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Encouraging Learning with the Aid of Virtual Money

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Interactive Qualifying Project
Final Report

Encouraging Learning with the Aid of Virtual Money

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1 Abstract

Motivation has been a key factor to meeting any goal. Motivation involves providing a reason for someone to act a certain way. It involves an incentive to meet a certain end, either driven by intrinsic or extrinsic motivation. Students today have been afflicted with a loss of motivation. The loss of motivation is mainly caused by a lack of faith in one's ability, laziness, fear of failure, stress, and other impediments. We have found that educational software is a growing medium for teaching students. Our group carried out an experiment to observe the effects our designed monetary system in an academic environment. We have determined that maintaining motivation can be accomplished by providing incentives to students.

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5 Introduction

Motivation is a key factor to meeting any goal. Motivation involves providing a reason for someone to act a certain way and includes both internal and external incentives to meet a specific outcome. Today's students have been afflicted with a loss of motivation caused by: doubt in their ability, laziness, fear of failure, stress, or other impediments.[1] Motivation allows students to be focused and points them in a positive direction when working on improving their performance. Creating a foundation for motivation involves providing incentives to students to restore their motivation, paving the way to improved learning.

For decades, numerous actions were taken in order to encourage student learning. The educational system has attempted to stimulate motivation through various methods such as: giving verbal praise, modifying work environments, providing care, wages, and rewards. We seek to determine the best method to motivate a student to perform at optimal levels. Educators have become increasingly aware of entertainment software as a teaching tool in the classroom. Educational games have the potential to keep students engaged because video games mix instruction and demonstration. This combination was found to be more effective than the scheme used in classrooms today.[2] Researchers at the University of Michigan have found that puzzle games which exercise memory have a direct correlation to the improvement of abstract reasoning and problem solving.[3] There is, however, a problem with most educational gaming software. A major issue inherent to educational programs is that it lacks the ability to keep students focused on the material. Furthermore, these programs fail to consistently motivate students to perform at optimal levels. In order to determine a solution to this major problem, professional experiments and countless case studies sought to provide further insight in the matter.

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[1] http://www.successconsciousness.com/lack-motivation-enthusiasm.htm
[2] http://www.theesa.com/games-improving-what-matters/education.asp
[3] http://www.theesa.com/games-improving-what-matters/education.asp

The motivational aspects of education are commonly divided into two psychological concepts, intrinsic and extrinsic motivation. With much research, our team has arrived at the concept involving both intrinsic and extrinsic motivation when incorporating a monetary system in the educational environment. Implementing a simple financial system into the educational environment encourages students to not only perform at optimal levels, but preform with added interest in education material. Through the variety of completed case studies, motivation through extrinsic factors can be seen to have strong immediate effects.

Throughout this paper, elements of motivation are analyzed though many studies done by professionals with extensive knowledge in education and psychology. It is widely observable in case studies that intrinsic motivation does not always provide adequate motivation to students to perform optimally. We will seek to determine, through analysis of professional work and case studies, the extent of which extrinsic motivation through virtual money adds to the overall motivation in the educational environment.

6 Background

6.1 Educational Videogames

Liz Simpson, founder of the Learning Research Institute, states, "Many students are now underserved by the public school system, and video games offer educators a potential way to reach them."[4] According to Simpson, students have more specific needs that the education system at the moment cannot fill. However, these needs potentially can be satisfied by educational game software. There are certain aspects of videogames which are more advantageous over the standard teaching methods in the standard school system. Games apply the use of many teaching skills such as: tutorials, reward systems that correspond to user

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[4] http://www.technewsworld.com/story/56516.html

behavior, multiplayer aspects that involve culture and social interaction, and a gradual introduction to rules allowing for adaptation and efficient learning.[5] Students who grew up with computers find learning through technical media more rewarding than through traditional teaching methods. Videogames, like all software, readily presents information for the user, allowing course-related material to be available whenever it is needed.[6]

With technology rapidly expanding with time, new vectors of education are becoming available. One vector is the use of educational software. The education of the baby boomer generation occurred during a period of time when computers existed in very limited environments and in no way could it be utilized on a large scale. Furthermore, the baby boomer generation relied more on traditional methods of education, such as textbooks and not on computers, because that was the most universally available segment of information. Fast forward to the current day, we see that less of the student population read print and prefer quicker vectors of information, such as those provided from computers. According to IBIS World, an industry analysis provider, the Internet publishing and broadcasting industry is expanding at a rate of 11.4 percent per year, and is a 34 billion dollar industry.[7] Furthermore, the newspaper industry has realized an annual growth of -11.1 percent per year.[8] Book publishing is also suffering with the advances in telecommunication and virtual information availability. The book industry sees an annual growth of -2.2 percent.[9] These statistics provide us with the insight of how communication advances have changed the way individuals seek information. Educational software can utilize this momentum and develop innovative methods to provide education. To

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[5] http://tegd.arizona.edu/content/introduction-educational-video-games
[6] http://tegd.arizona.edu/content/introduction-educational-video-games
[7] http://www.ibisworld.com/industry/default.aspx?indid=1974
[8] http://www.ibisworld.com/industry/default.aspx?indid=1231
[9] http://www.ibisworld.com/industry/default.aspx?indid=1233

further show how the industry of printed information is declining, there is heavy reliance now on virtual vectors of information.[10]

Table 2-1 Newspaper Trends

News Paper Company	Circulation as of Sept 2010	Percent Change (Year to Year)
Wall Street Journal	2,061,142	1.82
USA Today	1,830,594	-3.66
New York Times	876,638	-5.52
Los Angeles Times	600,449	-8.67
Washington Post	545,345	-6.43
New York Daily News	512,520	5.82
New York Post	501,501	-1.29
Chicago Tribune	441,508	-5.23
Houston Chronicle	343,952	-10.53
Philadelphia Inquirer	342,361	-5.29
Newsday	314,848	-5.29
Denver Post	309,863	-9.12
Arizona Republic	308,973	-2.49
Minneapolis Star Tribune	297,478	-2.32
Dallas Morning News	297,478	-2.32

These figures places further emphasis on the need to change the way education is brought to the students today. Videogames, as well as other software that utilizes virtual environments, readily present information for the user, allowing course-related material to be available whenever it is needed.[11]

Dr. Kurt Squire of the University of Wisconsin-Madison, directed a study on students who had never been exposed to the game franchise of Civilization III. This software, developed by Firaxis Games and Westlake Interactive, is a turn-based strategy game in which the user takes the role of a military commander and builds both structures and troops in an attempt to conquer opponents. The software incorporates real world empires and the qualities of which each empire possessed, according to historic recollection, as illustrated below.[12]

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[10] http://www.accessabc.com/
[11] http://tegd.arizona.edu/content/introduction-educational-video-games
[12] http://www.civ3.com/

Table 2-2 Summary of Factions in Civilization III

Civilization	Qualities	Advantage	Special Unit	Leader	Capital
Aztecs	Militaristic, Religious (in Conquests, Agricultural)	Warrior Code	Jaguar Warrior	Montezuma III	Tenochtitlan
Babylon	Religious, Scientific	Ceremonial Burial, Bronze working	Bowman	Hammurabi	Babylon
China	Militaristic, Industrious	Warrior code, Masonry	Rideer	Mao Zedong	Beijing
Egypt	Industrious, Religious	Masonry, Ceremonial burial	War chariot	Cleopatra VVI	Thebes
England	Expansionist Commercial	Warrior code, Alphabet	Man-o-war	Elizabeth I	London
France	Industrious, Commercial	Masonry, Alphabet	Musketeer	Joan of Arc	Paris
Germany	Militaristic, Scientific	Warrior code, Bronze Working	Panzer	Otto von Bismarck	Berlin
Greece	Scientific, Commercial	Bronze working, Alphabet	Hoplite	Alexander the Great	Athens
India	Religious, Commercial	Ceremonial burial, Alphabet	War Elephant	Mahatma Gandhi	Delhi
Iroquois	Expansionist Religious	Pottery, Ceremonial Burial	Mounted Warrior	Hiawatha	Salamanca
Japan	Militaristic, Religious	The Wheel, Ceremonial Burial	Samurai	Tokugawa Ieyasu	Kyoto
Persia	Scientific, Industrious	Bronze working, Masonry	Immortals	Xerxes I	Persepolis
Rome	Commercial, Militaristic	Alphabet, Warrior code	Legionary	Julius Caesar	Rome
Russia	Expansionist, Scientific	Pottery, Bronze Working	Cossack	Catherine II the Great	Moscow
United States	Industrious, Expansionist	Masonry, Pottery	F-15	Abraham Lincoln	Washington
Zululand	Militaristic, Expansionist	Pottery, Warrior code	Impi	Shaka	Zimbabwe

By allowing users to employ historic significances and provide essential historic backgrounds of these factions, the software is able to incorporate historic information while also allowing the user to be entertained. In the past, this information could only be conveyed through textbooks and other related media.

The study showed a significant increase in basic geography and history skills in students who used the software. After several runs through the game, the students were able to construct explanations for growth in cities. The students' understanding of world history terminology also improved after gaining experience in the game. Even after the conclusion of the experiment, the students were fascinated by the subject and voluntarily took their time to continue learning more about the subject matter.[13] This case showed that by involving educational material into entertainment, students would be more likely to be captivated by the scholastic material.

The educational system has failed in attempts to provide an environment where students have the freedom to pursue knowledge and learn from mistakes, as mistakes are almost always associated with lower grades. Students now lack the ability to learn freely and are limited to the predetermined activities, labs and assignments that are recycled from year to year. For example, science laboratories in schools involve preset instructions with predetermined outcomes and involve no freedom for students to experiment on their own and learn from their mistakes (Klopfer, 22). The game environment allows students to simply learn from trial and error, which is a method of education that is seldom utilized. Furthermore, the virtual educational environment provides students with the ability to learn at their own pace, understand actively with the ability to convey more interactive information and tutorials, and ideally reduce frustration.

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[13] http://tegd.arizona.edu/content/introduction-educational-video-games

Regardless of the benefits of using educational software, there have been barriers that hinder the involvement of educational game software in the classroom setting. The adoption rate for the software is quite low due to the reluctance of parents and teachers to move away from the traditional methods of teaching. There is also limited support for teaching professionals how to implement educational software in a limited school year. Development costs are another problem that must be addressed. Developers have a high risk of investment when creating software with such a low adoption rate. Creating effective learning software involves a large budget and a long development time, which to the developer may not be worth the effort with such a small consumer base. Moreover, there is very limited data and research on how to effectively create a successful educational game. Klopfer comments on how gaining access to testing students in classrooms is very difficult and makes producing a well-received educational game challenging (Klopfer, 19).

Regardless of the barriers of entry, members of the educational system are taking steps to integrate educational game software into learning. Developing a student's mind is the primary objective and educational professionals are expanding innovations to advance the educational environment. Students need to consistently use and practice with the software in order to reap the full benefits that scholastic games provide. Educational software can be developed in the same manner textbooks are developed, in levels. By providing multiple levels of software, the educational value will never reach an endpoint until the software package is mastered.

6.2 Motivation

Motivation is the power that compels someone to meet a personal goal. Motivation drives a person from the trivial goals such as drinking a glass of water to quench their thirst or to work toward meeting a grand dream such as ending world hunger.

There are three components to motivation. First, the activation component involves the initiation of a decision such as applying for a course or reading a book. To satisfy the activation component, any matter seeking motivation must be able to attract the activation component. Next, the persistence component involves providing incentives for an individual to perform at optimal levels and invest effort and time in a matter. Also, the persistence component must motivate an individual to overcome obstacles. For example, students who attend classes at 8 AM are required to wake up early enough to attend the class; some students choose to sleep through 8 AM courses. Certain internal and external motivations are at work for students to attend these classes and persist in attendance. Finally, the third component is intensity. Concentration and diligence in pursuing a goal depends on the intensity component. For example, to attain A-grade level work, one must perform at above average levels. For some, the A-grade satisfies the persistence component, but there are those who are satisfied with average level work, attaining a B-grade.

6.3   Intrinsic Motivation

Intrinsic motivation is motivation that comes from within. It is motivation from doing an activity for what it is rather than external rewards. When a person finds reaching the goal is a reward in itself, that person is intrinsically motivated. Intrinsic motivation is strongly inherent from the time humans are born. People are born active and curious ready to learn and grow without any physical incentives (Ryan, 56).

Intrinsic motivation is critical because it defines a person's personal interests that one could grow through knowledge and hard work. Learners show the positive effects of motivation in the classroom when intrinsically motivated. Students that are intrinsically motivated enjoy taking on challenging assignments and are prepared to learn new material.

There are seven components to intrinsic motivation:

- "Challenge" is for people who enjoy trying to complete a difficult task.

- "Curiosity" is for those who explore for the understanding of the outcome of their action.

- "Control" is for people who prefer having command over their choices.

- "Fantasy" is for those who dream about what could happen.

- "Competition" is for those who are motivated by competing with someone else.

- "Cooperation" is for those who find working along one another to be a stimulating experience.

- "Recognition" is for those motivated by how others perceive and recognize their accomplishments.[14]

Intrinsic motivation is important for reaching long term goals. For students, it is the stronger motivator of the two types of motivation to keep them focused on a long term goal such as completing a school degree. However, a large portion of students do not realize the importance of education. By incorporating extrinsic motivation in the educational system, the system as a whole can potentially be revolutionized and improved. Although intrinsic motivation is more influential in the long term, extrinsic motivation is another powerful motivating force, which is better for short term goals and immediate effects.

6.4 Extrinsic Motivation

Extrinsic motivation is the counterpart to intrinsic motivation which pertains to an activity is done due to an external outcome. A person is extrinsically motivated to achieve a goal for an incentive rather than for the learning, individual growth, and experience (Vallerand, 428). A student who gets high grades because they are paid to do so is extrinsically motivated. While

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[14] http://education.calumet.purdue.edu/vockell/edPsybook/Edpsy5/edpsy5_intrinsic.htm
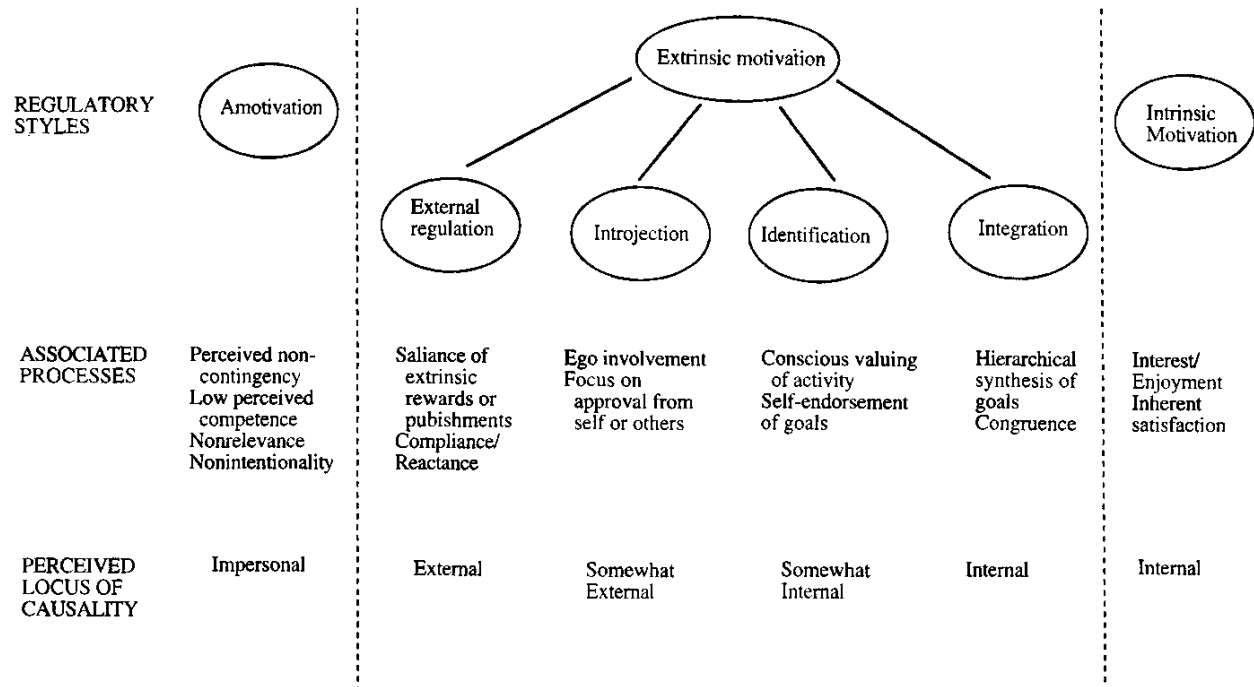
young, individuals are mainly motivated intrinsically and as they continue life through middle

and high school they become more extrinsically motivated. This is due to the significance placed

on good grades and on an individual's future by either parents or other authority figures.

Extrinsic motivation can be caused by external rewards such as money or a trophy, avoiding

punishment or guilt such as avoiding disappointing a parent, or following the standard because

they "should" do it because society says so.

     The figure below explains the different types of motivation and the sub-types of extrinsic

motivation. Amotivation refers to the inability to participate in any situation and is therefore the

lack of motivation. Intrinsic motivation was previously described as the motivation from within.

Extrinsic motivation is the motivation caused by external factors. Within external motivation

however are four other motivations. External is motivation due to rewards. Prestige of success,

such as receiving a gold medal, is a form of external regulation. By providing memorabilia of a

success provides some motivation and justification for effort. Introjection is motivation due to

guilt of failure or lack of effort. For example, those who seek internships must first attain a

respectable grade point average, then network with potential employers, interview, and finally

follow through and apply effort at an internship position. Introjection refers to the approval

related to putting effort into a task, such as applying and attaining an internship. The third

component of extrinsic motivation is identification. The identification component refers to the

knowledge of a task that must be completed, and if it is not completed, the individual would have

to face the negative consequences. The situation of attending a lecture provides many motives

that are illustrated in this component. For example, if one does not attend a lecture, one risks a

lower grade due to absence, missed quiz, or missed lecture material. Lastly, we have the

component of integration. This refers to the extrinsic motivation component that is triggered by

the need to satisfy intrinsic needs. An example of this would be to spend time on a research

paper to improve one's own knowledge, not only for a grade, but also for self-satisfaction.

Figure 2-1 Taxonomy of human motivation (Ryan, 61)

REGULATORY STYLES	Amotivation		Extrinsic motivation				Intrinsic Motivation
			External regulation	Introjection	Identification	Integration	
ASSOCIATED PROCESSES	Perceived non-contingency Low perceived competence Nonrelevance Nonintentionality		Saliance of extrinsic rewards or pubishments Compliance/ Reactance	Ego involvement Focus on approval from self or others	Conscious valuing of activity Self-endorsement of goals	Hierarchical synthesis of goals Congruence	Interest/ Enjoyment Inherent satisfaction
PERCEIVED LOCUS OF CAUSALITY	Impersonal		External	Somewhat External	Somewhat Internal	Internal	Internal

7 Related Work

7.1 Studies on Rewards as Motivation

7.1.1 Using Constructive Rewards
Rewards are a key motivating factor in education, whether in software or in the

classroom. With the ultimate goal of instilling in a child the notion that positive behavior and

performance are praised and often rewarded, there must be a consistent system. A system should

be implemented in a fashion that promotes persistent effort and persistent rewards for the effort.

To address this problem, by regularly rewarding positive behavior and performance,

educators can instill in a child a reason to continuously and persistently preform at their top

level. After a certain threshold is achieved, the rewards can be reduced and become more

intermittent. Eventually, self-determination and self-motivation will become the key motivating factors to the point in which rewards will not be needed.

Rewards given to a child can come in many forms; a few examples are objects, praise, and recognition. In the educational system, students will deal with many aspects of in-class and out of class environments, such as verbal, written, and virtual media. Forms of rewards that have been shown to dramatically improve performance and motivation are awards for such triumphs like attendance, high grades, and consistent effort. Rewards of this sort can come in the form of certificates. Furthermore, it has been shown that verbal praise from the teacher and peers have been motivating factors in students' performance. Lastly, privileges can be offered to students who maintain consistent effort and performance. These rewards can range from homework passes and going first to being the designer of the class bulletin board.

In the case of object-based rewards, it is more complex. To instill good habits in children, it is ill advised to offer rewards such as food and candy for students. Not only could this be detrimental to health, but can lead to the formation of bad habits in the future. Objects such as school supplies, sporting equipment, toys, and clothing are both affordable and useful for students.

7.1.2 Self-Efficacy

Self-efficacy is defined as the belief of one's own capabilities to achieve a goal or an outcome.[15] Self-efficacy is a motivating factor when it comes to education. If an individual believes that they are competent enough to complete and succeed in their own work, then they will provide more effort and enthusiasm in their work. Success will bring an increase in self-efficacy while failure will bring a reduction in self-efficacy. When students estimate their own competence and self-efficacy, it is ideal to correct estimate. An overestimation will likely bring

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[15] http://serc.carleton.edu/NAGTWorkshops/affective/efficacy.html

failure in a task and reduce self-efficacy. Furthermore, an underestimation of self-efficacy will bring reduced effort and enthusiasm, which will lead to lower learning ability. It is important to correctly estimate one's own self-efficacy (Nilson, 2009). It is ideal to estimate self-efficacy slightly above ones abilities (Csikszentmihalyi, 1990). This will provide challenges and increase effort while still allowing for success.

There are three primary components when estimating ones self-efficacy (Weiner ,1985). Simply, they are locus of causality, stability and controllability. Locus of causality refers to factors inside and outside of an individual. When attributing success to factors inside and in the control of an individual, the individual will see an increase in esteem, pride and emotion. This will positively affect self-efficacy. On the contrary, failure when attributed to factors inside an individual will detriment emotions and lower self-efficacy. Factors outside of an individual, when attributed to success, such as luck, will not affect self-efficacy. These factors are out of an individual's control. Stability and controllability refers to the factors such as sickness, which, for the most part, are not permanent. These factors are cyclic and change given time. The amount one studies and the knowledge one believes to have also effect self-efficacy.

Furthermore, outcome expectation affects ones effort and motivation. Incentives must be apparent to motivate effort. If a student does not see benefits for applying effort, then effort will not be applied. For example, exams are taken with prior studying to achieve the highest possible score. The SAT offers courses months in advance to prepare students. Opposed to this, if grades were not offered, effort and motivation will be significantly reduced because there is no indication of success and therefore no challenge or incentive to increase self-efficacy (Schunk, 1991).

The University of Adger had completed studies to determine whether or not self-efficacy affected one's effort and motivation. The university's students suffered from many performance problems. The university was experiencing increased drop-out rates due to poor performance, especially the IT department who was seeing significantly high dropout rate after the first year. This was attributed to poor performance and resources to assist students. The lecturers were not able to address every individual in the course simply because the course was too large. Assignments contributed to fifty percent of the final grade for a course. After a survey, students responded on the difficult of these assignments. There was a large variance in competence since not everyone in the course was on the same level. To address this problem, and to increase self-efficacy, instructors allowed students to complete assignments that challenged every level. Students formed groups which contained students of every level. These groups increase collaboration and motivation to learn. Course structure was altered to provide smaller goals and milestones instead of large milestones. For example, computer lab assignments featured several small goals which were set to challenge all levels of ability.

7.1.2.1 Results

The results of this case showed that there was an increase in effort and knowledge attained when assignments were specifically targeting different segments of the class. Students found it rewarding when they were able to complete assignments. This increased self-efficacy and increased effort throughout the course. Also, when students were able to collaborate with peers, they were more likely to ask for help, and peers were more likely to help. Success at any level increases individual self-efficacy, in turn motivation and effort. Students who succeed at lower levels applied more effort on problems in which they found challenging. In the lab environment, by providing several smaller goals as opposed to one final goal, students were more motivated to attempt problems. By succeeding in the lower level goals, students saw

boosted esteem and self-efficacy. Below is a table showing retention of students in the IT program. Unlike in 2005 where retention of students dropped over thirty percent, in 2006 retention dropped only ten percent.

Table 3-1 Retention Rates of IT Program

Year to year retention rate of IT program			
Start semester	First year	Second year	Third year
2005	61	42 (69%)	23 (37%)
2006	50	42(84%)	37 (74%)
2007	68	56 (82%)	
2008	55		

7.1.2.2   Analysis

This case shows that if tasks are too difficult for individuals, then they will see that there is no point in supplying effort and risk decrease of self-efficacy. By providing incentives to attempt these problems, whether they are intrinsic or extrinsic, will motivate effort. Assisting students and providing help when necessary would also help the student believe that they can accomplish their goals. Success at any level influences self-efficacy and it is a key motivator for success and effort. By providing students with smaller goals that are challenging yet within their reach one can promote a student's self-efficacy. From the case, we derive that it is important to let students experience success and emphasize student well-being and confidence.

7.2   Studies on Games as Motivation

7.2.1   What Makes Things Fun to Learn?

The paper entitled, "What Makes Things Fun to Learn?" focuses on establishing a set of guidelines for designers of instructional computer games. Malone organizes the paper into three categories which are essential characteristics of enjoyable computer games. Challenge, fantasy

and curiosity are the vital features of an entertaining game. Challenge provides a goal whose completion is ambiguous. Fantasy provides gamers with a more interesting and engaging environment to work in. Curiosity gives the audience the motivation to stick with the game and in turn, gives motivation to learn. The gamers' curiosity can be invoked by providing an environment which is neither too complicated nor too simple in regard to the gamer's existing experience.

7.2.2   Moving Learning Games Forward

The paper "Moving Learning Games Forward" introduces three main teaching concerns that must be met in order to integrate games into the existing school environment. The first concern is the need to cover required course content. The second is to face the skepticism of new technologies. Lastly, those who are unfamiliar with games need to be introduced and a point was made saying that there is, "no easy route to game competence" (Klopfer, 2). The article makes two main arguments. The first argument is that games are capable of appealing to players in education that can be relevant to schooling. The second argument is there are methods by which teachers can guide the learning in games without disrupting the worlds of either play or school.

Klopfer then discusses the role of games and play. The role of play is related to the exercise of freedom which can be separated into five different categories: freedom to fail, experiment, fashion identities, effort and interpretation. These freedoms are described as "free play" and allow the child to experience a kind of play a child desires entirely on their own terms.

Klopfer makes an argument saying many gaming communities use social networking to greatly benefit the gamers' experience. Social networking is used for many purposes such as a way to exchange information about the games, to strengthen or form teams, as well as to provide help for new and struggling players.

The author talks about "Games with A Purpose Beyond Play." Klopfer argues that this phrase accurately describes a broad range of games. Klopfer also identifies two aspects to differentiate games, what he calls "audience" and "purpose." Audiences include defense, industry and education, while purpose ranges from advertising, work, research, as well as the main focus of the paper, education and training. Learning games are distinguished from games for training in that they aim for the attainment of knowledge as its own end and foster habits of mind and understanding that are generally useful within an academic context. Klopfer stresses that learning games are associated with places of informal learning. Klopfer believes that the answer to good learning lies both in the design of games and in new and creative ways of imagining the integration of those games into schooling. Klopfer then creates a list of ways games can be integrated into the classroom to support different intentions and purposes.

7.2.3   Endogenous Fantasy and Learning in Digital Games

Habgood studies work done by Malone, who explored the motivational aspects of digital games and concluded that "the educational effectiveness of a digital game depends on the way in which learning content is integrated into the fantasy context of the game" (Malone, 333). Habgood says that this suggests that curiosity is aroused when learners discover that their knowledge is incomplete or inconsistent. Habgood argues that the roles of flow, representations, and game mechanics are factors that are likely to affect the motivation and learning content within digital games. Habgood brings up experimental studies that show how fantasy does not make a great case for the organization. Yet, it still represents an important factor in the motivational influences at work in digital games. This view on the importance and influence of fantasy is supported by one highly considered games-industry veteran, that Habgood mentions, who argued that while the organization is not necessarily an thorough or exclusive categorization, it still broadly agrees with his professional experience, even seventeen years after

the paper was written. Even so, Habgood believes that fantasy is the wrong term to use to describe this central concept and hopefully identifying and understanding this should yield for valuable growth and development to be made in this area of gaming and education.

7.3   Studies on Money as Motivation

7.3.1   Never Underestimate the Power of Cash: Extrinsic Rewards in the Classroom

7.3.1.1   Experiment

Economics is a rarely used technique to boost motivation in educational environments. Such a system when introduced to the classroom environment has been shown to increase learning potential and retention (Leonard, 2008). A classroom based money system has been shown in a case conducted at the Montana State University Billings has been shown to benefit both the student and the instructor as it increases attendance, while also laying a foundation for increase participation with respect to the instructor and peers.

The problem that arises in today's education system lies in the methods in which examinations are given. Students are paying more attention to the blind memorization of materials for the examinations rather than learning in a manner that is beneficial when applying lower level materials to higher level courses (Seifert, 2004). Furthermore, today's educational system bases performance on examinations grades rather than the amount one retains. By having such a one dimensional performance indicator, students lack the ability to retain knowledge as effectively.

In a case done at Montana State University Billings involving 12 classes over a 6 year period, a monetary system was introduced to determine whether a classroom based money system would benefit learning. The monetary system, outlined below, was introduced and enabled students to use β on exams or for trade with other peers in the course.

Table 3-2 Behavioral Rewards (Leonard, 5)

Item	Payoff
Perfect Attendance	$\beta5$
Unsolicited supplemental information	$\beta3 - \beta5$
Normal participation in experiential exercises and classroom games	Depends upon the exercise used but may be $\beta5 - \beta20$
The first to volunteer	$\beta1$
Well considered or outstanding answers	$\beta1 - \beta3$
Exam review sessions	Depends upon the review style used but may be $\beta5 - \beta20$
Impromptu presentations	$\beta1 - \beta3$

The classroom based money system enabled students to make purchases determined by the instructor. In the case, β could be used to purchase specific exam problems and not simply points added on exams. For example, students are able to purchase entire multiple choice, short answer, and essay problems. Students will use 1 β to purchase problems worth 1 point on exams, 5 β to purchase problems worth 5 points, and so on.

7.3.1.2   Results

The final results of the study showed impressive results. The primary focus of students was no longer on examination grades, but instead the focus shifted towards earning β. Students were shown to be less focused on performance based objectives, such as exam grades, and failure avoidance. Focus now shifted towards earning β by participating in class and retaining information to provide well thought out answers and questions for the professor. Not only did this show increased participation in regards to student and teacher interactions, the case showed that students were more focused on the materials. This was shown by students providing presentations and additional information not addressed in the course or syllabus regarding the topics at hand. The case showed that it is possible to shift the focus of education from memorization to applied learning. Students seemed to be immersed in the educational value of the course, and not just memorizing materials for the sole reason of exams.

With the primary objective of the case achieved, analysis of the case as a whole showed more findings which prove the benefits of a money system. In regards to attendance, the case saw an increase of attendance to 95 percent versus the 80 percent in a class without the monetary system. Students were more likely to attend class since the opportunities to earn β were sporadic. Also, the case showed that fifty percent of the students in the case earned β for perfect attendance. Students who attend class would be more likely to learn and retain information as opposed to those who did not attend class.

The monetary system significantly boosted class participation, energy and mood. With the increased participation, the class became more involved with the instructor in regards to the material, and more involved with peers in regards to collaboration. Students were more willing to interact with peers and the instructor. With regard to interacting with peers, students no longer had cliques where they primarily interacted with. Students were more open to speaking with everyone in the class to provide constructive criticisms. Competition in both individual and group work shifted focus from competing with peers, to emphasizing self-worth. Students were not as worried about wrong or inadequate answers and were more willing to assert their own ideas.

Some unforeseen consequences of the money system were also seen. A consequence was that students began handing in extra work in hopes to earn β. This situation proved to be difficult as instructors could not give extra credit. Also, students began to trade β to each other for tutoring and sometimes even homework. Exchanging β for tutoring was a positive benefit allowed by professors, whereas trading homework was not. For obvious reasons, trading homework is plagiarism. Such black market activities, such as trading for homework and help on

quizzes and exams, had to be carefully monitored. As a whole, this system showed that using an economic system in a class was an effective motivator.

7.3.1.3   Analysis

This case is a prime example of how extrinsic motivation, such as a monetary system, adds reason for motivation and effort. Not only did it increase motivation and effort, it increased the total amount of knowledge retained (Leonard, 2008). Exam grades, with and without the monetary system, exhibited similar means and variance across the groups. This is because of different modifications made by teaching staff. By offering the ability to choose certain questions to answer of an exam, students would be required to have prior preparation for exams, but not be limited to memorization of the material. This method, opposed to free points, students will still apply effort to exams and need to have adequate prior preparation to preform optimally on exams. By offering the monetary system, courses can suit all types of students, from those who are not high achievers, but are hard workers, and also those who are high achievers naturally by offering a different type of learning environment less focused on memorization.

This case shows that extrinsic motivation is beneficial to the educational system. The classroom based economic system, added enthusiasm, enjoyment and passion into the course which was not universally present. As previously stated, the classroom based money system increased participation and enhanced learning.

7.3.2   Reward System Implemented in School Districts

7.3.2.1   Experiment

The United States, at the ninth grade level, is ranked 28th in math, 22nd in science and 18th in reading achievement.[16] In areas such as Indianapolis, graduation rates are as low as thirty one percent. The performance of black and Hispanic students is roughly on par with scores of

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[16] http://www.oecd.org/document/2/0,3746,en_2649_39263238_48634114_1_1_1_1,00.html

Mexico and Turkey, two of the lowest Organization for Economic Co-operation and Development (OECD) countries. In an attempt to improve statistics, school districts have attempted innovative reforms. Reforms such as mandatory summer school, merit pay for teachers, after-school programs, and budget reform have not shown universal improvement.

One innovative strategy which cost-effective is to offer short-term incentives for students to perform at a certain level that is correlated to student achievement. This study is based on the belief that offering incentives for achievement will increase student performance.

In the 2007 and 2008 school years, public schools in several typically low preforming districts, including Chicago, Dallas, New York City and Washington D.C. distributed a $6.3 million to approximately 38,000 students in 261 schools (Fryer, 4).

In New York City, students at the fourth and seventh grade level were paid for performance on ten interim assessments, assessments which are administered annually by the Department of Education to all students. Furthermore, in Chicago, ninth grade students were paid for grades in five courses, every five weeks. In Dallas, students at the second grade level were paid two dollars per book read. To assess that the book was read, a short quiz was administered. In Washington D.C., students at the sixth, seventh and eighth grade levels were paid by calculating attendance, behavior, and inputs of productivity that were determined by each school. Inputs of productivity refer to the behaviors and actions that are positive for productivity such as attention and effort (Fryer, 11).

In the figure below, each of the four cities are broken down based on schools, students, reward structure, reward frequency, outcome interests, and operation costs.

Table 3-3 Incentive Treatments by School District (Fryer, 80)

Table 1: Incentive Treatments by School District

	Dallas	NYC	DC	Chicago
Schools	43 schools opted in to participate, 22 schools randomly chosen for treatment	143 schools opted in to participate, 63 schools randomly chosen for treatment	17 schools randomly chosen to participate from the set of all DC middle schools	70 schools opted in to participate, 20 schools randomly chosen for treatment from a pre-determined set of 40
Students	4,008 2nd grade students: 23% black, 74% Hispanic, 58% free lunch eligible	17,744 4th and 7th grade students: 43% black, 42% Hispanic, 90% free lunch eligible	6,039 6th-8th grade students: 85% black, 9% Hispanic, 72% free lunch eligible	10,628 9th grade students: 55% black, 38% Hispanic, 93% free lunch eligible
Reward Structure	Students paid $2 per book to read books and pass a short test to ensure they read it. The average student earned $13.81 ($80 max).	4th graders could earn up to $25 per test and $250 per year. 7th graders could earn up to $50 per test and $500 per year. The average 4th grader earned $139.43 ($244 max). The average 7th grader earned $231.55 ($495 max).	Students could earn up to $100 every two weeks, $1500 per year. The average student earned $532.85 ($1322 max).	Students could earn up to $250 per report card and $2,000 per year. A=$50, B=$35, C=$20, D=$0, F=$0 (and resulted in $0 for all classes). Half of the rewards were given immediately, the other half at graduation. The average student earned $695.61 ($1875 max).
Frequency of Rewards	3 times per year	5 times per year	Every 2 weeks	Every 5 weeks / report card
Outcomes of Interest	ITBS and Logramos reading scores	New York state assessment ELA and math scores	DC-CAS reading and math scores	PLAN English and math scores
Operations	$360,000 total cost, 80% consent rate. One dedicated project manager.	$6,000,000 distributed. 66% opened bank accounts. 82% consent rate. 90% of students understood the basic structure of the incentive program. Three dedicated project managers.	$2,300,000 distributed. 99.9% consent rate. 86% of students understood the basic structure of the incentive program. Two dedicated project managers.	$3,000,000 distributed. 88.97% consent rate. 91% of students understood the basic structure of the incentive program. Two dedicated project managers.

These four sectors were broken into two groups, inputs and outputs. The output groups of Chicago and New York City were based on exam scores and grades achieved. While the input groups of Washington D.C. and Dallas were based on behavior in class and reading. After these results are recorded, the case sought to determine what occurs after the incentives are removed. It was believed that intrinsic motivation risked a decrease after the incentives were removed (Fryer, 31).

7.3.2.2   Results

In New York City, results of exam grades did not show notable increase in either fourth or seventh grade. The results for mathematics scores were between -0.018 and -0.03 standard deviations while results for reading scores were between 0.018 and 0.033 standard deviations.

Furthermore, in the case of ninth-grade students in Chicago, student grade point average saw an increase of 0.093 and 0.131 standard deviations. In Chicago, there was no effect on standardized test scores of math or reading.

Incentives for reading in the second-grade Dallas class showed marked increase in reading comprehensive by 0.180 and 0.249 standard deviations. Next, vocabulary showed an increase of 0.051 and 0.071 standard deviations and language increased by 0.136 and 0.186 standard deviations.

The Washington D.C. case, in which students were paid for behavioral aspects of education, showed statistical increase of reading achievement between 0.152 and 0.179 standard deviations and mathematical achievement between 0.114 and 0.134 standard deviations.

After the conclusion of the study, the incentives were removed and again recorded. On all fronts, achievement increase began to fade out. There was no indication that intrinsic motivation decreased after the incentives were removed.

7.3.2.3 Analysis

This study, done by Roland Fryer of Harvard University tested the strengths of extrinsic motivation in the school system. According to the study, there was a correlation, however statistically insignificant, between extrinsic motivation and increased exam scores. As seen in the results of the case, exam scores increased with the presence of incentives. By providing incentives, students were more likely to study. This fact shows that the current school system does not adequately interest students to perform at optimal levels (Fryer, 38).

Intrinsic motivation and extrinsic motivation in education is hard to balance in a manner that teaches students good schooling habits. Detrimental qualities might be instilled by offering incentives for activities that do not normally offer incentives. Qualities such as "the love of learning," (Fryer, 29) should be naturally instilled in individuals. As a whole, the case showed

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positive benefits only when incentives were offered and no lasting benefits were observed after the incentives were removed. Therefore, the study showed that extrinsic motivation did motivate the students to apply more effort, but did not have lasting effects after incentives were removed.

8   Designs

8.1   Design 1

A motivational component that our group saw as an important asset is the implementation of a money system. From the prior research it was concluded that extrinsic motivation provides an immediate effect when attracting students to the game software. Several design implementations were proposed using the money system. The game-like elements that our team designed was the implementation of currency, in-game booster items, as well as a shop for personalization. Money would be used as a basic short term reward which would later be used to obtain long term rewards.

The money system that we designed was built around a game currently in development known as "Monkey's Revenge." It is a tutoring system for 8th grade geometry which was testing the game-like properties and the effects on learning and motivation.

8.1.1   Earning Money: Daily Allowance

The first issue that needed to be addressed was how a student would earn money. In order to appease the idea of motivating a student as well as giving them a moderate amount of money to get them started, the idea of a daily allowance was proposed. Some students have grown up having an allowance which money is given when completing a certain task. The money that would be given would be for a simple task of logging into the game and completing a certain number of problems. The task would be simple and the reward would be worth more than the action needed in order to obtain the reward. At first login the game would provide a low base

amount, 20 coins for example. Consecutive logins would increase the base amount by 20 till it reaches a cap of 500 coins. However, if a student did not login the next day the coins gained from a login would decrease at a much quicker rate than it increased.

Figure 4-1 Example of Money Earned Through Allowance
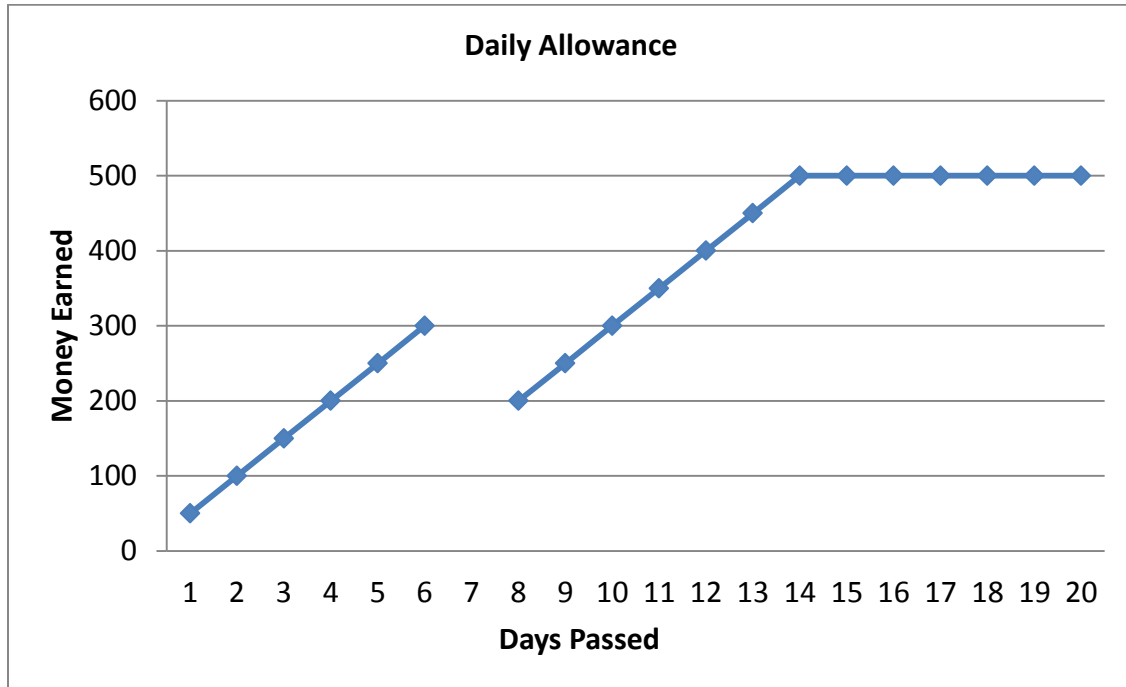
According to "Motivation Theory Applied to the Allowance/Chore Debate" by Karyn Hodgens a Kid's Personal Finance Educator children should understand the work ethic of earning money through persistence, initiative, hard work and diligence.[17] Hodgens also encourages teaching children through the Self-Determination Theory. The theory emphasizes drawing on the initiative of children, in our case, students. The initiative is caused by intrinsic motivation which is drawn out by providing students with opportunities. The opportunity that we are providing students in our design is the chance to earn money by logging in and completing problems and rewarding them even further for continually taking that opportunity.

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[17] http://kidnexions.com/pdf/MotivationTheoryAppliedtotheAllowance.pdf

8.1.2　Earning Money: Time Mechanic

Completion of problems is another method of earning money. In most games, the difficulty of the problem at hand corresponds to the reward obtained when completing the problem. Likewise, our system rewards students who answer problems correctly and provide them with more money for more difficult problems. There is a deeper mechanic involved with completing problems. A time mechanic would be used while a student is solving a problem. The longer it takes a student to complete a problem, the amount of money that they could earn steadily decreases to a base amount. A time limit would motivate the student to focus on the question in order to attain the maximum amount of money possible. Timed problems would occur once students have practiced with problems in the subject area. In this way they have background knowledge and wouldn't be continuously discouraged if they don't find a solution to the problem within the time limit.

Figure 4-2 Income per Problem as a Function of Time
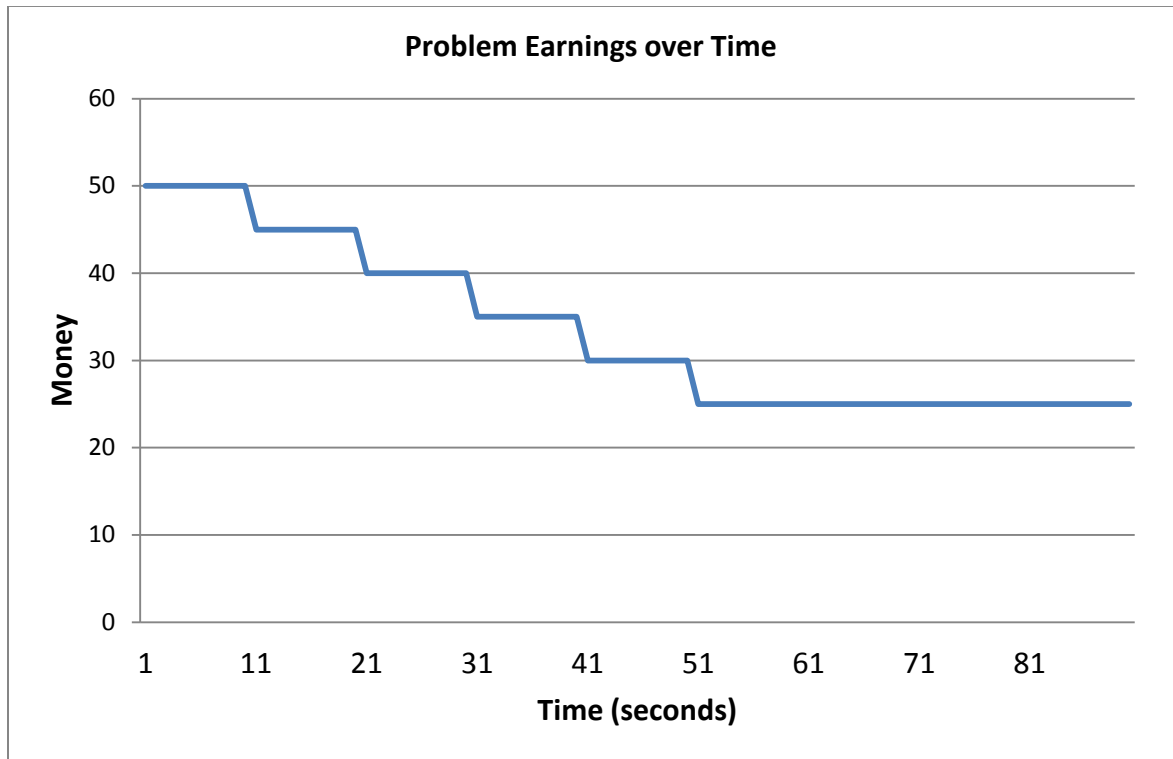
Another design implementation we had decided to use was allowing students to have two free attempts at a question before they start losing money. In this way we don't punish failure immediately, which if we did would possibly lower the confidence of the student. Students should be allowed to make mistakes because "the most powerful learning experiences often result from making mistakes." [18] So when the student is given a problem he/she is allowed to have up to two mistakes, however if they continue to keep getting the question wrong, their total possible amount of money that can be earned for the would be reduced.

8.1.3 Earning Money: Challenge Questions

Many students enjoy challenges in their school work, which is a strong indication of intrinsic motivation. To appease these students' need for a challenge we have proposed the design implementation of challenge questions. There are different components of the challenge

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[18] http://math.about.com/od/reference/a/Errors.htm

problem. Challenge questions are more difficult than the problems that they would've done prior and therefore will give a chance at a greater reward. The program will ask the student if he wants to bet his money on a problem from a reasonable set of preset amounts. The student has three attempts at the problem, each with a different outcome.

Table 4-1 Challenge Question Reward Layout

Attempt	Bet	Attempt Effect	Amount earned for correct answer
1	20 coins	Double Bet	40 coins
2	20 coins	Break even	20 coins
3	20 coins	Lose Everything	0 coins

There are a limited number of challenge questions that can be done per day so students do not get attached to the betting aspect of the question but rather on the challenge of the question. Referring to Section 7.1.2 on self-efficacy, the results from the University of Adger show that by creating shorter and more significant goals that are challenging and reachable, one can improve the self-confidence of students in their abilities. The described goal can be seen in our challenge questions. The questions are somewhat more challenging than the regular questions but are achievable. These short term goals would improve a student's self-efficacy levels which in turn would improve their overall performance.

Self-efficacy can also be improved by allowing students to have choices. By giving students flexibility and allowing them to make their own choices, students would find themselves more confident in their abilities.[19] In order to satisfy this requirement we allow the student to choose how much they want to bet on this question, if anything at all. This allows them to be in control how much pressure they are under when wagering their money. By allowing the student to control the risks they aren't as stressed and have more confidence in their own abilities.

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[19] http://serc.carleton.edu/NAGTWorkshops/affective/efficacy.html

8.1.4 Spending Money: In-game Store

After a student accumulates money, the student is given many options to spend their money on. Customization would be one of the main options to spend their money on. The student would have the ability to customize his in-game character and the pet monkey character in game for a more personalized experience. The store where they would be able to purchase from would contain a wide selection of items such as hats, shirts, pants, faces, shoes, glasses, gloves, and accessories. These extrinsic motivators are meant to give students a short term goal to work towards. The intrinsic motivation occurs through personalization and creating a unique experience. By creating a unique character different from those of the student's peers the student would be intrinsically motivated to maintain his character or even improve on it.

8.1.5 Earning Money: Boosters

Students can also purchase items called boosters. Boosters are items that would assist or enhance the experience of the student's learning while the student is solving problems. If a student is struggling on a question there are multiple boosters that are available that can help them with the problem. These boosters are there so students do not get frustrated or discouraged when they are stuck on a problem. There are also students who enjoy a challenge and do not want hints so we provide it as an option. The list of available boosters can be seen in the table below. The booster system is another way of improving self-efficacy. By providing assistance and even allowing the student's peers to help the student would understand how to go about solving the problem and therefore improve their self-confidence.[20]

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[20] http://serc.carleton.edu/NAGTWorkshops/affective/efficacy.html

Table 4-2 Explanation of Boosters

Booster	Description
Double Up	For the next 10 minutes the base amount of money students can earn per problem is doubled.
Challenge Multiplier	The frequency of challenge problems is increased.
Ask a monkey	Ask the players monkey for help on a question. Depending on how cared for the monkey is the more reliable the monkey's advice is.
50/50	Reduces multiple choice question answers by half.
Phone a friend	If a friend is online you may ask him or his monkey for help.
Hint	A useful recommendation in how to answer the question would be provided to the student.

8.2 Design 2

8.2.1 Purpose

The purpose for our experiment was to receive feedback from students on our money system. We would also rate student's performance on the test taken using the money system and without using the money system. We would be going to Dr. Arthur F. Sullivan Middle School to test our design on 7th grade students.

8.2.2 The Design

Although we wanted to test our complete money system implementation we were limited in time and resources so we had tested with a smaller model. Testing the daily allowance component would be difficult due to having only one testing session with the students and a repeated testing session was not possible. The item shop for purchasing clothing for a customizable character was not able to make it into the test design due to the extensive coding needed to set the store up which was outside of our knowledge. Challenge questions were another design component that was not implemented because it is a question that would occur by chance in the software and we are only currently testing their performance and feedback on the current booster system.

Overall we decided that the test should be simple and straightforward. The design goal was to make the test in a way so students could do problems without having to worry about

external rules. Using an academic program known as Castle Learning we handpicked ten multiple-choice questions ranging from beginner to intermediate difficulty on 7th to 8th grade math material. The areas of mathematics that we chose were word problems, algebra, geometry, and trigonometry. A copy of the test is provided in Appendix A.

The game aspect that we've included into the test was the booster system. The student would begin the test with a total of 200 dollars and would be able to purchase boosters during the test. Each question had a point value which corresponds with the difficulty of the question. The student would be able to purchase boosters during the quiz and the test monitor would assist the student with the booster that the student bought. The test monitor would also record the amount of money that the students have earned or spent and would let the student know their balance at the end of each question. The monitor oversees the point balance so the student is focused on doing well on the exam and not on the money. The test monitors would also record the time it takes to complete each question, which boosters were bought, and the number of correct answers of each student.

Table 4-3 Boosters available during the exam

Boosters available during the exam	Price
50/50	200 Dollars
25/75	100 Dollars
Hint	150 Dollars
Double Up	50 Dollars

8.2.3 The Experiment

Due to the time constraint the Sullivan class was split into groups of five. The first group of five that was being tested was the experimental group. The experimental group was told that they are given a base amount of 200 dollars at the beginning of the test and during the test they would be given additional money for each question answered correctly. The boosters were explained before the test and students were given a cover page containing information on the

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boosters as a reference. After explanations were given, students were asked to complete all ten questions. The students would be informed if they got the question correct or incorrect after the question has been answered.

While the student takes the exam the test monitor would record the time spent on each question and the amount of questions that were answered correctly. If a student uses the 25/75 or 50/50 booster the test monitor would eliminate one or two wrong answers. If a student asked for a hint the monitor would also provide a hint to assist the student in getting the correct answer. At the end of every question the monitor would state the amount of money in the student's balance. These were the procedures for the experimental group.

There were four students in our control group. The four students in the control group would not be permitted to use any boosters during their test session. The control group would complete their test with no interruptions and wouldn't be notified if they got a question right or wrong till the end of the exam.

8.2.4   The Results
In our results, the experimental group had three more incorrect answers than the control group. However there was one extra student in the experimental group so the number of incorrect answers for the experimental group than the control group should be between 0 to 1 errors. The figure below shows the number of times the questions were gotten wrong by both test groups. Questions 4, 6, and 10 were some of the more difficult problems which are portrayed by the spikes above two incorrect answers.

Figure 4-3 Number of Incorrect Answers

Problems Incorrect
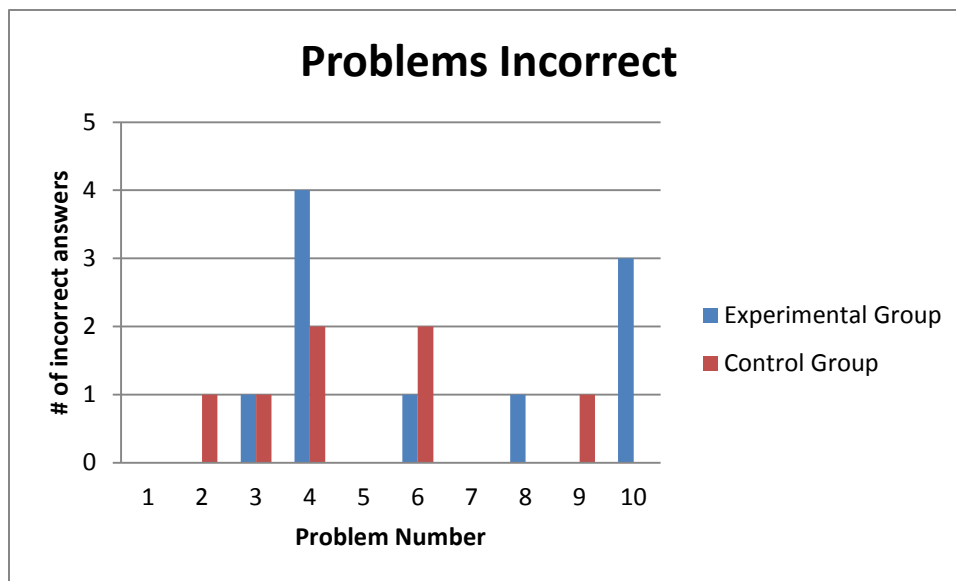
A result we found interesting was the time difference for completion of each problem between the two groups. The experimental group took about double the time to complete the test as the control group. However, the time during certain problems seemed to be higher because of the hints asked during the test. Hints need time to be explained and is the possible reasons for the time increase. The questions that the control group got wrong were the questions the experimental group got correct. For example, for problem number 6 the control group had more errors than the experimental group. The experimental group in this case had used hints for this question and took a longer time to answer. Nevertheless the experimental group answered the questions correctly. This result shows that the hints do help students solve problems correctly. Conversely, results don't show they had learned anything from using the hints. Even though they had gotten the right answer at that moment there is no information to show that they retained the information in solving that problem. After recording the statistical results, we conducted a verbal feedback session with the students.

Figure 4-4 Total Time Taken on Each Problem

Time Taken on Each Problem
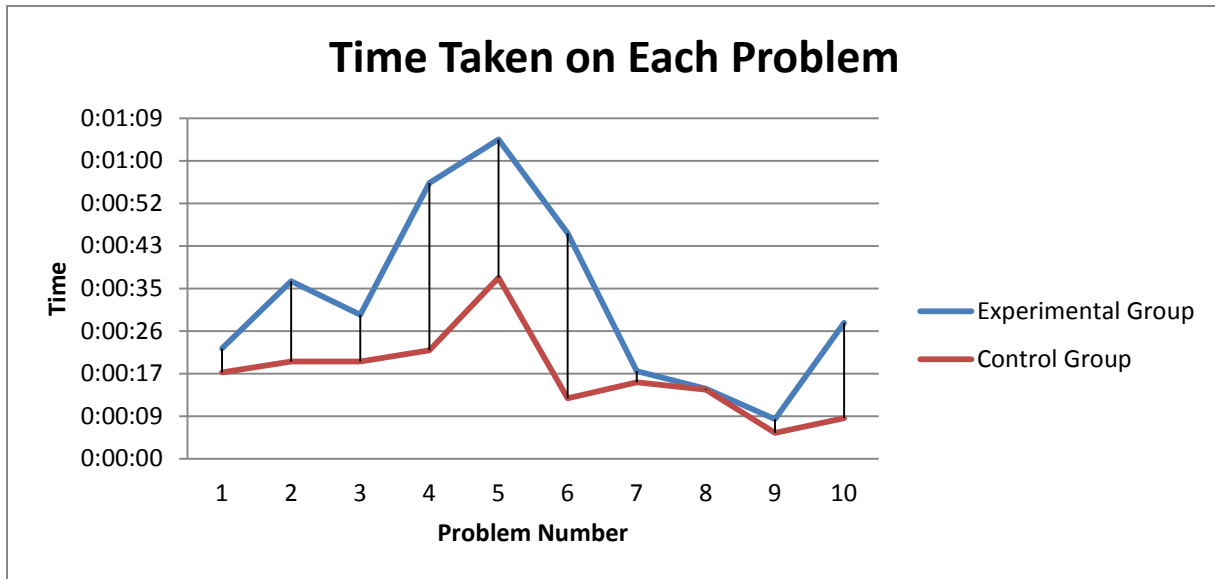
There was a lot of feedback received regarding the test that the students had taken. We noticed from the feedback that the level of difficulty changed from student to student. Many of the students stated that our test was fairly simple but for others it was much more difficult. The reason for the varying level of difficulty was answered with our next question. When we had asked what grades the students were in there were some 7th graders and some 8th graders mixed together which would explain why some of the simpler problems for 8th graders could not be answered correctly.

We then asked the students of the experimental group on their opinion of the booster set we had given them. Some students stated that some of the boosters were a little confusing, and they didn't find much use for them. The double point booster seemed irrelevant during the test because students mainly purchased the 50/50 and hints, which shows that students would rather get the question correct than accrue money. The reason for not accruing money could possibly be because there was no larger goal at the end of the test. The boosters were miniature rewards that could be attained without accumulating a great deal of money however they were not given a

larger goal that would require an amount such as $1000. Students had also said they enjoyed taking tests through this method because it was more interactive. When the students were asked which booster they enjoyed the most, it was mostly unanimous that the hints booster was the most popular. We also asked the students what they would think about the implementation of an item shop. This shop would be a place where the students can customize their avatar and with clothing and accessories using the money they earned in the game. The majority of the students replied that they would enjoy having an item shop added to the game. The students had also stated that if they had the option of a store they probably would have bought the double up booster to get more dollars.

The control group was asked if they would've liked hints or help on the test and many of them said there were times when they needed help on a question or reassurance of the answer they've concluded on. One student from the control group said that she had liked how our system had given the option of giving a hint. Most educational software provides hints automatically when the student is struggling with a question, regardless if the student wanted the help or not. The student had difficulty on the test however they enjoyed the challenge and satisfaction of answering problems on her own without help.

8.2.5   Analysis

Overall, both our test and control groups were significantly small. The results would have been more accurate with a larger test group. One other flaw in our experiment was that the students who were being tested were part of the math club and was not a random sample which would skew our results. Regardless of the faults in our experiments, we were able to receive substantial feedbacks about our system. The booster and money system does work because students preferred to receive help when needed. They also found the test more enjoyable when it was an interactive experience. If we were given a larger test group and more amount of time to

conduct our experiment, we would have performed a more complete experiment as we had intended for.

9   Future Work

9.1   Design 3

9.1.1   Sample Size

If given time there were many revisions that would be done in order to get improved and more accurate results. The flaw in our first test was the sample size. The target of our test are middle school students however having nine students as a sample is too miniscule when compared to the number of middle school students. To get an adequate sample size we would need to satisfy the statistical equation below, where "N" is the population size and "e" is the desired level of precision.[21]

$$n = \frac{N}{1 + N(e^2)}$$

If testing was to be done on a larger scale on the Sullivan Middle School again, it's important to find the population size of the students and the precision of representation of the sample size. For example if there were 700 students in the middle school and you would want to represent them using a 95 percent confidence interval you would need a sample size of 254 students. The confidence interval is an interval estimate used to indicate the reliability of an estimate. Here we want a reliable estimate to 95 percent. This would create more reliable and accurate results than our previous test had provided. To provide a more feasible test you could also reduce the confidence interval to 90 percent and would only need a sample size of 87 students.

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[21] http://edis.ifas.ufl.edu/pd006

9.1.2 Random Sample

The test we had created in Design 2 was intended to be taken by the general 7th grade population. Many of the chosen questions would provide intermediate to hard difficulties for 7th grade students. Before the test we discovered that the 7th graders at the Sullivan Middle School were part of the school's math group, which is not at all a random sample. Another note that should be taken into consideration is the fact that the students were allowed to separate into their own groups. By giving them this choice they would create groups with friends who they most relate to, which further reduces the randomness of the sample. For another testing session, the ideal situation would be to collect a random sample of students in order to receive reliable results.

9.1.3 Automation

There was a large increase in time taken on questions with the experimental group than the control group because they were given boosters such as hints. When hints were given the time varied between test monitors. To reduce the variation, the removal of the human element is necessary and a more automated process should be put into effect. The test should be given through a computer program in order to keep consistency of time. It would also remove all influence of a human contact in order to remove external contact. If students found having another person give the hints to be more engaging then it would skew the results, so an automated test method is preferable.

9.1.4 Monetary System

To improve our money system, we would remove the 25/75 booster since the students favored the 50/50 option. We would also allow students to see long term rewards gained at the end of the test to encourage them to save money instead of hastily spending it on boosters. This way the students would be stimulated to complete problems on their own without the continuous

use of boosters. We would continue the use of the other boosters and rewards in future tests to further examine their potential in the educational gaming world.

9.1.5 Summary

Overall if this test would be done again it would be reworked using the information we had obtained in Design 2. A larger more randomized sample, than the nine students in Design 2, would represent a decent majority of students. Having a larger sample would produce more accurate results producing a lower margin of error. Secondly, having a computerized standard for the test would remove external human contact and therefore students would only focus on the test and would not feel pressured into doing well for those monitoring them.

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11 Appendices

11.1 Appendix A

Encouraging Learning with the Aid of Virtual Money

Power Ups

50/50 – Remove 2 Multiple Choice Answers- **200 Dollars**

25/75 – Remove 1 Multiple Choice Answer -**100 Dollars**

Hint – Ask for a tip -**150 Dollars**

2x dollars – Double Money Received For Next 2 Problems -**50 Dollars**

Kevin Keane
Dennis Leung
Jibin Mathew
Simon Yeung

Quiz 1

Name: _____

1.

There are 100 people at the restaurant. The party of twelve finishes their dessert and leaves. How many people are still in the restaurant?

1. 112
2. 88
3. 78
4. 62

50 Dollars

2.

The frequency table shows the different weights, in pounds, of all the athletes on a team.

Weight	Frequency
160-179	9
140-159	8
120-139	6
100-119	2
80-99	7

🔊 Listen

How many athletes are on the team?

1. 9
2. 25
3. 30
4. 32

50 Dollars

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3.   Solve for x: $3(x - 2) = -9$

1.   1
2.   −1
3.   −7/3
4.   3/7

100 Dollars

4.

For which value of x will the fraction $\dfrac{3}{2x+4}$ be undefined?
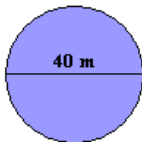
1. –2
2. 2
3. 0
4. –4

100 Dollars

5.

The sum of $3x^2 + x + 8$ and $x^2 - 9$ can be expressed as

1. $4x^2 + x - 1$
2. $4x^2 + x - 17$
3. $4x^4 + x - 1$
4. $3x^4 + x - 1$

100 Dollars

6.

How do you write the circumference of the circle in terms of π?

40 m

1. 10π
2. 20π
3. 30π
4. 40π

100 Dollars

Compare: $685 - 260$ _____ 500

7.

1. <
2. >
3. =

50 Dollars

8. A person's *weight* would most likely be measured using--

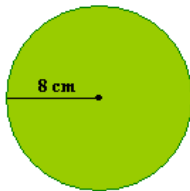1. meters
2. kilograms
3. liters
4. milliliters

50 Dollars

9.

45°

How would you classify this angle?

1. acute
2. right
3. obtuse
4. straight

50 Dollars

---

10. How can you express the area of the circle in terms of π?

8 cm

1. 8π
2. 16π
3. 64π
4. 80π

100 Dollars