any ability or skill, such as an achievement given for attending an in game event, or simply starting a serious game for the first time.

Incentive and reward programs are proven methods for manipulating employee behaviors. If performance-contingent achievements are viewed as a form of incentive program built into video games, there are lessons that can be taken from industries utilizing organizational behavior modification. Research has shown that incentives have a significant positive effect on task performance (Kluger & DeNisi, 1996; Stajkovic & Luthans, 1997, 2003; Jenkins et al., 1998; Condly, Clark, & Stolovitch, 2003). Non-performance-contingent achievements, which have been shown to have no negative affect on intrinsic motivation (Deci, 1972), can be utilized as well, but to a lesser degree. Because they lack a performance measure they must be paired with social reinforcement, which has been shown to enhance the effect of rewards and feedback (Stajkovic & Luthans, 1997). They will often be used as a measure of experience or play time, thus enhancing a player's social status in a game.

However, some have suggested that rewards, like completion achievements, may have some negative effects. For example Deci and Ryan (1985) theorized that when rewards are given for completing tasks too often the person receiving the reward can feel like their autonomy is being infringed upon. Cognitive Evaluation Theory (CET) predicts that a decreased sense of autonomy will lower intrinsic motivation. Persons who receive rewards are therefore less likely to return to the task later on of their own free will (Bandura, 1986; Dickinson, 1989). The quality of work can also be lowered because the player will be less likely to go "above and beyond" expectation because an artificial ceiling for performance has already been created at the reward threshold (Csikszentmihalyi, 1975). People receiving a reward are also potentially less likely to take risks because they do not want to risk not earning the reward. The lack of risk taking would

then have a negative effect on creativity (Amabile et al., 1986) which in a game setting could cause avoidance of experimental play.

Expected vs Unexpected achievement

Players either know what achievements can be earned before they play a game or they come upon them unexpectedly during play. In games with expected achievements, players can view what achievements are available before they begin game play. This will allow them to set goals by deciding which achievements they would like to try to earn. Unexpected achievements are unknown to the player until they earn or "unlock" them. Players are typically aware that they exist in the game, but are never told how specifically to earn them. There are benefits and detriments to both expected and unexpected achievements.

Expected achievements provide players with the opportunity to establish goals for themselves before a game play session. Locke and Latham (2002) break down the positive effects of goals on performance into four mechanisms. First, goals provide direction by clearly laying out objectives for a learner. This allows them to allocate resources properly to ensure they meet the goal. Second, goals increase the amount of effort someone will put toward a task. Like runners sprinting to a finish line, someone using a serious game will be more motivated to finish and will try harder when there is a goal they can strive for. Third, having goals makes a participant more likely to continue on even when facing a daunting task. Having a goal is a motivating factor and without it people will quit long before they should when facing a task they perceive as difficult. Fourth, goals encourage the use of knowledge and skills that they already possess but also make them more likely to acquire new knowledge and skills in order to complete the task. In addition to the benefits associated with goals, expected achievements have the added advantage of notifying the player when the goal has been met.

Expected achievements can also provide the opportunity to create a schema about the game they are about to play, which has been shown to be beneficial for learners. The use of schemas in training has been shown to improve learner performance in mathematics (Jitendra et al., 2002), reading comprehension (Singer & Donlan, 1982), and word problem solving (Fuchs et al., 2010). To facilitate this, achievement descriptions should be worded to accurately represent the framework of the game that is about to be played.

Although not as popular as expected achievements, there are benefits to having unexpected achievements in games. Unexpected achievements should be randomly inserted throughout games in order to give the players incentive to experiment and test boundaries outside of normal play. Fostering creative play in order to "unlock" rewards could increase play time. Although unexpected rewards do not affect intrinsic motivation (Tang & Hall, 1995), free-choice behavior (Cameron & Pierce, 1994; Eisenberger & Cameron, 1996), or attitudes (Cameron & Pierce, 1994; Eisenberger & Cameron, 1996), unexpected objectives do not effectively create a level of expectation for learning. Therefore, unexpected objectives should not be used for important learning or performance goals.

When achievement notification occurs

Players can be alerted about an earned achievement either during play as the event takes place, or after play in a review of their performance. In the MMO World of Warcraft, players receive a small unobtrusive pop-up and a lengthier description in their quest log when an achievement is earned. Other games, like StarCraft 2 (Blizzard Entertainment), let the players know about earned achievements after a game play session on a review screen.

Achievement alerts, like those in World of Warcraft that happen as soon as they are earned, are a form of immediate feedback. Some studies have shown immediate feedback produces superior learning outcomes (Kulik & Kulik, 1988; Bangert-Drowns et al., 1991) and increased

efficiency (Schooler & Anderson, 1990). However immediate feedback may not always be appropriate for more advanced learners as it may impede their ability to critically evaluate their own performance (Schmidt & Bjork, 1992). Immediate feedback should be given to novice learners and slowly decreased as they reach greater skill levels (Brown & Ford, 2002).

For achievement alerts that occur during play, whether they are disruptive or non-disruptive is an important design consideration. There are several benefits associated with a flow state including increased motivation (Paras & Bizzocchi, 2005), control (Garris, Ahlers, & Driskell, 2002), and enjoyment (Chen & Nilan, 1999). Achievement alerts that occur during play but are disruptive can break flow. Csikszentmihalyi notes that "flow denotes the holistic sensation present when we act with total involvement" (1975). An achievement earned during play would almost certainly break a player's flow when the notification is given. The notification would be unexpected and would make questions like "am I doing well?" or "what am I doing here?" or "should I be doing this?" (Csikszentmihalyi, 1975). However an achievement that is expected and ideally being strived for by the player would narrow focus and enhance flow up until the moment of earning it.

When designing achievements that promote flow, Csikszentimihalyi's flow activity characteristics in (Fu, Su, & Yu, 2008) are a good guide:

(1) Clearly defined goals with manageable rules

(2) Make it possible to adjust opportunities for action to their capabilities (autonomy)

(3) Provide clear information on how the participants are doing (feedback)

(4) Screen out distraction and make concentration possible

StarCraft 2 and other games that have clearly defined play sessions, broken into levels or matches, use an achievement notification system that alerts the player after game play. Systems like this offer delayed feedback to the player. Delayed feedback has been shown to

improve learning and retention (Epstein et al., 2002; Smith & Kimball 2010; Metcalfe et al., 2009). The definition of what constitutes a "delay" when giving feedback is ambiguous in the literature. Game play sessions for games like StarCraft 2 are relatively short, 5-50 minutes, so by some standards these could also be considered immediate feedback. From a game design perspective, notification systems like this are most viable for games that take place over chunked play sessions. Games with short play sessions, like StarCraft 2, are usually very frantic and require a great deal of the player's attention. Because of this, they may not even notice a pop-up during a play session or have the capacity to read it while they are trying to play. Due to the nature of the game play, a slightly delayed achievement notification system may be the only viable option.

Permanence

Permanence of achievements must be discussed in terms of tangible vs. intangible rewards and the player's ability to reflect on what he or she has accomplished. Tangibility in video games is an abstract concept because all earned items are digital. This leaves the definition of "tangible" open for interpretation. Rewards in games that can be seen and manipulated by the player and their peers are "digitally tangible" within the context of the game world. Therefore, while the player is in the video game world all the same rules should apply as in the physical world. Examples of digitally tangible achievements in games might include a tabard (a purely cosmetic change to a player's avatar), a title, or a unique pet. The effects of rewards on intrinsic motivation are well documented. Tangible rewards are generally considered to have a negative effect on intrinsic motivation (Greene & Lepper, 1974), can adversely affect a player's feeling of autonomy, (Deci & Ryan, 1985) and decrease the likelihood of a player returning to the task after obtaining the reward (Bandura, 1986; Dickinson, 1989). Digitally tangible game rewards are often times, in the case of multi-player or community driven games, status indicators within

the game environment. This variable may drive players to achieve the reward outside of intrinsic motivation. Players' ability to reflect on their accomplishments is another important aspect of permanence. Systems such as the World of Warcraft armory and Xbox Live make characters and rewards viewable online without requiring the player to be in the game. These types of "digitally tangible" rewards and lists of stored accomplishments allow players to recall prior learning and obtain a greater level understanding (Linn & Hsi, 2000).

Intangible achievements would amount to positive verbal reinforcements, which have been shown to increase intrinsic motivation (Deci & Cascio, 1972). These rewards are purely informational and fulfill a need for competence (Deci, Koestner, & Ryan, 1999) while not infringing on feelings of self-determination (Eisenberger, & Cameron, 1996). An example of intangible achievements in entertainment games would be the announcements in Unreal tournament declaring a player to be "Unstoppable" or "God-like". For serious games the use of verbal reinforcement could utilize simple phrases like "Great Job" or reinforcements relevant to the instructional material like "Mathlete!"

Achievements as currency

Earned achievements in some games can be used as currency. Players receive points, coins, stars, or some other manner of currency for each achievement they earn. The currency can then be spent on in-game special items or real world objects. Currency systems are usually run by third party websites that house leader boards and play logs. They also often have close ties to social media sites. These types of systems incentivize increased play time by offering an alternative to real money micro transactions and combining achievements across games.

Monetary rewards have been shown to have a significant positive effect on task performance (Stajkovic & Luthans, 2001; 2003) and have been found to result in higher performance gains

when compared to tangible incentives (Condly, Clark, & Stolovitch, 2003). Locke and Latham (1984) felt money could be a good incentive for goal completion. The effect of monetary incentive programs in educational settings are currently being evaluated in school systems. In one study class attendance, test scores, and college attendance with no evidence of negative behavoir changes were observed in Texas school districts (Jackson, 2009). Another study, (Fryer, 2010), showed that received data from schools in four major cities has shown increased achievement, but only when rewards are tied to inputs rather than outputs.

Deci and Cascio (1972) found that monetary rewards decrease intrinsic motivation, and others have shown it to lower creativity (Amabile et al., 1986). The exchange rate between achievements and the currency earned is another consideration because a high exchange rate could negatively affect performance. (Ariely et al., 2009)

Who can see earned achievements

A player's personal achievements can be in the public's view in multi-player and single-player games. In some multi-player games, avatars can be inspected to see digitally tangible achievement rewards or a list of accomplishments built into the interface. Even single player games can have earned achievements that are visible to the game's community pages or social networks. Public achievement systems come in two varieties: mandatory and player-defined. Mandatory public achievement systems do not give the player any options about what information is available to their peers. World of Warcraft, for example, has an in game menu that allows you to inspect another player's achievements to compare them to your own. Alternatively, player-defined public achievement systems like those used in Farmville and StartCraft 2 allow the owner of the achievements to reveal what they want the public to see.

Social approval is one of the external motivators that entice people into playing video games (King & Delfabbro, 2009). The need for social approval can be leveraged to encourage

certain positive behaviors. Official recognition, like titles in games, reinforces social status (Kollock & Smith, 1999) and causes players to notice the success of others. Striving for and eventually earning achievements and their associated ranks or titles can increase feelings of self-efficacy (King & Delfabbro, 2009). Seeing the achievements earned by other players can motivate individuals to seek out information about earning the achievement for themselves. Referred to as "vicarious positive reinforcement" (Bandura, Grusec, & Menlove, 1967), players will emulate the behavior of someone who they have seen be awarded for their actions. The players who are being observed receive social recognition for their feats. Social recognition has been shown to have a significant positive effect on task performance when used as an incentive motivator (Stajkovic & Luthans, 2001; 2003; Peterson & Luthans, 2006; Yap et al., 2009). Public achievement systems could also create social-competitive situations which have been shown to be an important factor in video game enjoyment (Vorderer et al., 2003). In addition to the potential for competition seeing the achievements of others in games can act as a digital resume. Previous achievements in similar games might indicate a fellow player will be a fast learner and a good potential teammate.

A potential downside of social recognition is that it does not influence future performance effectively because recipients of recognition associate it with some tangible reward they will get at a later date (Peterson & Luthans, 2006). The benefits of the gaming resume listed above could also have a negative affect on some players. Players lacking certain game credentials could be subjected to negative stereotypes, low expectations, prejudice, and discrimination (van Laar et al., 2010). This creates an environment where less experienced players are excluded from play, creating a Catch-22 situation where one must *have* experience to *gain* experience.

Serious games that wish to utilize social achievement systems will have to take additional considerations to ensure these negative situations do not arise. Grouping players according to

skill level and creating achievements that require mentoring can be effective strategies. Making the achievements in an educational setting socially popular is another challenge that designers of serious games will face. Achievements in entertainment games are socially persuasive because they are desirable. For social achievements to be successful in serious games, that same level of desirability must be fostered within the game's player base.

Incremental and meta-achievements

Incremental achievements are awarded in a series for completing the same task through scaling levels of difficulty. Examples of incremental achievements are catching 25, 50, 100, 250, 500, and 1000 fish in World of Warcraft, earning different colored ribbons in Farmville, and the star rating in Angry Birds. Meta achievements are earned for completing a series of achievements that are for different tasks, for instance earning the title of "Salty" by completing all fishing related achievements in World of Warcraft.

Incremental achievements can be used as a type of scaffolding in order to break up a player's progress into specific and moderately difficult goals that will lead to better performance (Locke & Latham, 2002). The increasing levels of difficulty in incremental achievements, when paired with other scaffolding techniques like task sequencing (Dennen, 2000) and chunking of information (Miller, 1956), can facilitate the expansion of the player's zone of proximal development as their skill level increases over many sessions of game play (Borthick, et al., 2003). These types of achievements are grouped together into a schema so it is apparent to the learner that they are related and if completed are a model for success. Incremental and meta achievements that can only be completed over extended periods of time are similar to long-term incentive programs which have been shown to return greater performance gains when compared to shorter-term programs (Condly, Clark, & Stolovitch, 2003). Incremental achievements, if designed properly, could work like scaffolded learning objectives that increase

performance and set the bar higher and higher. Cross-game meta achievements will signify a history of play and a breadth of experience that other players will recognize.

However, these types of achievements have a potential downside. A player's sense of autonomy could be decreased if they are lacking self direction and the achievements feel like a carrot on a stick (Deci & Ryan, 2000). If the achievements are too numerous and do not provide adequate challenge, the players' performance could be impeded (Garland, 1983).

Competitive achievements

Competitive achievements pit players against each other in either direct confrontations or indirectly through their scores on solo tasks. Competitive achievements can be completed individually or in groups where members work together to defeat other groups.

Competition has been implemented into classrooms with some success. Computer science and programming classes in particular (Ebner & Holzinger, 2007; Adams, 1998; Burguillo, 2010) have used competition to evaluate students and make the classroom experience more enjoyable. The results often cite improvements in student attitudes. In particular, winning during a competition has been shown to increase intrinsic motivation by influencing perceived competence (Reeve & Deci, 1996). Competitive environments have also been shown to increase performance on easy tasks (Lam et al., 2004).

Although several studies show a positive outcome associated with incorporating competition into learning environments, the overwhelming majority of the literature indicates a more negative position. Competitive environments have been shown to interfere with the learning process (Goodman & Crouch, 1978). This can be tied to the encouragement of egocentric behavior (Bryant, 1977) and a negative effect on student self-efficacy (Chan & Lam, 2008) by infringing on feelings of self determination (Reeve & Deci, 1996). Competition also causes participants to rate themselves and their teammates more harshly (Niehoff & Mesch, 1991) depending on the

success of the team's performance (Ames, 1981). Competition has even been shown to offset the performance gains caused by goal setting (Campbell & Furrer, 1995).

Hrycaiko (1978) indicated that the use of competition as a motivator is best used after players have attained a certain skill level. Players that are high in achievement motivation enjoy competitive tasks to a greater extent (Tauer & Harackiewicz, 1999) and have more intrinsic interest (Epstein & Harackiewicz, 1992) than their counterparts, who were low in achievement motivation. These points imply that if competitive achievements are used in a game, having them appear in later levels and making them self selected are best practices.

Non-competitive cooperative achievements

Cooperative achievements are earned based on the performances of two or more people working together in a game to reach a goal. These typically take place in multi-player games where players directly interact with a peer, a mentor, or a protégé. The achievements can be rewards for completing a specific task, like killing a monster as a team, or built into multi-player games to encourage teamwork, like earning 1000 assisted kills in a first person shooter.

A great deal of research supports the use of cooperation to improve performance. Cooperative settings have been associated with academic achievement (Slavin, 1980), increased self esteem (Ames & Felker, 1979), positivity when evaluating peers (Bryant, 1977; Slavin, 1978), and the facilitation of collaborative learning (Dillenbourg, 1999). Incentive programs requiring teamwork have been shown to have a greater effect on performance (48%) than individual incentive programs (19%) (Condly, Clark, & Stolovitch, 2003). Working cooperatively in groups also has the added advantage of giving team members access to tasks that are more complex than they could complete when working alone (Hansen, 1999). In cooperative environments where there will be participants who are more experienced than others, achievements encouraging more advanced players to assist a less experienced players

can be implemented. The proteges in mentoring programs "have greater satisfaction, career mobility/opportunity, recognition and a higher promotion rate than non-mentored individuals" (Fagenson, 1989). Mentoring programs are not only beneficial to the less experienced partner, but they also increase performance and social status for the mentor (Liu et al., 2009), making the partnerships mutually beneficial.

Although cooperation has many benefits, the group dynamic can have some potential downsides. A phenomenon called "group-induced attitude polarization" (Myers & Lamm, 1976) leads to more cautious or risky decision making as a group than individuals within the group make on their own (Isenberg, 1986). Process loss (Steiner, 1972), another problem affecting some groups, can take place when the additional workload from coordinating communication and assisting others hinders group performance. The communication difficulties that can cause process loss could be accentuated in games because of the limitations of technology. Social loafing could also be a problem in larger groups where an individual's performance is hidden and they will put forth less effort (Jackson & Harkins, 1985).

Although expected rewards do not significantly motivate someone to share knowledge, the relationships that are developed and the contribution to the group performance do (Bock & Kim, 2002). Cooperative achievements can leverage this by making accomplishments viewable to the public to fulfill the need for relationships and recognition. To foster a cooperative environment, offering achievements for more advanced players to assist less experienced players is an option. The groups for cooperative achievements should be kept relatively small to lessen the Ringelmann Effect, also known as social loafing. The metrics used for earning achievements should assess individual performances within the group setting. For example, achievements like "Everyone in the group must earn an 80% on the task" could be used.

CHAPTER 3: REASERCH MODEL AND HYPOTHESIS

Based on the literature review, the following taxonomy of achievement design features has been developed for testing purposes:

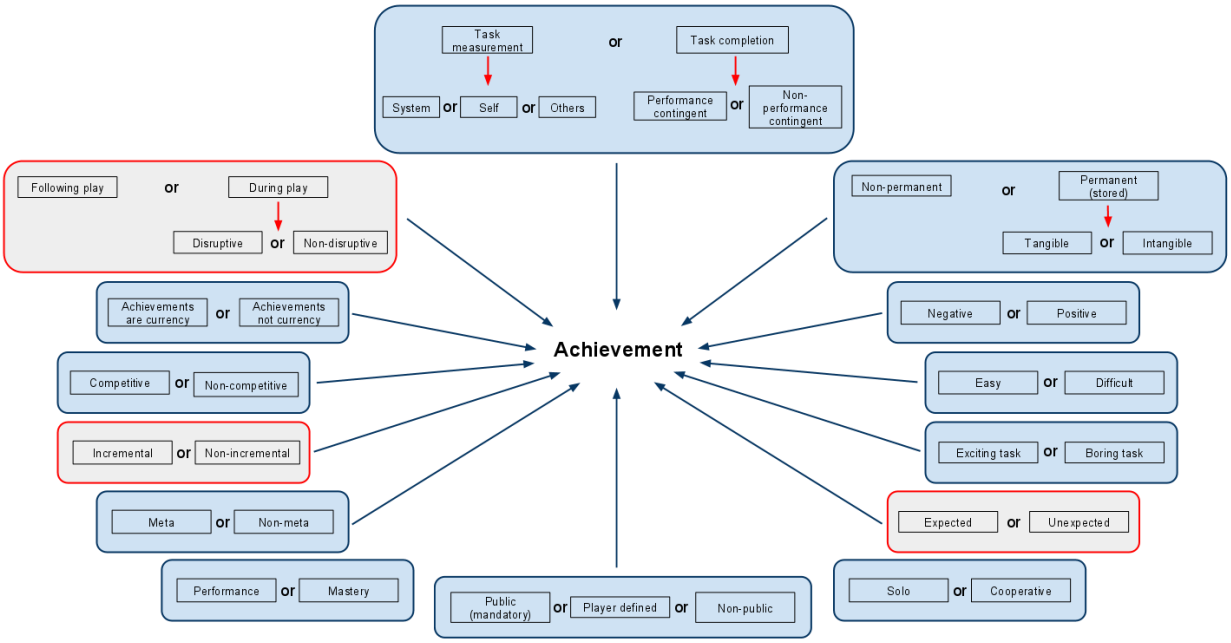


Figure 1: Achievement design features

From the taxonomy of design features, the following features have been identified as mechanisms of action that lead to an increase in performance and learning.

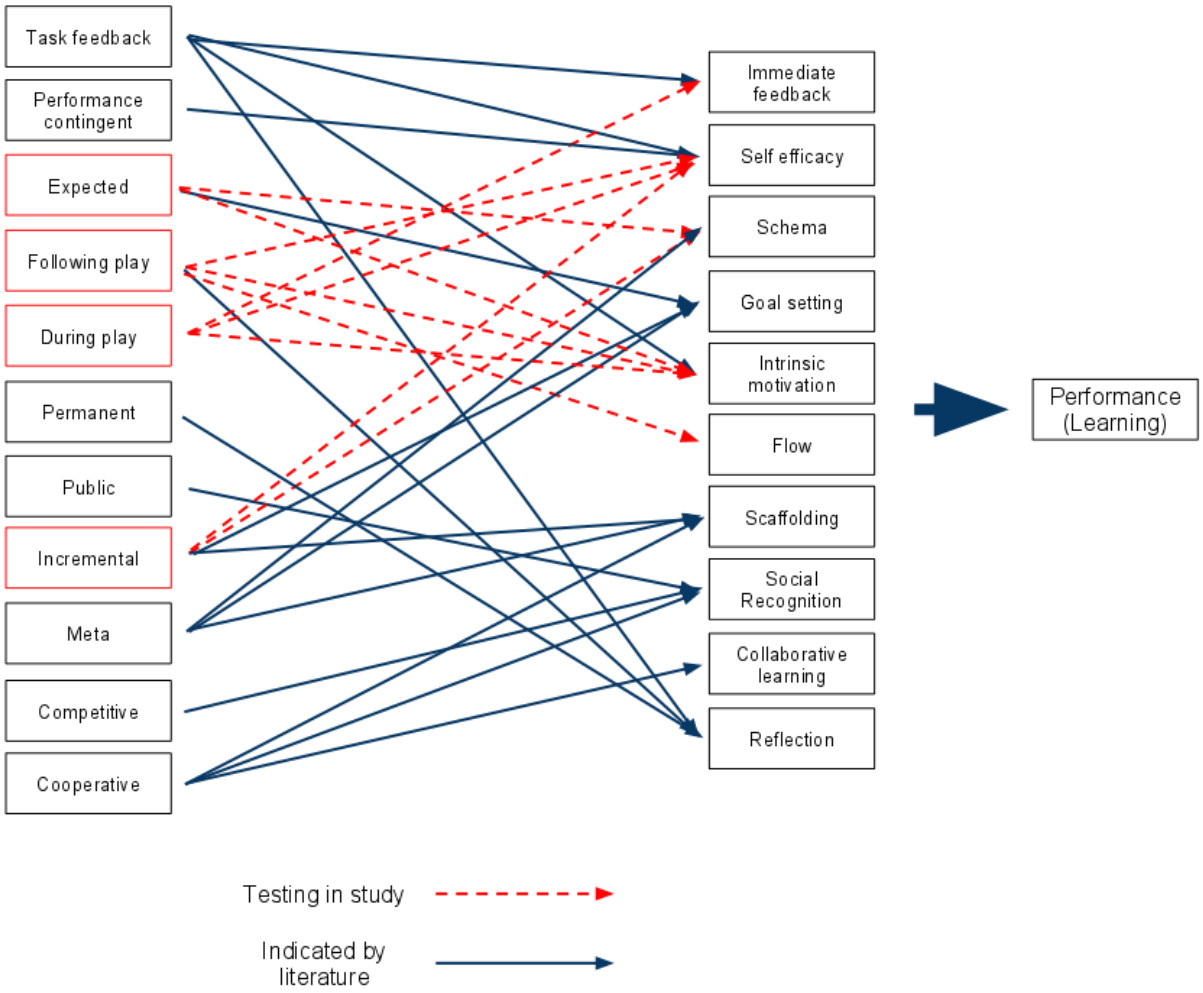


Figure 2: Mechanisms of action

Hypotheses

H1: Players who have expected achievements will perform better than those who have unexpected achievements

H1a: Players who have expected achievements will have better retention than those who have unexpected achievements

H2: Players who have incremental achievements will perform better than those who have non-incremental achievements

H2a: Players who have incremental achievements will have better retention than those who have non-incremental achievements

H3: Players who have incremental achievements will spend more time playing than those who have non-incremental achievements

H4: Players who receive notifications after play will perform better than those who receive notifications during play.

H4a: Players who receive notifications after play will have better retention than those who receive notifications during play.

H5: Players who receive notifications after play will report more enjoyment than those who receive notifications during play.

H6: The relationship between achievements and performance will be mediated by intrinsic motivation.

H7: The relationship between achievements and performance will be mediated by self-efficacy.

H8: The relationship between achievements and performance will be mediated by the creation of schemas.

H9: Players who have the “combined achievement” will perform better than the control.

H9a: Players who have the “combined achievement” will have better retention than the control.

CHAPTER 4: METHODOLOGY

Measurements

Video Game Self-Efficacy:

The Video Game Self-Efficacy Scale (VGSES) questionnaire consist of 10 items for use with assessing perceived self-efficacy when playing video games (Pavlas, 2009). The VGSES is an adaptation of the Generalized Self-Efficacy Scale (GSE) (Schwarzer & Jerusalem, 1995) used to assess perceived self-efficacy. The GSE scale has been utilized by numerous studies since 1995 and and is optimal for adults and adolescents over 12. The questionnaire was used to measure H:7.

Relevance & Usefulness:

The Relevance and Usefulness questionnaire consist of 16 items for use with assessing "motivation variables of self-efficacy, enjoyment, and learning goal orientation in order to predict the use of Web-based information systems" (Yi & Hwang, 2003). Adapted for use with video games by Evans (2009). The questionnaire contains 16 items utilizing a Likert scale measuring Usefulness, Behavioral Intention, Ease of Use, Application-Specific Self Efficacy, and Enjoyment. The questionnaire was used to measure H:5 and H:7.

Game Engagement Questionnaire:

The Game Engagement Questionnaire (GEQ) measures engagement during video game play (Brockmyer et al., 2009). The questionnaire consists of 19 items scored on a Likert scale measuring specifically absorbion, flow, presence, and immersion. "Cronbach's alpha for the current 19-item version of the GEQ was .85. The Rasch estimate of person reliability (the Rasch

analog to Cronbach's alpha) for the 19-item version was .83 and the item reliability was .96 (Brockmyer et al., 2009). The questionnaire was used to measure H:3, H:5 and H:6.

Intrinsic Motivation Inventory (IMI):

The Intrinsic Motivation Inventory (IMI) utilizes several sub-scales that relate to user experience during a targeted activity. For this study the Interest/Enjoyment sub-scale that contains 7 questions and the Effort/Importance sub-scale that contains 5 questions will be used.

The interest/enjoyment sub-scale is associated with self-reported intrinsic motivation. It has been utilized in the following studies: (Ryan, 1982; Ryan, Mims & Koestner, 1983; Plant & Ryan, 1985; Ryan, Connell, & Plant, 1990; Ryan, Koestner & Deci, 1991; Deci, Eghrari, Patrick, & Leone, 1994). The questionnaire was used to measure H:5 and H:6.

TPL KATS structural knowledge assessment tool:

The TPL-KATS tool (Hoeft et al., 2003) allows users to create concept maps or mental representations of schema. This tool will be used to compare the differences in player ability to create schema when given achievements are present and not present in games. The tool was used to measure H:8.

Phone Dash game

Achievement variation - Expected vs Unexpected:

Unexpected achievements were available in a version of the game but the players did not know that they existed or how they were earned. Expected achievements were available in another version of the game. In this version players were informed up front what the achievements were and how to earn them.

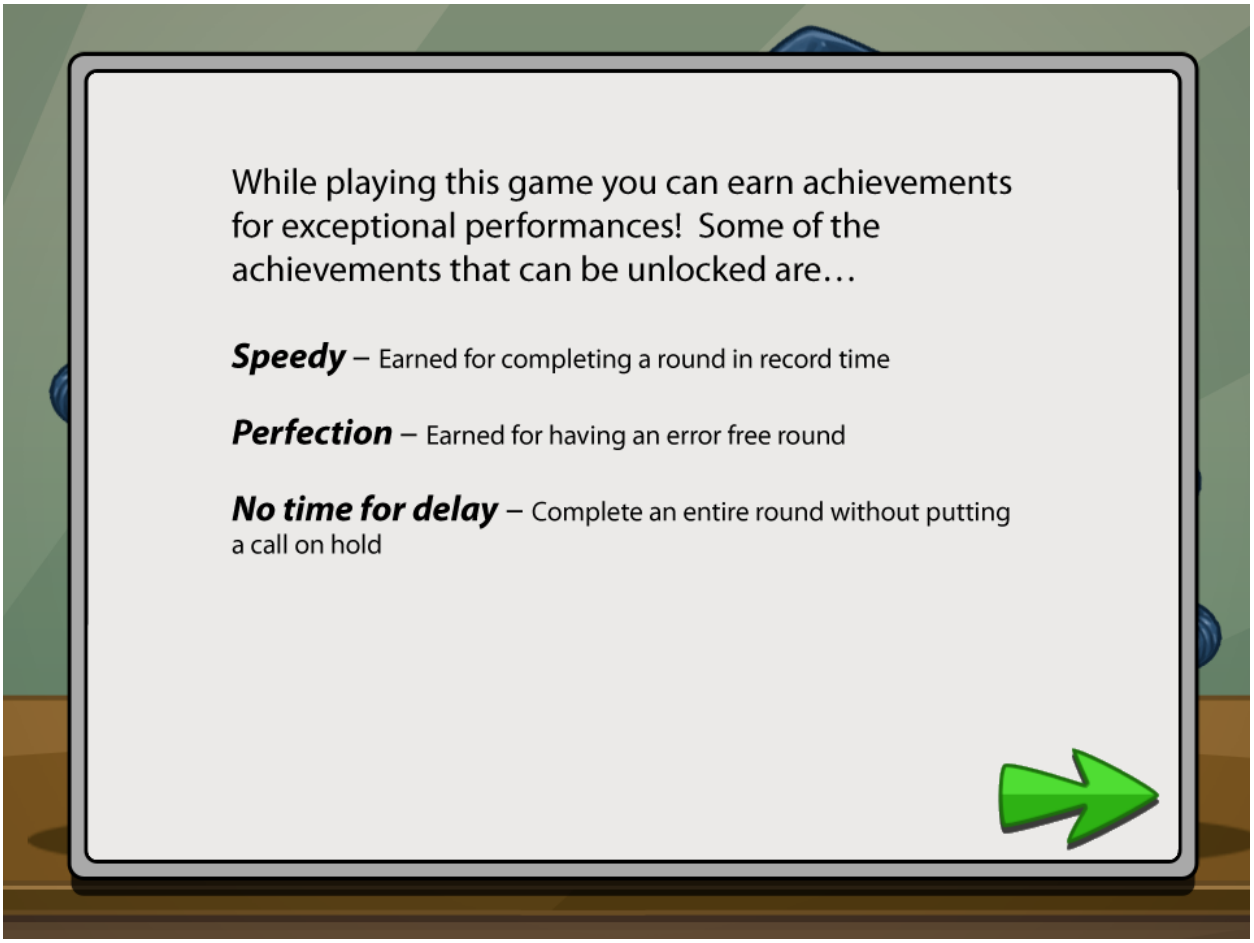


Figure 3: Expected Achievements

Achievement variation - Incremental vs. Non-incremental:

Incremental achievements consisted of a three star rating. Each star represented a different level of performance. Non-incremental achievements were given for a single accomplishment at the two star level of difficulty.

Figure 4: Incremental achievements

Achievement variation - During vs. After notifications:

During play notifications took the form of an unobtrusive pop-up. After play notifications were given out in a review screen after the game has been completed.

Figure 5: During play

Figure 6: After play

Achievement variation – Combined achievement

The combined achievement contained several design features that were hand-picked from the other variations. This achievement was created to assertain the aggreate effect of multiple design features. The Combined Achievement was expected and incremental with notifications that occurred after the play session had ended.

Study design 1

Objective

This study looked for differences in participants' schema creation, intrinsic motivation, and performance when achievements were expect and unexpected.

Procedure

- 30 participants were randomly assigned to the condition.
- Participants were briefed about the study and provided with the waiver of documented informed consent.
- Participants were asked to complete a demographics form.
- Participants in the expected achievements group were given a screen that summarizes possible achievements they could earn before game play begins. Participants in the unexpected achievement group were not informed of the available achievements before play began.
- Participants were asked to complete the Intrinsic Motivation Inventory (IMI) questionnaire and the TPL KATS tool.
- Participants were given a pretest for the game content
- The participant played the game Phone Dash (with achievements) for as long as they liked, before a posttest was given. The amount of time they played was measured.
- The control group played a version of the game with no achievements
- Participants were given a posttest for the game content that is equivalent to but containing different content than the pretest.
- Participants were asked to complete the Relevance & Usefulness, Game Engagement, and Intrinsic Motivation Inventory (IMI) questionnaires.

Table 1: Study 1 design

Ø	10
Expected	10
Unexpected	10

*Data includes demographics, questionnaire responses, and game performance.

- Players were given a follow-up quiz one week after the play session in order to assess retention.

Study 2 design

Objective

This study looked for differences in participant's intrinsic motivation, perceptions, and performance when achievements were incremental and non-incremental.

Procedure

- 30 participants were randomly assigned to the condition.
- Participants were briefed about the study and provided with the waiver of documented informed consent.
- Participants were asked to complete a demographics form.
- Participants were asked to complete the Video Game Self-Efficacy questionnaire and the TPL KATS tool.
- Participants were given a pretest for the game content
- Participants were given a screen that summarizes the possible achievements they could earn before game play begins. Participants in the incremental achievements group played a version of the game Phone Dash that had three levels of each achievement that were awarded based on performance. Participants in the non-incremental

achievement group played a version of the game Phone Dash that had only one level for each achievement. Participants could play the game for as long as they would like, before a posttest was given. The amount of time they played was measured.

- Participants were given a posttest for the game content that was equivalent to but contained different content than the pretest.
- Participants were asked to complete the Video Game Self-Efficacy, Relevance & Usefulness, and Game Engagement questionnaires

Table 2: Study 2 design

Non-incremental	15
Incremental	15

*Data includes demographics, questionnaire responses, and game performance.

- Players were given a follow-up quiz one week after the play session in order to assess retention.

Study 3 design

Objective

This study looked for differences in participant's intrinsic motivation, perceptions, and performance depending on when notification for earning an achievement occured.

Procedure

- 30 participants were randomly assigned to the condition.
- Participants were briefed about the study and provided with the waiver of documented informed consent.
- Participants were asked to complete a demographics form.
- Participants were asked to complete a Video Game Self-Efficacy questionnaire.

- Participants were given a pretest for the game content
- Participants were given a screen that summarizes possible achievements they could earn before game play began. Participants in the “during” group played a version of the game Phone Dash that notified them immediately when they earned an achievement. Participants in the “after” group played a version of the game Phone Dash that notified them after game play had finished which achievements they earned.
- Participants were given a posttest for the game content that wass equivalent to but containing different content than the pretest.
- Participants were asked to complete the Video Game Self-Efficacy, Relevance & Usefulness, Game Engagement, and Intrinsic Motivation Inventory (IMI) questionnaires

Table 3: Study 3 design

During	15
After	15

*Data includes demographics, questionnaire responses, and game performance.

- Players were given a follow-up quiz one week after the play session in order to assess retention.

CHAPTER 5: RESULTS

Demographics

The demographics breakdown of the participants for each study is as follows:

Table 4: Demographics

Condition	
Control	32
Expected	30
Unexpected	30
Incremental	10
Non-incremental	10
During	11
After	11
Combined	16
Gender	
Male	64
Female	86
Race	
Caucasian	75
African-American	22
Asian-American	11
Hispanic	28
Other	1

Performance

Hypothesis 1 predicted that players who had expected achievements would perform better than players who had unexpected achievements. Performance was assessed by number of replays, achievements earned, calls answered, and pretest/posttest scores. A MANOVA indicated the following:

- Test scores improved across test administrations, regardless of condition F (2,76) = 21.46, p < .05). However, there was no interaction between test administration and condition (F (2, 76) = .51, p = n.s.

Table 5: H1 test scores

Condition	time	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Expected (2)	1	7.767	.238	7.291	8.242
	2	9.333	.215	8.903	9.764
Unexpected (2)	1	8.200	.238	7.725	8.675
	2	9.067	.215	8.636	9.497

- No significant difference in the number of achievements earned as a function of condition (F 2,92) = 1.47, p = n.s.
- Players with expected achievements answered significantly more calls than the control.

  F(1,88) = 8684.407, p < .001, eta2 = .990

  F(2,88) = 3.164, p < .047, eta2 = .067

Players with unexpected achievements did not perform better than the control.

Table 6: H1 performance

Condition	level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Control	1	7.871	.227	7.420	8.322
	2	9.129	.240	8.651	9.607
	3	9.774	.235	9.307	10.241
Expected (2)	1	8.933	.231	8.475	9.391
	2	9.533	.244	9.048	10.019
	3	10.133	.239	9.658	10.608
Unexpected (2)	1	7.967	.231	7.509	8.425
	2	9.667	.244	9.181	10.152
	3	10.067	.239	9.592	10.542

Hypothesis 2 predicted that players who had incremental achievements would perform better than players who had non-incremental achievements. A MANOVA indicated the following:

- No significant difference in the number of achievements earned.
- Test scores improved from pre-test to post-test ($F(1,18) = 26.00$, $p < .01$; M = 8.1 and 9.6, respectively). However, there was no interaction between condition and trial ($F(1, 18) = .62$, p = n.s.
- Players answered more calls from level 1 to level 2 ($F(1,18) = 13.1$, $p < .05$; M – 7.1 and 9.2 respectively), but there was no interaction with condition ($F(1,18) = .16$, p = n.s.).

Hypothesis 4 predicted that players who had notifications after game play would perform better than players who had during game play. A MANOVA indicated the following:

- No significant difference in the number of achievements earned.

- Participants, regardless of condition, improved in the test scores from pre-test to post-test ($F(1,19) = 41.997$, $p < .001$, eta2 = .689). However, there was no difference as a function of condition ($F(1,19) = .208$, $p < .653$, eta2 = .011)
- Regardless of condition, players answered more calls from pre-test to post-test ($F(2,40) = 11.437$, $p < .001$, eta2 = .364). Players who received notifications during play showed a greater increase in calls than did the "after" group. $F(2,40) = 3.698$, $p < .034$, eta2 = .156

Retention

Hypotheses H1a, H2a, and H4a predicted the retention differences between conditions. These hypotheses were evaluated using repeated measures ANOVA's with the following results:

- When investigating expected vs. unexpected achievements, there was a main effect of time ($F (1,38) = 5.67$, $P < .05$, $p < .05$. The post-test mean was 9.3 while the retention test mean was 8.5. There was, however, no difference between the groups when considering condition ($F (1,38) = 1.42$, $p < .05$).
- While all groups decreased in learning from post-test to retention test ($F (1,9) = 16.12$, $p < .05$; M = 9.5 and 8.3, respectively), there was no difference as a function of incremental feedback($F (1,9) = .13$, p = n.s.
- While all groups showed a decrease from post-test to the retention ($F (1,11) = 4.36$, $p < .05$; M = 9.6 and 8.7, respectively), there was no difference as a function of the timing of feedback ($F (1,11) = .89$, p = n.s.

Enjoyment and time spent

Hypothesis 3 predicted that incremental achievements would cause players to spend more time playing the game. This was evaluated with an ANOVA revealing that players who had incremental achievements did not spend significantly more time playing than those who had non-incremental achievements.

Table 7: H3 time spent

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.200	1	.200	.086	.773
Within Groups	42.000	18	2.333		
Total	42.200	19			

Hypothesis 5, which predicted players who received notification after play would have more enjoyment, was also evaluated with an ANOVA. This test revealed no significant difference was found in reported enjoyment between players who received notification during and those who received notification after.

Table 8: H5 enjoyment

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.050	1	.050	.084	.775
Within Groups	10.700	18	.594		
Total	10.750	19			

Mediation

Hypotheses 6, 7, and 8 all predicted that the relationship between achievements and performance (pre, post, retention) would be mediated by an outside factor. All three hypotheses were evaluated using a series of mediated multiples regressions which revealed the following:

- Hypothesis 6 - The relationship between achievements and performance (pre, post, and retention) was not significantly mediated by intrinsic motivation.

- Hypothesis 7 - The relationship between achievements and performance (pre, post, and retention) was not significantly mediated by self-efficacy.
- Hypothesis 8 - When testing for incremental vs. non-achievements, schemas were a significant moderator between achievements and performance (pre, post, and retention). $F(1,7) = 5.813$, $p < .047$, eta2 = .454

  However, after the mediator was taken into account there was still no significant relationship between achievements and learning.

Combined achievement

The combined achievement trial players had significantly higher improvements in the pre to post test scores than the control group ($F(1,45) = 9.73$, $p < .003$, eta2 = .178).

Table 9: Combined Achievement test scores

	Condition	Mean	Std. Deviation	N
Number Correct on Pre-Test	Control	8.5806	.71992	31
	Combined	7.7500	1.48324	16
	Total	8.2979	1.10168	47
Number Correct on Post-Test	Control	9.3548	.79785	31
	Combined	9.6250	.80623	16
	Total	9.4468	.80240	47

The combined achievement trial players had significantly higher improvements in knowledge organization than the control group ($F(1,38) = 4.35$, $p < .044$, eta2 = .103).

Table 10: Combined Achievement knowledge organization

				95% Confidence Interval	
Condition	time	Mean	Std. Error	Lower Bound	Upper Bound
Control	1	.809	.017	.775	.843
	2	.879	.011	.856	.901
Combined	1	.786	.022	.742	.830
	2	.919	.014	.889	.948

There was a significant difference between the combined achievement trial players (M=4.36, SD=0.9) and the control group (M=3.73, SD=1.04) in perceived relevance; t(46)=-2.04, p=.047

There was a significant difference between the combined achievement trial players (M=3.63, SD=0.83) and the control group (M=2.92, SD=1.06) in behavior intention; t(46)=-2.33, p=.024

The combined achievement trial players had significantly higher improvements in intrinsic motivation than the control group (F(1,46) = 4.21, p < .046, eta2 = .084).

Table 11: Combined Achievement intrinsic motivation

				95% Confidence Interval	
Condition	time	Mean	Std. Error	Lower Bound	Upper Bound
Control	1	4.696	.164	4.366	5.027
	2	5.656	.164	5.327	5.985
Combined	1	4.938	.232	4.470	5.405
	2	5.295	.231	4.829	5.760

CHAPTER 6: DISCUSSION

The intent of this study was to measure the effect that different types of video game achievements have on player's performance and attitudes. Improvements in performance and retention were the predicted outcomes (H1, H1a, H2, H2a, H4, H4a) of using expected and incremental achievements, as well as, notifications after play. Improvements in performance were also predicted for the "combined achievement" (H9). Enjoyment, another important consideration for video games, was expected to be affected by certain design decisions (H3, H5). Incremental achievements causing extended playtimes and notifications after play encouraging flow states were both expected to improve enjoyment. The relationship between achievements and performance was expected to be mediated by intrinsic motivation, self-efficacy, and schemas (H6, H7, H8).

For Hypotheses 1, 2, and 4 the performance of all groups improved from pre-test to post-test. However, this improvement did not differ as a function of acheivement condition. However, it was noted that the overall number of calls answered was significantly higher in the expected achievement condition, which may provide partial support for Hypothesis 1. This finding indicates that players increased their effort because they saw what achievements they could potentially earn. In contrast, players who had unexpected achievements did not put forth as much effort, resulting in fewer answered calls. However by levels 2 and 3, the expected and unexpected conditions became roughly the same in number of calls answered. A potential cause of this could be that after level 1, players in the unexpected group earned an achievement. Once players were aware that achievements could be earned by performing well and their level of effort would have increased.

Players receiving notification of an earned achievement during play had an increased number of calls answered when compared to those who received notification afterwards. Hypothesis 4

predicted that the opposite result would be observed due to the notifications during play being disruptive and breaking the player's flow state. The "during" play notification in this case, however, were implemented in such a way to not be disruptive. Without being disruptive they do not affect the player's flow and instead act as immediate feedback, which in turn increased their effort, leading to an increase in the number of calls answered. Immediate feedback, in this case, could have also increased efficiency (Schooler & Anderson, 1990). The enjoyment predicted by Hypothesis 5 showed a similar, contrary result, due to the non-disruptiveness of the "during notifications". The predicted difference in enjoyment would have been caused by the same anticipated break in flow. Because there was no break in flow players reported almost identical enjoyment between the two, with a slight advantage going to during notifications.

Hypothesis 3 predicted that players would spend more time playing if they had incremental achievements. Which are designed to increase overall playtime by providing scaffolded goals. There was however no observed difference in playtime between incremental and non-incremental achievements. One explanation for this could be the time span that was used to evaluate playtime. The evaluation was performed on what would be considered one play session. An additional measure that may have yielded better results could have been the option for players to return to the game at a later date. Incremental achievements may not have increased the length of time for a single play session but they may increase the likelihood of returning for additional play sessions.

The results of the combined achievement were by far the most successful. In the combined trials the achievements were incremental, expected, and notifications occurred after play. The design features used in the combined achievement seemed to have a more powerful effect in unison than when they were measured independently. The expected incremental stars may have made it apparent to the players that in order to achieve mastery at the game they would

have to play the game frequently and seriously. This would account for the significant finding in the behavior intention measure. The expectation and anticipation caused by the expected incremental achievements may have been intimidating to players, which would explain the lower intrinsic motivation.

The increase in knowledge organization is difficult to explain because the content of the expected achievements was unrelated to the information in the card sort. This can only be explained by an increase in effort indicated by the behavior intention measures.

CHAPTER 7: CONCLUSIONS

The intent of this study was to illustrate the potential use of video game achievements to enhance player performance and attitudes. Although there were unexpected circumstances that may have limited the results. The significant findings for several design features should indicate not only the strength of the case for using achievments but the necessity for future study. With the popularity of serious games on the rise and the recent trend in gamification sweeping multiple industries the need for a standardized system of achievment design should be apparent. Hopefully this study will lay the groundwork for what can hopefully be a much larger body of research in a quickly growing field.

Limitations

The content of the game was originally intended to be about UCF campus services. Content of this type would have been relevant to students and hopefully increase their sense of relevance. The content was created as planned and then tested in a quick trial. Mean scores from the trial run were too high and it was determined this would make the knowledge performance measures unusable. The UCF content was replaced with content about mental health issues relevant to military veterans. This content tested better than the UCF content but was probably still not difficult enough to prevent a ceiling effect. Other studies intended to repleicate or improve upon the findings of this study should consider using content relevant to the population but difficult enough to prevent a ceiling effect.

One of the benefits of using a game like Phone Dash is the simplicity of play. Users could pick up the game relatively quickly and become proficient. This simplicity of the game however limited how achievments could be implemented into it. The simplicity of the game, in addition to the content type, may have limited players motivation. A more robust game that required more investment from players may have yielded more positive results.

This study was done with relatively short playtimes and provided no oportunity for players to return on their own. The amount of information that can be absorbed by players in that short amount of time was most likely not effective enough to foster retention. Returning to the game for a second play session could have also increased the retention test results. Giving players the ability to go back later and play the game on their own would also have been a better indicator of their dedication than a survey.

Although the study yielded several significant results the performance measures related to knowledge acquisition and retention may have been stifled by a ceiling effect. This was the result of higher than expected means on the pretest scores. The higher pretest scores did not leave room for overall improvement in the post and retention tests. This caused the knowledge performance measures, which were used to make predictions in H1, H2, H4, H6, H7, and H8, have a limited or negligible effect. This also could have affected the retention hypothesis H1a, H2a, and H4a.

Future study

There are a multitude of future studies that can come out of this research. Many different combinations of design features from the taxonomy should be implemented and tested to see which are the most effective. The combined achievment portion of this study is an indicator of how complex and unpredictable the interaction between features are. Public achievments, which could not be feasibly implemented into this study, should be of particular interest to designers given the recent wave of popular social media sites and social games.

The environments in which the achievments are studied also has great potential for future work. Non-game environments like social media sites or gamification efforts, that are now growing in popularity, show great potential for future study.

APPENDIX A: VIDEO GAME SELF-EFFICACY

Please answer the following questions about how you play video games using the provided response scale, from 1 (strongly disagree) to 6 (strongly agree).

#	Item	Strongly Disagree					Strongly Agree
1	I can always manage to solve difficult problems within a video game if I try hard enough.	1	2	3	4	5	6
2	In a video game, if someone opposes me, I can find the means and ways to get what I want.	1	2	3	4	5	6
3	It is easy for me to stick to my plans and accomplish my goals in a video game.	1	2	3	4	5	6
4	I am confident that I could deal efficiently with unexpected events in a video game.	1	2	3	4	5	6
5	Thanks to my resourcefulness, I know how to handle unforeseen situations in a video game.	1	2	3	4	5	6
6	I can solve most problems in a video game if I invest the necessary effort.	1	2	3	4	5	6
7	I can remain calm when facing difficulties in a video game because I can rely on my coping abilities.	1	2	3	4	5	6
8	When I am confronted with a problem in a video game, I can usually find several solutions.	1	2	3	4	5	6

9	If I am in trouble in a video game, I can usually think of a solution.	1	2	3	4	5	6
10	I can usually handle whatever comes my way in a video game.	1	2	3	4	5	6

APPENDIX B: RELEVANCE AND USEFULNESS

Please rate the extent to which you agree with each of these items by circling a value from **1** (**strongly disagree**) to **5** (**strongly agree**), where **3** indicates you **neither agree nor disagree**.

		strongly disagree				**strongly agree**
1	Playing the game would improve my overall performance while [learning goal specific].	**1**	**2**	**3**	**4**	**5**
2	Playing the game would increase my productivity while [learning goal specific].	**1**	**2**	**3**	**4**	**5**
3	Playing the game would enhance my effectiveness while [learning goal specific].	**1**	**2**	**3**	**4**	**5**
4	I find playing the game to be useful for learning how to [learning goal specific].	**1**	**2**	**3**	**4**	**5**
5	To better learn how to [learning goal specific], I would intend on playing the game frequently.	**1**	**2**	**3**	**4**	**5**
6	To better learn how to [learning goal specific], I would intend on playing the game competitively.	**1**	**2**	**3**	**4**	**5**
7	Learning to play the game is easy for me.	**1**	**2**	**3**	**4**	**5**
8	I find it easy to do what I want it to do in the game.	**1**	**2**	**3**	**4**	**5**
9	My interaction with the game is clear and understandable.	**1**	**2**	**3**	**4**	**5**
10	I find the game is easy to use.	**1**	**2**	**3**	**4**	**5**
11	I believe I have the ability to access the game myself.	**1**	**2**	**3**	**4**	**5**
12	I believe I have the ability to operate the functions of the game myself.	**1**	**2**	**3**	**4**	**5**
13	I believe I have the ability to understand the scoring output of the game program myself.	**1**	**2**	**3**	**4**	**5**
14	I believe I have the ability to complete the game myself.	**1**	**2**	**3**	**4**	**5**
15	I enjoyed playing the game.	**1**	**2**	**3**	**4**	**5**
16	I thought the game was a lot of fun to play.	**1**	**2**	**3**	**4**	**5**

Usefulness – Yellow
Behavioral Intention - blue
Ease of Use - Purple
Application-Specific Self Efficacy – Green
Enjoyment - Red

APPENDIX C: GAME ENGAGEMENT QUESTIONNAIRE

1 I lose track of time
2 Things seem to happen automatically
3 I feel different
4 I feel scared
5 The game feels real
6 If someone talks to me, I don’t hear them
7 I get wound up
8 Time seems to kind of stand still or stop
9 I feel spaced out
10 I don’t answer when someone talks to me
11 I can’t tell that I’m getting tired
12 Playing seems automatic
13 My thoughts go fast
14 I lose track of where I am
15 I play without thinking about how to play
16 Playing makes me feel calm
17 I play longer than I meant to
18 I really get into the game
19 I feel like I just can’t stop playing

APPENDIX D: INTRINSIC MOTIVATION INVENTORY(IMI)

For each of the following statements, please indicate how true it is for you, using the following scale:

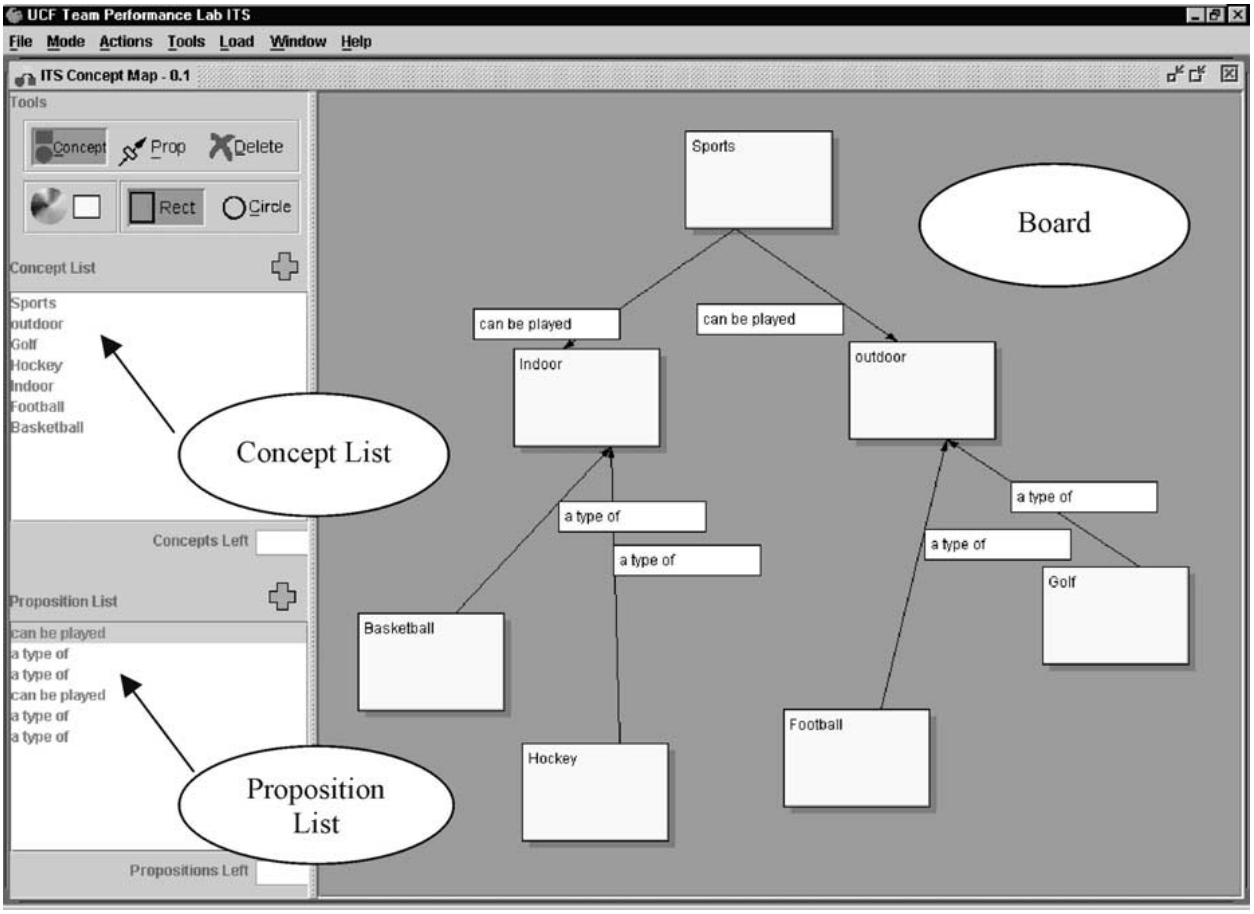
1	2	3	4	5	6	7
not at all true			somewhat true			very true

Interest/Enjoyment

I enjoyed doing this activity very much
This activity was fun to do.
I thought this was a boring activity. (R)
This activity did not hold my attention at all. (R)
I would describe this activity as very interesting.
I thought this activity was quite enjoyable.
While I was doing this activity, I was thinking about how much I enjoyed it.

Perceived Competence
I think I am pretty good at this activity.
I think I did pretty well at this activity, compared to other students.
After working at this activity for awhile, I felt pretty competent.
I am satisfied with my performance at this task.
I was pretty skilled at this activity.
This was an activity that I couldn't do very well. (R)

APPENDIX E: TPL KATS KNOWLEDGE ASSESSMENT TOOL


UCF Team Performance Lab ITS
File Mode Actions Tools Load Window Help
ITS Concept Map - 0.1
Tools
Concept
Prop
Delete
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Circle
Concept List
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outdoor
Golf
Hockey
Indoor
Football
Basketball
Concept List
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Propositions Left
Board
Sports
can be played
can be played
Indoor
outdoor
a type of
a type of
a type of
a type of
Golf
Basketball
Hockey
Football

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3246 Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Lucas J. Blair**

Date: **February 14, 2011**

Dear Researcher:

On 2/14/2011, the IRB approved the following human participant research until 2/13/2012 inclusive:

Type of Review: UCF Initial Review Submission Form Project Title: The Use of Video Game Achievements to Enhance Player Performance, Self-Efficacy, and Motivation Investigator: Lucas J Blair IRB Number: SBE-11-07464 Funding Agency: BBN (BBN) Grant Title: Tools for Game-Based Training and Assessment of Human Performance Research ID: 64018118

The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 2/13/2012, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Joseph Bielitzki, DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 02/14/2011 10:37:14 AM EST

Joanne Muratori

IRB Coordinator

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