HÖGSKOLAN SKÖVDE
Institutionen för kommunikation och information

Positive Reinforcements in e-Learning

Dan Eriksson

Examensarbete i datalogi med inriktning mot dataspelsutveckling
30 hp C-nivå, vårterminen 2010

Positive Reinforcements in e-Learning

Examensrapport inlämnad av Dan Eriksson till Högskolan i Skövde, för Kandidatexamen (B.Sc.) vid Institutionen för kommunikation och information. Arbetet har handletts av Mikael Thieme.

2010 - -

Härmed intygas att allt material i denna rapport, vilket inte är mitt eget, har blivit tydligt identifierat och att inget material är inkluderat som tidigare använts för erhållande av annan examen.

Signerat: _____

Positive Reinforcements in e-Learning

Dan Eriksson

Abstract

This project is a study on the effect on motivation when adding positive reinforcements, in the form of audiovisual rewards, to an e-learning application. Two e-learning applications (designed to teach Japanese Kanji) were created; one *experimental* version with audiovisual rewards (to act as positive reinforcements) and one *control* version without. Two groups of test subjects were gathered, one using the control version, the other using the experimental version. Using questionnaires their experiences and progress were measured, compared and analyzed. The study indicated that the experimental group learned slightly more than the control group, but that there were no difference in overall motivation between the groups.

Keywords: Motivation, positive reinforcements, game development, game design, e-learning

Table of Contents

Table of Contents ..... **I**

1 Introduction **1**

2 Background **2**

2.1 Definition of Commonly Used Minor Terms 2

2.1.1 Japanese Kanji 2

2.2 Reinforcements 3

2.3 Audiovisual Rewards 3

2.3.1 Peggle Deluxe 3

2.3.2 Diablo II 4

2.4 Self-efficacy 4

2.4.1 Source of Self-efficacy 4

2.4.2 Near Miss Instead of Loss 5

3 Problem Definition **6**

3.1 Rewards as Motivation 6

3.2 Purpose 7

3.2.1 Educational Point-of-view 7

3.2.2 Marketing Point-of-view 7

3.2.3 Game design Point-of-view 7

3.3 Method 7

3.3.1 Implementation 8

3.3.2 Testing 8

3.3.3 Analyzing 9

4 Implementation **10**

4.1 The Product 10

4.1.1 Why Adobe Flash? 10

4.1.2 The e-Learning Tool 10

4.1.3 Design Decisions 15

4.2 Experimental Study 16

4.2.1 The Test Subjects Used 16

4.2.2 Questionnaire Before the Test 16

4.2.3 Using the e-Learning Test Application 17

4.2.4 Questionnaire After the Test 18

4.3 Analysis of Data 23

4.3.1 Effects on Motivation 24
4.3.2 Other Effects of the Experimental Version 25
5 Conclusion 26
5.1 Summary of Results 26
5.2 Discussion 26
5.3 Future Studies 26
5.3.1 In-depth Study on Motivation and Sub-groups 27
5.3.2 Study on Learning 27
5.3.3 Professional vs. Casual Learners 27
References 29

1 Introduction

The purpose of this study is to see if there are any positive effects on motivation, as well as measuring any such effects, when adding positive reinforcements (Skinner, 1953) in the form of audiovisual rewards in an e-learning (Stockley, 2010) situation.

Audiovisual rewards as a positive reinforcement in a computer game could be, for example, showing a glinting gold medal and playing the distinctive sound of a cash register closing whenever the player completes a difficult task, or fireworks and rainbows covering the screen while victory music is played (Popcap Inc., 2007). The behavior to keep playing and aiming for a high score is thus *reinforced*. In the same way, this study examines the effects of this concept when used to accentuate success and progress.

The study also attempts to bridge the motivational chasm that may emerge based on the sheer scope of the subject at hand, using the concept of strengthening the user's "self-efficacy" – his own belief that he has what it takes to successfully perform a task (Bandura, 1994). In the same way as Sjödén (2008) in his study on self-efficacy in a game based driving simulator, one can give the user of an e-learning application positive feedback and encouragement upon success and even *near* success. According to Parke & Griffiths (2004) *almost succeeding*, or making a "near miss", may be an important method for slot machines to keep gamblers playing by persuading the players that *they are close to winning*. While gambling is usually pure chance, the concept of this particular form of social persuasion in order to increase self-efficacy should still be usable in skill and effort –based situations such as learning.

There are several reasons to why this is interesting. From a teaching point of view it is interesting to see whether one method of teaching is better than another. From a game design point of view it is interesting to see if game-like elements can increase the quality of learning and motivation. From a marketing point of view, being able to motivate more customers to keep paying for an e-learning subscription service is naturally a positive thing.

Two versions of an e-learning application were created; one control version without an additional reward system, and one experimental version deigned with additional rewards and self-efficacy in mind. The platform used was Adobe Flash CS4 Professional (Adobe Systems Inc., 2008), because it allows for quick prototyping as well as experiment portability due to the fact that most Internet browsers support the Flash plugin.

The subject being taught in the e-learning application is Japanese kanji –symbols (Wikipedia, 2010). Specifically, the users of the application is meant to learn the English translation of a presented Japanese kanji.

Two groups of test subjects were assembled, where one group got to test the control version and the other group the experimental version. This yielded one point of origin (the control version) with which the results from the experimental version could easily be compared.

The experiment sought to examine how much the subjects learned, and using questionnaires it gathered data on the subjects' experience and motivation. This data was then compared and analyzed to see if there were any effects on motivation, what these effects were, and also if there were signs of other effects or phenomena.

2 Background

This chapter explains various concepts and theories that serve as the foundation upon which the hypothesis and reasoning of the study build. First, various minor terms used through-out the report are defined, such as the meaning of “e-learning”, “player” and “progress”, in order to avoid misunderstandings.

This is followed by the theory of reinforcements, and how these can be used in order to reinforce positive behavior in a subject by giving rewards upon success as well as promising more such rewards for further success. This leads in to the subject of audiovisual rewards as a type of reinforcement, with examples of how this is used in games, and how this and similar concepts used to keep customers playing even in casinos might be used to improve the user’s self-efficacy – the *belief* in his capability to successfully perform a task – and therefore help him overcome any potential motivational barrier in learning that might arise from the sheer size of such a task.

2.1 Definition of Commonly Used Minor Terms

This study will be using the term “e-learning” as defined by Stockley (2010), as education through electronic means, or to be more specific, using educational software on a computer accessed either stored on the same computer locally or online over the Internet.

While the audience of this project is not in any way purposely shifted towards any gender in particular, the words “he”, “his” or “him” will be used to describe the subjects in general. Also, it should be noted that the term “player”, “user” and in some cases “student” will all be used to describe the subjects discussed.

The act of a person using a method of learning, and through it acquires knowledge as well as the confirmation of learning, will be referred to as “to progress”. The noun “progress” is used to define the result of that act, in the context of learning. For example, when someone studies a bunch of to him previously unknown Japanese kanji symbols, and then gets a confirmation that he has learned them through taking a test, then he has *progressed*. The summary of what he has learned is, shortly put, his *progress* in learning Japanese kanji.

The term “game-like” will be used to describe elements which stereotypically tend not to belong in applications and tools designed for a professional purpose such as teaching. Though an absolute definition of what a “game” is does not exist at the time of writing due to its highly subjective nature, this paper will use the term to define applications with tendencies toward having built-in goals other than *only* providing the user with externally usable skills and knowledge.

2.1.1 Japanese Kanji

While the central focus of this study is not to specifically observe the effects of positive reinforcements when teaching *Japanese kanji*, it is still the central part of the e-learning application created in order to perform the experiment. The application aims to teach the user the *meaning* of Japanese kanji, but not their pronunciations or how they are correctly drawn. Here follows an overview of what kanji is.

The Japanese written language has 5 different set of symbols. These are called *hiragana*, *katakana*, *Indo Arabic numerals*, the *Latin alphabet* and *kanji* (Wikipedia, 2010). Kanji are in fact Chinese characters and the word “kanji” means just that.

While there are tens of thousands of kanji, only a fixed set of 1006 are expected for Japanese school children to learn during the first six years of elementary school. Yet one need to know an additional 939 kanji in order to fluently read newspapers and literature in Japanese. The total amount (1945 kanji) is expected to be learned before the end of the ninth grade.

Kanji symbols consist of radicals which can be seen as the parts of one kanji. While the main purpose of radicals is to be able to categorize and order the kanji into groups that share the same primary radicals, it is also used as a tool in learning. One way of learning kanji is to create memory stories connected to how these radicals and the kanji *look* in order to help the student associate the kanji with their meanings. This is how the e-learning application constructed for this study works. Illustrations, animations and sounds are used to create memorable stories for each kanji, in the hopes of making a long lasting impression in the user so that he might remember the kanji and the kanji's meaning more easily than if he was *only* presented with the kanji and its literal translation.

2.2 Reinforcements

According to Skinner (1953), a reinforcement is a stimuli added to (or removed from) a situation when a certain action is performed by a subject, in order to reinforce a behavior. In other words, a reinforcement can be giving a cookie to a child every time he completes his homework in order to reinforce the behavior of completing homework in the future, as the child will come to expect the cookie and work to attain it. The cookie is called a *positive* reinforcement as it is *presenting* stimuli. Another way of interpreting this would be to say that the child is *rewarded* for his behavior.

A *negative* reinforcement, instead of presenting stimuli, works by *removing* negative stimuli. For example, a teenager may have to do the dishes and scrub the floors and toilet every day, but if he makes his bed and keeps his room tidy every day instead, he won't have to. So, when he does make his bed and generally keeps his room clean, his parents remove the negative stimuli that is the other household chores. Again, this negative reinforcement can be interpreted as the teenager being *rewarded* for his behavior of cleaning his room, even though the reward is removal of an element.

2.3 Audiovisual Rewards

Audiovisual simply stands for elements with both visual and audible components. The term "audiovisual reward" is used here to define an audiovisual element in an application that is intended to invoke positive feelings in the user, rather than only presenting the user with a more lasting reward (such as points or some form of usable currency). This is a common way to try to increase excitement over a success in games, but also to provide a clear indication to the player that he is doing something right.

2.3.1 Peggle Deluxe

Clear use of audiovisual rewards can be seen in games such as Peggle Deluxe (Popcap Inc., 2007) where the objective is to aim and launch a ball from the top of the screen and then watch the ball bounce around on various "pegs" on its way down to the bottom of the screen, with generally no interaction from the user once the ball has been launched. The game will however present the player with purposely extravagant animations, music and sound effects from time to time as the player succeeds in hitting the correct pegs. As the ball hits all the correct pegs, the bottom of the screen

(which before just acted as a bottomless pit) changes and shows five different lanes into which the ball can fall. At the same time, the game goes into slow-motion, parts of the interface starts flashing in colorful patterns and Beethoven's song "Ode to Joy" starts playing. Hitting the central lane will give the player most points, accompanied by music and an extravagant rainbow covering the entire background. While a high score is generally of lesser interest, hitting all the pegs as well as trying to hit the central lane will become a goal anyway due to the audiovisual reward that is given. Through these positive reinforcements and the promise of more such rewards, the player is motivated to continue.

2.3.2 Diablo II

The game Diablo II (Blizzard Entertainment, 2000) also works with audiovisual rewards to make a reward feel *more than it actually is*, even though it's still the same reward. Diablo II is a game where the player battles large amounts of lesser and larger demons. Very often, these demons drop valuables and gold when killed which flies up into the air before it lands, making a suitable sound as it does so. This means that when gold is dropped by a monster, it will glint and then land with the sound of an actual sack of gold coins being emptied onto the ground.

An example relevant to the study is when the player defeats a boss named "The Countess". When that monster dies she drops a large sum of gold, but instead of dropping one large pile of gold, she starts dropping many small piles of it one after the other. While it would be the same *actual* monetary reward to drop all gold at once, the game makes it feel much more rewarding by filling the ground with small piles of it instead for the player to pick up. The *perceived* reward is larger than the actual one.

2.4 Self-efficacy

Motivation to perform a task may also depend on self-efficacy. Self-efficacy is defined by Bandura (1994) as a person's belief in his own capabilities to perform a specific task successfully. A strong sense of self-efficacy means to have a strong *belief* in one's own capabilities, but it is not necessarily the same as actually *having* these capabilities. In the same way, having a weak sense of self-efficacy does not need to reflect such an individual's actual capabilities either. However, the difference between having a strong and having a weak sense of self-efficacy is that those who believe in their capabilities usually tend to try to actually perform the task, while those who do not believe in their capabilities may be held back and altogether avoid the task.

2.4.1 Source of Self-efficacy

According to Bandura (1994), there are four main sources of self-efficacy. Much like Sjödén (2008) in his experiments with design to improve user self-efficacy in a game based driving simulator, this study chooses to focus on only two of those sources, as the remaining ones more or less fall outside of the scope of what can be dealt with easily in an e-learning situation due to their dependency on human-to-human interaction. The two sources focused on are the following:

- **Mastery experiences.** When a person succeeds in something, he strengthens his self-efficacy because he has proven to himself that he can succeed. In a learning situation, one could develop a method of teaching that at least *starts out* easy enough for beginners to learn new information without much effort.

Then, as the subject feels that he can do it, the difficulty can gradually increase.

- **Social persuasion.** When a person is being told that he has the capabilities to succeed, he may be persuaded into believing so himself, thus strengthening his self-efficacy. In a learning situation, one could compare these following two examples and easily tell that the latter of the two is the one most probable to persuade the student that he has what it takes:
  1. "The last part was easy. It's only going to get tougher and you've a long way to go."
  2. "Keep it up! You are now one step closer to mastering the subject, and are ready to take the next step!"

In the game based driving simulator (Backlund et al. 2008), the difficulty of the game adapts to the users capabilities in order to increase the chance of getting a good score and thus strengthening self-efficacy through mastery. On top of this, it uses written and spoken (audiovisual) cues now and then to inform the player of success, as a means to increase self-efficacy through social persuasion.

2.4.2 Near Miss Instead of Loss

According to Parke & Griffiths (2004), one of the addictive properties of slot-machines may be the concept of "near misses". They mean that instead of presenting the gambler with either concrete wins and losses, slot-machines often present a loss as a *near miss*, giving the gambler a false sense of "being close to win". Of course, the following gambling sessions will have nothing to do with the previous ones as they are based almost entirely on chance which keeps resetting each time the lever is pulled, however the psychology of "being close to winning" is there.

We can again take a look at Peggle Deluxe, which quite literally has an example of what is meant by "near miss". If there is only one peg left in a game session, and if the ball is heading towards it, the game will slow down, zoom in on the ball, play a drum roll, and if the ball just grazes past without hitting, the game will resume in its normal speed and an "aaaw" is played through the speakers. While the sacrifice of trying again is a lot less in Peggle Deluxe than in a real gambling situation, and while there is usually substantially more skill involved in lining up a shot in Peggle Deluxe than in games of chance, the player is still "rewarded" similarly. The player didn't just *miss*, he *almost won*. In a way, we can see this as socially persuading the player that he is better than what we can actually prove by saying that *"you got really far, almost to the goal"* instead of *"you didn't get far enough, you failed to reach the goal"*, hopefully improving self-efficacy.

3 Problem Definition

The purpose of this project is to see if there are any positive effects on motivation, as well as measuring any such effects, by adding positive reinforcements in e-learning in the form of audiovisual rewards (acting as goals in addition to the goal of learning) to accentuate success and progress and to motivate the user to continue and perform.

This chapter explains the problem the study is attempting to examine, and why it is interesting in the perspective of both education, game design and marketing. It also explains and argues for the chosen method, which is to let two groups of test subjects each use one of two versions of an e-learning application (one with and one without added audiovisual rewards) and then compare their results and experiences.

3.1 Rewards as Motivation

While the accomplishment of learning and retaining new knowledge can be considered rewarding for the player, and that that in itself has the possibility to reinforce the behavior of studying (thus progressing), it makes no sense to stop at that if we can increase that possibility even further.

By giving the player additional feedback externally via audiovisual rewards, we don't just rely on himself to form a sense of accomplishment, but give him a more tangible confirmation of it. By promising more such rewards in the future at the cost of continued effort from the player, a behavior can thus be reinforced as it will act as a motivator. The player knows what he has to do in order to get more such rewards.

Using reinforcements to motivate a behavior in the user is only one thing, however. *Knowing* what to do, that there are rewards for successfully doing so, and even *wanting* to reach the rewards may not automatically result in the player actually attempting – especially if the effort is daunting and difficult. He must believe in his ability to reach his goals, or in other words, he needs to have a strong sense of self-efficacy. By giving the player praise to accentuate success, the application can help strengthen the player's sense of self-efficacy through *mastery experiences* as mastery becomes more apparent and obvious.

However according to Bandura (2004), giving a person rewards for easy successes to strengthen self-efficacy may actually backlash if or when he eventually faces defeat, as he may have come to expect easy and quick victories. Thus, an e-learning application can't give the user big rewards *too* frequently or for every small victory, but only for victories that require a relatively substantial effort. But then again, this would defeat the concept of giving the user constant rewards for success in order to strengthen self-efficacy. This is where the concept of "near miss" might be utilized.

In slot-machines, a "near miss" might be considered to strengthen the gambler's belief that he can win big if he keeps going and that victory is just around the corner, even though the game is all about chance. If the illusion of "near miss" were to be replaced with a "you win" and "you lose" sign, the gambler would probably not be as motivated to keep playing. Instead, he is persuaded (by a form of *social persuasion*) that he can win if he keeps playing. In an e-learning context however, chance is obviously replaced with actual effort and a relatively high amount of direct control of the outcome of the effort.

So, instead of giving the user of an e-learning application rewards for every small victory (which might backlash), and instead of presenting only more difficult

challenges and giving rewards only when overcoming them (which might prove too difficult and unrewarding), can the concept of “near miss” be injected to replace much of the “defeat” part of the spectrum and thus persuade the player that he actually not just “failed” but instead “was close to success” and thus avoid damaging his sense of self-efficacy (and maybe even strengthen it)?

3.2 Purpose

The purpose of the study is to see if there are any effects on motivation, and attempt to measure them, when extra rewards is added in an e-learning environment. There are several reasons why this study is interesting.

3.2.1 Educational Point-of-view

From an educational point-of-view, it is of great value to see if one method of learning is more successful in motivating further study than another, as is trying and pinpoint exactly what makes one method better than the other. If the matters taught by one method are the same as another method, but one of the methods motivate their users to study harder and/or for longer periods of time, it will be assumed that this particular method is more successful than the other.

3.2.2 Marketing Point-of-view

From a marketing point of view, it is interesting to see whether a product fitting for a monthly subscription fee can retain paying customers better than another product. This is where trying to shift the application towards being more of a game with addictive properties becomes more apparently interesting. If the player can be made to want to keep playing through relatively simple means, then you have a higher probability of that customer renewing his subscription.

3.2.3 Game design Point-of-view

From a game design point of view it is of interest to see if a more game-like system is more successful at teaching Japanese letters than an “e-learning application”. How far can it be taken if proven successful? What happens with e-learning when it turns more into a game? What happens with a game that starts leaning towards e-learning? Can both game and e-learning be successfully combined to cater both people looking for a game and people looking to learn?

3.3 Method

The practical part of this study aim to find whether there is validity in the hypothesis, by a number of steps.

- **Implementation** and preparation of two prototype e-learning applications. One prototype version with added positive reinforcements, and one without. This allows for a straight-forward study on any differences in experiences between test subjects using the different versions.
- **Testing** the two prototypes on two different groups of test subjects.
- **Analyzing** test data from the two groups, and comparing them to see what conclusions can be drawn.

3.3.1 Implementation

Two versions of an e-learning application will be created. The base functionality of both applications should be the same, encompassing the following:

- Being able to teach a number of Japanese kanji symbols.
- Being able to give the player challenges and tests, in the form of relatively isolated minigames, intended to find out how much he has so far learned. The minigames can be selected freely by the player, but the kanji appearing in them will be selected by the application based on what kanji the player seem to know least.

This should be considered the "control" version of the application, providing a point of origin with which the results of the second version can be compared. The second "experimental" version of the application will get an added layer of positive reinforcements.

These positive reinforcements include the following:

- Whenever the player shows a certain amount of progress by succeeding in minigames, he will be presented with purely audiovisual rewards (in the form of animations, sound and encouraging words) showing clearly how much progress he has made.
- Acquirable bigger rewards unlocked by progressing in the grade past certain milestones, more or less evenly spread out over the grade. These milestones will always be visible, and are intended to act as motivation to keep progressing.

3.3.2 Testing

To test the hypothesis (that extra rewards *do* effect motivation positively), two test groups will be assembled. One group will be presented with the control version of the application, and the other group with the experimental version. They will be given a small test on paper in the beginning, where their knowledge in a set of kanji will be tested. They will then be given an introduction to how to use the application, and then be given 20 minutes to sit with their versions. When the time is over, they will be asked a couple of questions about their experience and motivation when using their application. After this, they will be given a kanji knowledge test again on paper, where we will be able to see how much they have learned.

Note, however, that this study does not aim to examine *knowledge retention* over a longer period of time, in which case an additional knowledge test several weeks after the initial test would be needed. This study only measures how many kanji were learned at the time of the experiment, and because the knowledge test happens immediately afterwards the results cannot be used to derive any substantial conclusions regarding knowledge retention.

The questions given in the test aim to find out about the subject's feelings about the application they got to use and to what extent they believed they had learned anything, how much they believed in their ability to progress and learn more through this method, and whether they wanted to continue using the application or not.

This method yields a point of origin (the control version) showing how subjects use the application in its normal purely "teaching" state. Then by adding only audiovisual

reward elements to that application and testing it (the experimental version) we get a set of data that can directly and easily be compared to the point of origin.

Also, it is of interest to try and establish exactly how much the subject's actually wish to learn Japanese kanji, and for what reasons; whether for professional reasons, day-to-day use, or just casually and "for fun". This might affect the outcome of their actual intake of new knowledge in some way, and might also affect how they perceive the arbitrary rewards given in the e-learning application.

3.3.3 Analyzing

The results from their individual tests, before and after they used the application, will be compared to see if there are any distinct differences in amount of new information learned between the control and experimental versions of the application.

Their answers on the questionnaire will be compiled and compared to see if there are distinct differences between the control and experimental versions of the application. Individual scores, regardless of version used, will also be compared to see whether perhaps the greatest differences are not between versions but instead between users and their aspirations.

4 Implementation

This chapter explains decisions, functionality and important design regarding the e-learning application used in the study. This is followed by a description of the test procedure, the test subjects used, the questionnaires they answered as well as the raw data gathered, and an analysis of this data.

4.1 The Product

This sub-chapter gives a brief overview of the e-learning application (both the "control" and "experimental" version) and why the Adobe Flash CS4 Professional (Adobe Systems Inc., 2008) platform is used. It explains how to use the e-learning application as a tool in this study and how it works from the perspective of an end-user. This is followed by an argumentation of important design decisions related to the study and how positive reinforcements and self-efficacy theories are applied to them.

4.1.1 Why Adobe Flash?

There are several reasons to why the Adobe Flash platform is used for this project.

- Adobe Flash is an effective tool to create quick prototypes, especially when it comes to interface design (which is the focus of this study). There are usually only a few steps between an idea and a visual implementation of that same idea.
- Tests for the study at hand can relatively easily be performed remotely if needed, as long as the test subject has access to a computer, a browser with the latest Adobe Flash player, and an Internet connection.
- The product is a prototype of what might in the future become a commercial online service. That idea is that people from all around the world shall be able to go to a specific website and use the application from their Internet browser for a fee. Most major Internet browsers support it and there is little need to conform to any specific hardware or operating system, thus we get an as broad an audience as possible.
- Having all resources accessible online for developers makes it possible for collaborative work where, for example, graphical artists can add animations and new lessons while the work on the application continues independently. This helps eliminating the bottle-neck that might occur of only one person in the team is able to add new content.

4.1.2 The e-Learning Tool

The main purpose of the application (both versions) is to teach Japanese kanji symbols, using an array of "lessons" containing colorful and often humorous animations, sounds and stories explaining the appearance of each kanji. The concept is to make a long lasting impression in the user by deliberately being "over the top" and not seldom far-fetched.

In the images below, elements of interest will be explained in more detail using ➲ symbols followed by letters. These same symbols can be found (with their respective letters) placed next to the elements in question inside the previously mentioned figures.

When using the application, the user must first run the SWF-file (or navigate to a webpage which starts the SWF-file for him). The application will then show a login screen, where the user will only be required to click the “Enter” -button without filling in any specific login information.

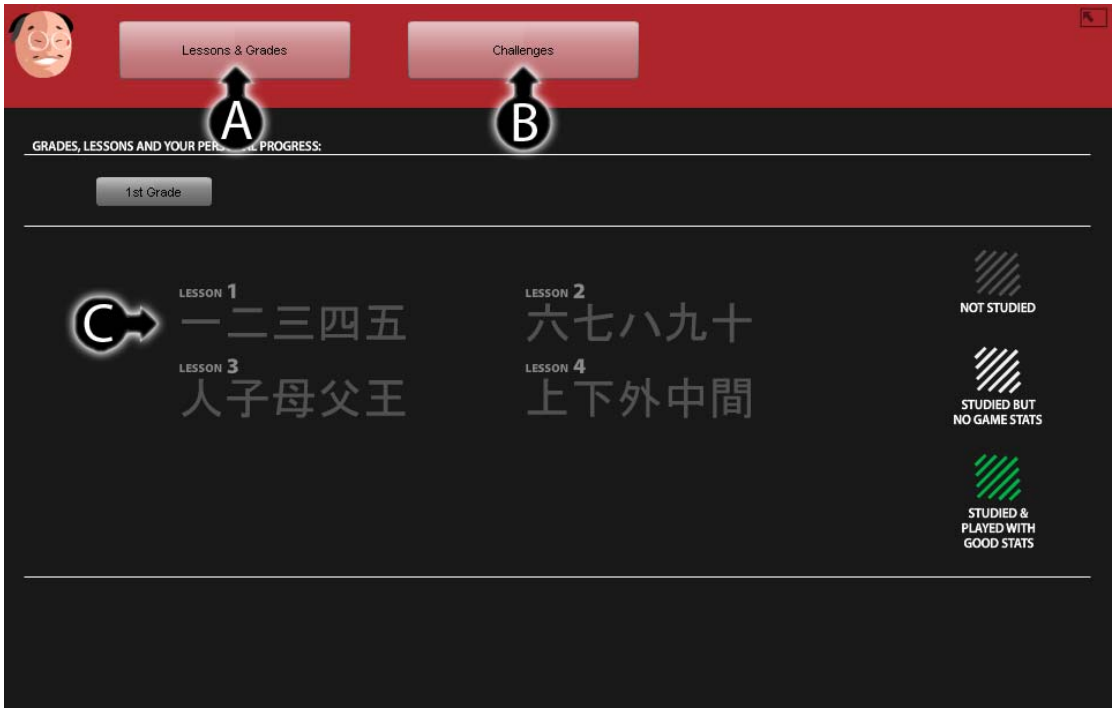

Figure 1

After this, the user is taken to the “Lessons & Grades” screen (Figure 1). At the top there are two buttons (➧A and ➧B) which takes the user to either the “Lessons & Grades” screen (the current screen) or the “Challenges” screen (a screen showing all available minigames). These can be clicked at any time during the use of the application to immediately end any lesson or challenge and go to that screen.

In “Lessons & Grades”, the user can browse the various grades in the game (currently showing only one grade called “1st Grade”) by clicking the respective button at the top of the black field.

By selecting a grade in this manner, an overview of all available lessons (with icons showing the kanji within those lessons) is shown in two columns beneath the grade buttons. Initially, these lessons and their kanji are all colored grey, but once the user has taken one of the lessons and encountered various kanji, those kanji will light up in white.

Clicking one of the lessons in this overview (➧C) will take the user to that particular lesson.

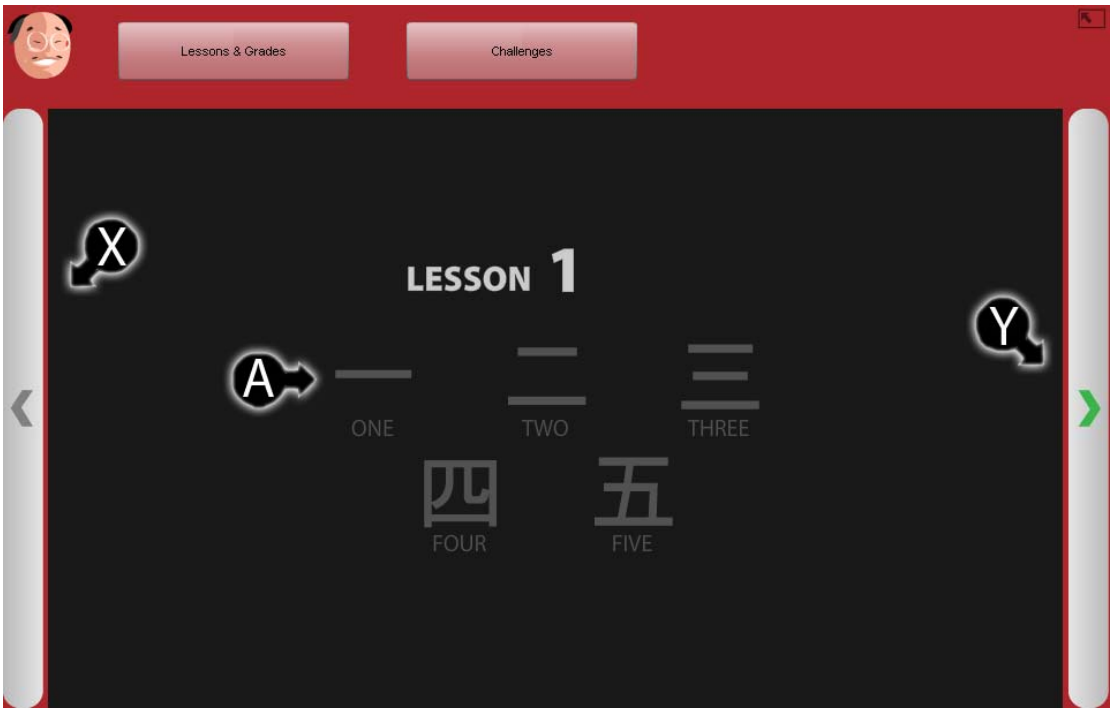

Figure 2

On the lesson front page (Figure 2) he can choose to either keep clicking *next* (Y) to view the lessons for each kanji in order, or he can simply click one of the kanji (A) on the lesson front page to be taken to that kanji instantly. Just like in the "Lessons & Grades" screen, kanji are colored either grey (the user have not yet seen its lesson) or white (the user has viewed that kanji's lesson). The user can also navigate backwards in a lesson by clicking *previous* (X).

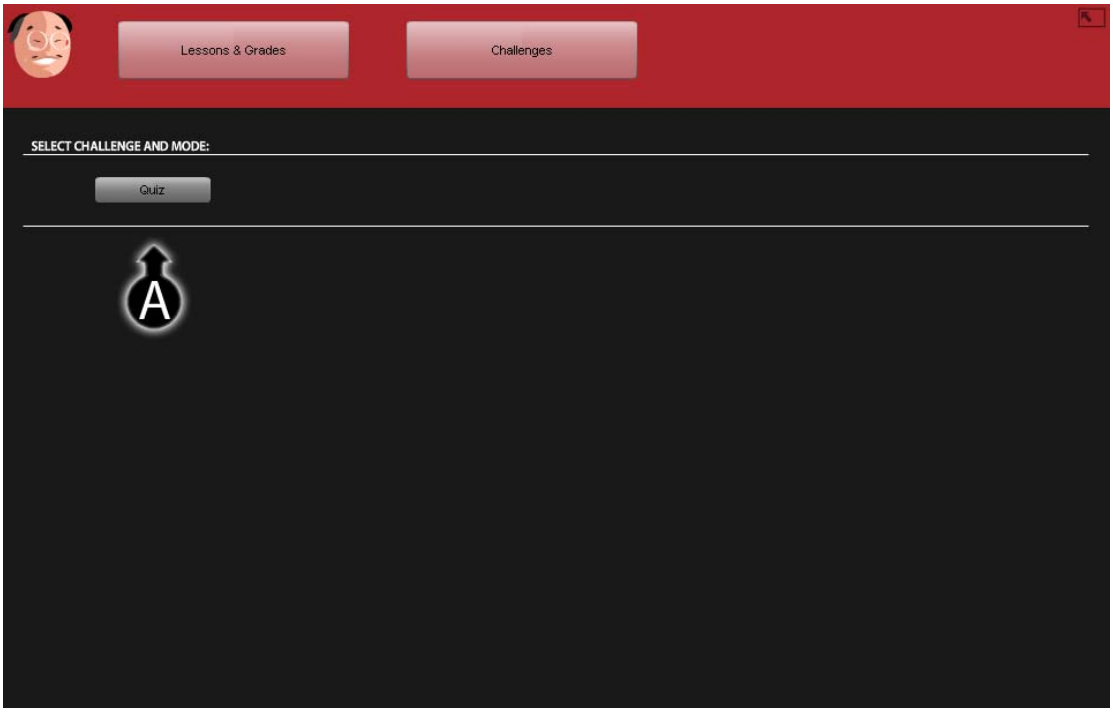

Figure 3

When clicking "Challenges", we are taken to a screen (Figure 3) similar to the "Lessons & Grades" screen, but instead of showing a selection of grades, we show a selection of minigames. These are small games of various kinds that challenge the

user's knowledge in the kanji he has encountered in lessons so far. The application used in this study has only one challenge called "Quiz" (●A).

The purpose of challenges is to see how many kanji the user has learned. A challenge calculates a score for each kanji based on for example how many times a kanji was correctly and incorrectly identified, and after the challenge is completed (or failed) this data will be analyzed to see whether the user has actually improved or not.

Figure 4

The difference with the *control* version of the application and the *experimental* version (Figure 4) is that while both keep track of the user's progress in the same way, we only show it by coloring the kanji white or green in the control version (●A), whereas in the experimental version we also show a colorful progress bar with collectible silver and gold tokens (●B). This progress bar fills with white for each kanji that the user has encountered in lessons, and with green every time the user proves he learns by doing challenges. It also shows milestones; special points on the progress bar that, when reached, unlock something extra (in this case gold and silver tokens that do nothing other than aim to give a more tangible feeling of achievement).

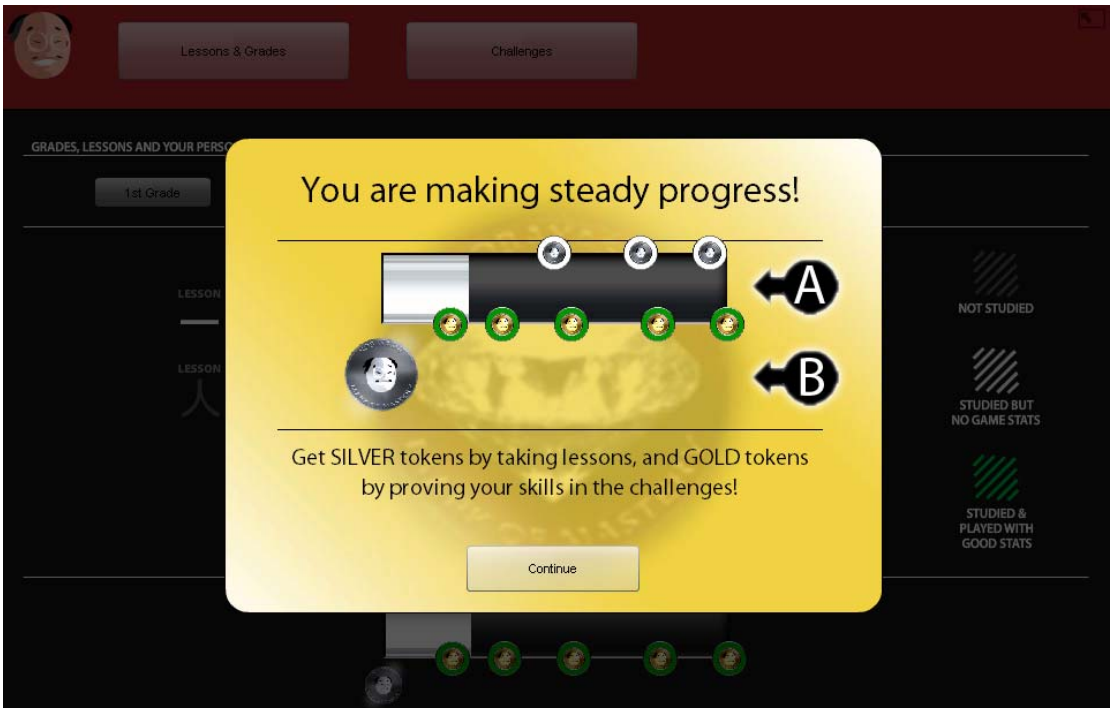

Figure 5

Also, every time the user has completed a challenge or lesson in the experimental version and increased his kanji score, a popup will appear (Figure 5). This popup will essentially show the same progress bar (A) as can be seen on the "Lessons & Grades" screen, however this one will also show (using animation and sound effects) how the progress bar grows from its previous state to the new one. If the progress bar passes coins on the way, there will be an audible "ping" sound as they too animate and move down to a row (B) beneath the progress bar, indicating that the user has "collected" these coins.

In addition to this, the user will be given positive verbal feedback in the form of a text just above the "Continue" –button depending on the degree of progress (referred to as *white* or *green* progress). Following is a complete list of this feedback (in order of priority where the first alternative is checked first and last is checked last, overriding any potential previous feedback alternatives) and an explanation of when they are shown:

- When neither white nor green progress is 100%: *"Get SILVER tokens by taking lessons, and GOLD tokens by proving your skills in the challenges!"*
- When white progress is 60% or greater and green progress is 50% or greater: *"You are well on your way! Get more SILVER and GOLD tokens by taking more lessons and more challenges respectively!"*
- When white progress is 65% or greater and green progress is lower than 5%: *"Don't forget to try your skills on some challenges where you can collect GOLD tokens!"*
- When white and green progress is the same, but none of them is 100%: *"Don't forget that challenges will ONLY test your skills in those kanji that you've encountered so far in lessons!"*

- When white progress is 100% but not green progress: *"You have taken all the lessons of this grade! Now try some challenges and aim for the GOLD tokens!"*
- When white progress is 100% and green progress is 35% or greater: *"Do you find it hard to get those GOLD tokens? Maybe you should refresh your memory with some lessons!"*
- When white progress is 100% and green progress is 85% or greater: *"You are ALMOST there! Refresh your memory with lessons if you need to, then get those last GOLD tokens!"*
- When both white and green progress is 100%: *"You have completely nailed this grade!"*

4.1.3 Design Decisions

The choice to use a colorful bar to show the user's progress was based on the principle of having overview and being able to clearly see *how much had been done and how much was left*. The colors white and green is taken directly from the colors that are used to show the state of the different kanji, where the white progress bar shows how many of the grade's kanji had yet been encountered in lessons, and where the green progress bar shows the "challenge progress" for all kanji in the current grade.

If the user's progress has improved after a lesson or challenge, a popup will appear showing the progress bars grow (as mentioned in 4.1.2). There will also be messages giving positive remarks about the progress, aiming to improve the user's self-efficacy through social persuasion. When the animated progress bars reach coins, the coins will be "collected".

The "milestones" (the various coins spread out across the progress bar) are intended to provide an incentive to keep on studying and taking challenges, and also to provide an additional sense of achievement, improving self-efficacy through mastery experiences. Each time the user progresses enough, a coin is collected, and the user is rewarded with positive feedback. This aims to positively reinforce the behavior of wanting to get to the next coin, which can only happen by putting effort into studying and taking challenges.

There are two kinds of coins; gold and silver coins. The silver coins have white borders before they are collected, and the gold coins have green borders. The reason for the colored borders is to clarify that the coins are collected by increasing its respective progress bar. The silver coins can only be collected by increasing the white progress bar, which admittedly is very easy, since the user only has to quickly peek at a kanji lesson for the application to increase the white progress bar. The gold coins, require the green progress bar to increase which is a lot more difficult as this requires the user to have actually learned some kanji and done well in challenges. Coins are essentially nothing more than an extension of the progress bar, and have no value other than being "pretty" and providing the user with a more tangible feeling of success.

The coins act as a source of motivation in that they are fairly spread out and not far in-between, so the user is always relatively near the next one even though he might just have collected one. They also aim to provide the user with "near misses", motivating the user to perform just a little bit more in order to reach that next glinting coin.

4.2 Experimental Study

First, details of what test subjects were used, and why those particular individuals were picked. This is followed by details of how the experiment was conducted, what questions were asked before and after the test and why, as well as a compilation of the collected data of interest.

4.2.1 The Test Subjects Used

A total of eight test subjects were picked from the author's immediate social network due to convenience and a restricted time budget. This group was divided at random into two groups, one given the control version of the test and the other group given the experimental version.

The test subjects will be referred to simply as **subject 1** through **8**. Subjects 1 through 4 are the members of the control group and subjects 5 through 8 are the members of the experimental group.

Although the project does not aim to be directed towards one gender in particular, one would probably prefer a more balanced distribution of men and women than the current one (one single female in one of the groups, while the rest are male). If there is indeed a difference in how men and women experience parts of the test, there will not be enough data in this test to make any assumption as to what these differences are or why they are there.

The age of the test subjects are ranging from 25 and 30. Again, not a conscious choice, but simply the result of limited resources. However, the similarity in age *might* normalize some data spikes that might occur due to age differences, removing the age difference as a variable and giving this relatively small study more focus. While it would be interesting to study whether one age group feels more or less motivated by different things than other age groups, the focus and scope as well as time of the study do not permit it.

Most subjects had some experience in game development either professionally, academically or both. This was not the goal but simply the result of having picked subjects from the author's social network. None of the subjects knew what the goal or focus of the study was before they took part in the experiment.

In order to avoid contaminating questionnaire answers, the subjects were informed that the absolute best and most useful thing for the study was that they answered truthfully about everything, and that there were no such thing as bad criticism.

4.2.2 Questionnaire Before the Test

Each test subject, regardless of whether they were given the control version or the experimental version, were given a series of questions before they used the application.

The first question was "*Do you aspire to someday learn Japanese kanji?*" to which the subject could answer either *yes* or *no*. If they answered yes, they got to answer the question "*What is the reason for wanting to learn Japanese kanji?*" with a number from 1 to 10, where 1 would be a purely personal interest, 10 would be a purely professional reason, and 5 would be equal amounts of both reasons (see Table 1 and Table 2 for results). The reason for this question was to be able to see if there are differences in experience between subjects who wish to learn kanji for professional purposes, personal purposes and those who do not aspire to learn kanji at all.

	Subject 1	Subject 2	Subject 3	Subject 4	*average*
Do you aspire to learn?	no	yes	yes	no	-
Reason to learn (1 = personal, 10 = professional)	-	1	1	-	*of those what answered "yes": 1*

Table 1 Control group's answers to first two questions

	Subject 5	Subject 6	Subject 7	Subject 8	*average*
Do you aspire to learn?	yes	yes	yes	yes	yes
Reason to learn (1 = personal, 10 = professional)	3	3	4	3	*3,25*

Table 2 Experimental group's answers to the first two questions

Next, the test subjects were given a sheet with all the 20 kanji (in random order) that appear in the application, and were given the task to type the English translation of all and any of these that they knew (see Table 3 and Table 4 for results). The reason for this was to find out what they knew so that any knowledge gain after the use of the e-learning application could be measured.

	Subject 1	Subject 2	Subject 3	Subject 4	*average*
Correct answers (maximum: 20)	0	0	3	3	*1,5*

Table 3 Control group's results on the first knowledge test

	Subject 5	Subject 6	Subject 7	Subject 8	*average*
Correct answers (maximum: 20)	0	3	0	0	*0,75*

Table 4 Experimental group's results on the first knowledge test

4.2.3 Using the e-Learning Test Application

Each test subject was instructed on how to use the application, screen-by-screen, and what to expect from a lesson. As an example, the lesson pages for kanji "one" was used. The subject was then asked to restart the application so that all progress was reset. Then they were given 20 minutes to simply use the application, look at lessons and try their skills with the "Quiz" challenge. Regardless if they felt that they hadn't covered all lessons within this time, or if they in fact felt that they had seen it all and achieved full score on all challenges, they were instructed to use the application until the 20 minutes were over, not more and not less.

At the end of the 20 minutes, they were told to simply close down the application completely, and open up the second and last questionnaire.

4.2.4 Questionnaire After the Test

The second questionnaire contained mostly the same questions for both the control and experimental version, the difference being a few additional questions for the experimental version.

The first five questions were the same for both groups, and aimed to find out how the subjects felt about the test and their abilities. The questions were as follows (see Table 5 and Table 6 for results, and Figure 6 for a comparison of the averages of both groups):

- *How much progress did you personally feel you made?*

  An answer from 1 to 10 was requested, where 1 meant *no progress* and 10 meant *good progress*. The data gathered from this is of less direct interest for this study, due to the lack of definition of what *progress* actually is and so can mean different things to individual test subjects.

- *How many of the Japanese kanji do you think you learned?*

  The answer was a number from 1 to 10, where 1 meant *none* and 10 meant *all*. The reason for this question was to find out if there was a greater difference in perceived progress and actual progress between the control and experimental groups. In retrospect it would have been better to make the scale 0 to 20 to match the amount of kanji in the test. In this way, a 1:1 comparison of the knowledge test results could more easily be made. See Figure 10 for a comparison of this data (converted to a scale from 0 to 20) and the actually learned amount of kanji.

- *Would you have liked more than 20 minutes time?*

  Again the answer was a number from 1 to 10, where 1 meant *not at all* and 10 meant *definitely*. The reason for this question was simple – if a subject felt that he wanted more time, then this could indicate that he was more motivated to continue than one who did not want more time.

- *Did you have time to watch all kanji lessons?*

  Answer from 1 to 10, where 1 meant *no*, 5 meant *missed half* and 10 meant *yes*. This is a question to find out if they actually had time to watch all lessons, which is more or less required for them to learn the meaning of all kanji. The aim with the test was to give them barely enough time to feel *done*. Since they could use the application in more or less any way they wanted, skip lesson pages, and watch lessons and try challenges in any order they liked, it was impossible to find a general time limit that would encompass all potential situations without making it too short to get "into it" for some of the test subjects.

- *How well did you feel you did on the Quiz challenge?*

  A number from 1 to 10, where 1 meant *bad* and 10 meant *good*. Again, a question to find out if there was any difference between perceived success and actual success between the test groups. The results on this question can be seen in Table 5 and Table 6, but also in Figure 10 (converted to a 0 to 20 scale) where it is being compared with *perceived* and *actual* amount of kanji learned.

	Subject 1	Subject 2	Subject 3	Subject 4	*average*
How much progress did you feel you made? (1 = none, 10 = good)	7	9	10	10	*9*
Amount of kanji learned? (1 = none, 10 = all of them)	4	9	10	10	*8,25*
Did you want more time? (1 = not at all, 10 = definitely)	4	2	3	5	*3,5*
Had enough time to watch all lessons? (1 = not at all, 10 = definitely)	10	10	10	10	*10*
How well did you do on the quiz challenge? (1 = bad, 10 = good)	5	9	10	10	*8,5*

Table 5 Control group's answers (on scales from 1 to 10) on how they felt about their experience

	Subject 5	Subject 6	Subject 7	Subject 8	*average*
How much progress did you feel you made? (1 = none, 10 = good)	7	10	8	10	*8,75*
Amount of kanji learned? (1 = none, 10 = all of them)	8	8	10	10	*9*
Did you want more time? (1 = not at all, 10 = definitely)	3	6	4	1	*3,5*
Had enough time to watch all lessons? (1 = not at all, 10 = definitely)	9	10	10	10	*9,75*
How well did you do on the quiz challenge? (1 = bad, 10 = good)	10	10	8	10	*9,5*

Table 6 Experimental group's answers (on scales from 1 to 10) on how they felt about their experience

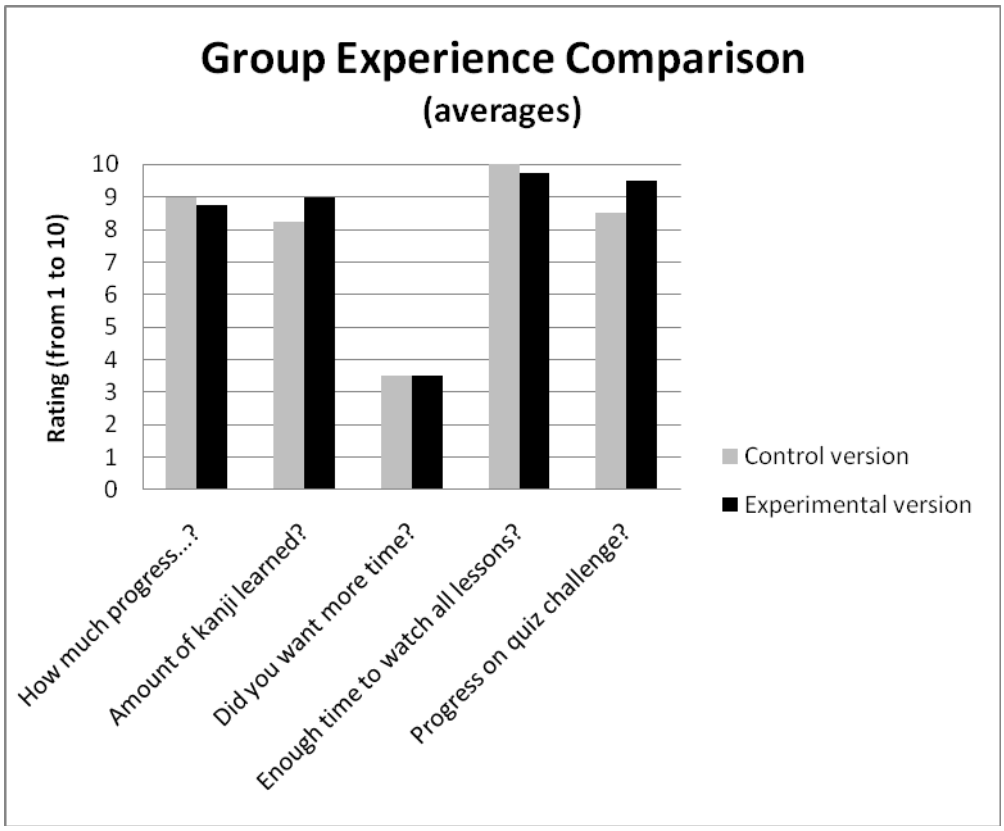

Figure 6 Comparison of Control and Experimental group's experiences (averages)

The next question asked the test subject to rate a couple of elements in the application ("*What motivated you most to continue?*"), from motivating them least to continue (lowest score), to motivating them most to continue (highest score). One of the alternatives was "*I was not very motivated at all*", and the test subject was informed that if that alternative was true, then give it a high rating.

The elements in both the control and experimental version were *"1. Watching new lessons", "2. Learning new kanji", "3. Taking Challenges", "4. I was not very motivated at all".*

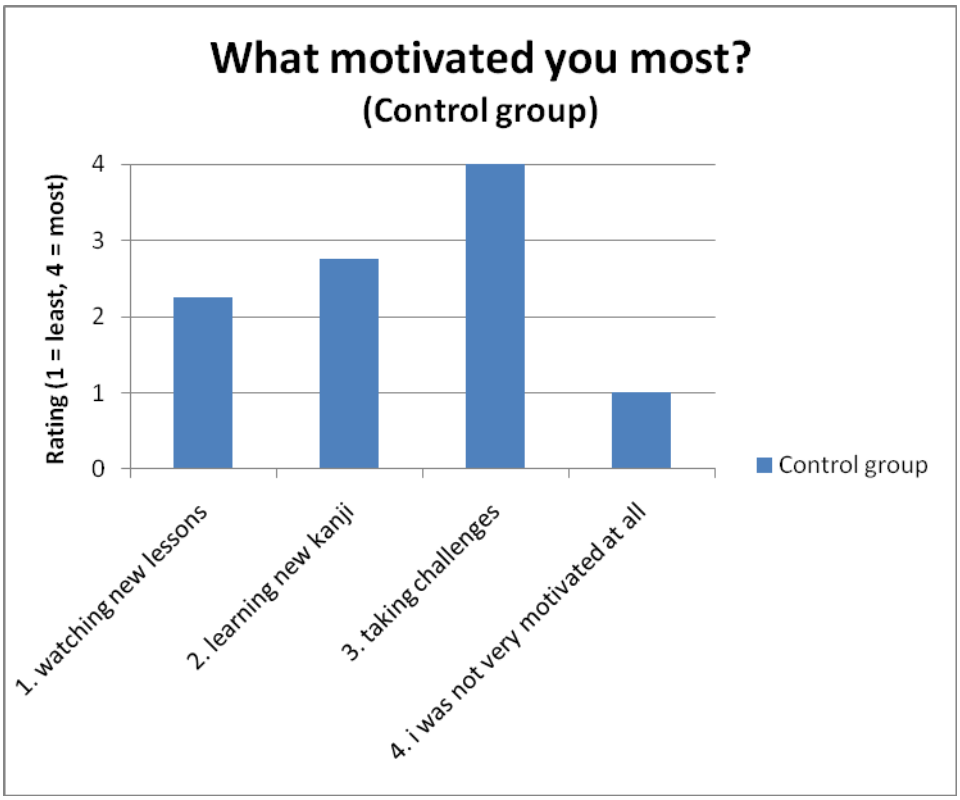

Figure 7 Control group's average answers on what motivated them most

In addition to those, the experimental version also contained a "*4. Progressing and collecting tokens*" –element, making *"I was not very motivated at all"* number *5* in this list.

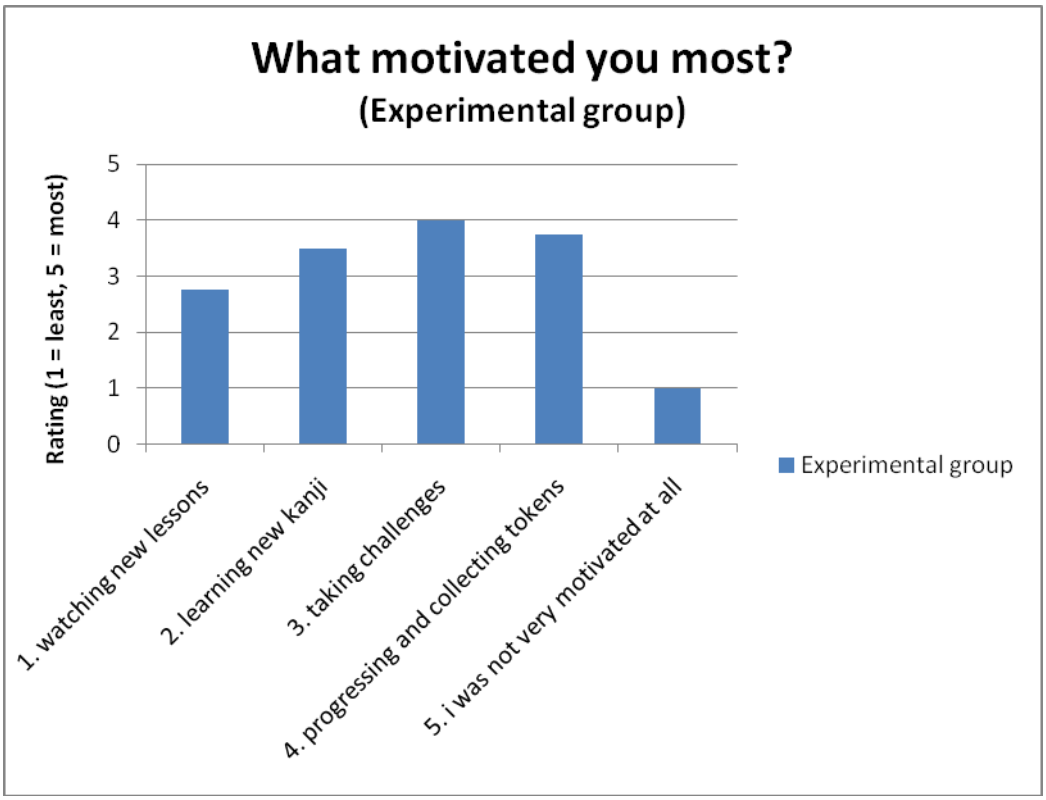

Figure 8 Experimental group's average answers on what motivated them most

Although this question differs between the control and experimental version and its results cannot therefore be *directly* compared, it might show what motivated the individual groups most, but also if certain mutual elements scored remarkably lower in one group than in the other, potentially indicating a shift in what drove the subjects forward. See Figure 7 and Figure 8 for the average ratings for the control and experimental versions respectively.

Next followed a series of questions for the subjects of the **experimental version only** (see Table 7 for results):

- *Did you collect any silver tokens?*

  The test subject were asked to type the amount of silver tokens collected, where 4 meant *all*.

- *Did you collect any gold tokens?*

  The test subject were asked to type the amount of gold tokens collected, where 5 meant *all*.

- *How did you feel about the reward popup screen?*

  An answer from 1 to 10 was requested, where 1 meant *encouraging*, 5 meant *didn't make a difference*, and 10 meant *discouraging*.

- *Did the reward screen feel in the way?*

  To this the subject would give a *yes* or *no* reply.

	Subject 5	**Subject 6**	**Subject 7**	**Subject 8**	*average*
Silver tokens collected (4 = all)	4	4	4	4	*4*
Gold tokens collected (5 = all)	4	5	5	4	*4,5*
Opinion about reward popup? (1 = encouraging, 5 = neither, 10 = discouraging)	1	3	1	3	*2*
Did the reward screen feel in the way?	no	no	no	no	*no*

Table 7 Experimental group's answers on questions regarding the additional rewards

Next, the test subjects from **both groups** were given another knowledge test sheet with the 20 kanji from the application (results in Table 8 and Table 9, and a comparison of averages for both groups *before* and *after* in Figure 9), again in a random order different from the sheet shown before the test.

	Subject 1	**Subject 2**	**Subject 3**	**Subject 4**	*average*
Correct answers (maximum: 20)	**13**	**18**	**20**	**20**	*17,75*

Table 8 Control group's results on the second (final) knowledge test

	Subject 5	Subject 6	Subject 7	Subject 8	*average*
Correct answers (maximum: 20)	**16**	**19**	**16**	**20**	*17,75*

Table 9 Experimental group's results on the second (final) knowledge test

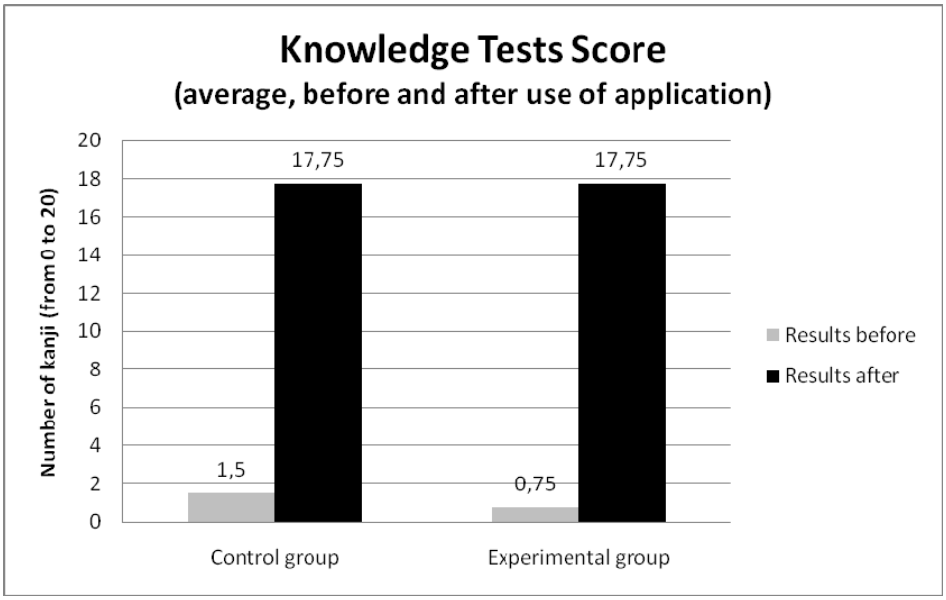

Figure 9 Both groups' average score on both knowledge tests

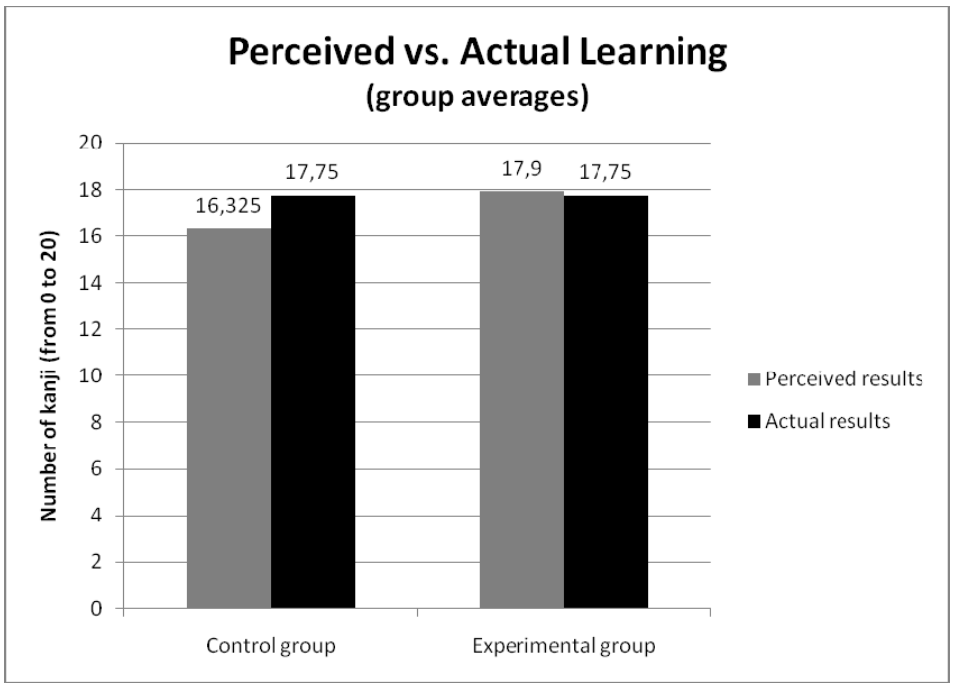

Figure 10 Both groups' average perceived amount of kanji learned vs. actual amount learned

4.3 Analysis of Data

This section provides an analysis of the retrieved data to see if there are any effects on motivation when using the experimental e-learning application compared to the control version. It also explores if there are signs of effects on other things as well,

such as learning, and examines differences and tendencies within the groups, and what they might indicate.

4.3.1 Effects on Motivation

According to the results on "*Would you have liked more than 20 minutes time?*", there is no difference on the average answer between the control and experimental groups. As this question is the one that most directly tries to measure the subject's motivation (specifically *desire*) to continue, this would indicate that the exclusively experimental reward features yield no positive effect on motivation.

In the control version (Figure 7), the item scoring highest (on "*What motivated you the most to continue?*") was *"Taking challenges"* followed by *"Learning new kanji"*, and then *"Taking lessons"*. In the experimental version (Figure 8), the items came in the same order apart from *"Progressing and collecting tokens"* taking second place between *"Taking challenges"* and *"Learning new kanji"*. This suggests that although the extra rewards did prove motivating, it was the challenges that generally motivated the most in both groups.

According to the results, the test subjects in the experimental group that leaned towards wanting more than 20 minutes were the ones who gave "*Progressing and collecting tokens*" slightly lower rating. On the other hand, those who did *not* want more than 20 minutes gave "*Progressing and collecting tokens*" the highest possible rating, which might indicate that the extra rewards were not that motivating at all compared to the rest of the items.

Those that wanted more time gave "*Taking challenges*" the highest rating instead, followed by "*Learning new kanji*". Couple those subjects' general opinion regarding time with the fact that they were the only ones who actually collected all the tokens, and it might suggest that they were driven more by a desire to learn kanji and proving their gained knowledge from the beginning than by the extra rewards. Because one possible conclusion would be that they were motivated most by collecting tokens *first* but then shifted their focus to challenges once they were done with the tokens. However, then it would seem more likely that they would not want more than 20 minutes, as then they would have reached their goal already.

This, in turn, might suggest that there were two groups within the experimental group. One that were driven primarily by learning but little interested in the extra rewards, and one that were driven primarily by the extra rewards but also about learning and proving their skills. In the control group, however, no such distinction can be seen in what motivated them most as all subjects in the group rated "*Taking challenges*" the highest, followed by "*Learning new kanji*" by all but one of the subjects.

A question that arises from this is what would have happened if the subjects in the experimental group, who rated "*Progressing and collecting tokens*" highest followed by items *other than* the otherwise unanimously popular "*Taking challenges*" –item, had instead used the control version. Would the lack of extra rewards and tokens have caused them to shift their focus towards "*Taking challenges*" instead, or would they have stood out here as well and perhaps rated "*Learning new kanji*" or "*Watching new lessons*" the highest since these were their second choices in the current test? This, however, is a question that cannot be answered without a new test or the use of many more test subjects.

4.3.2 Other Effects of the Experimental Version

The results from both the *before* and *after* knowledge tests (Figure 9) shows the same average *after*-score (17,75) for both the control and experimental group, but the fact that the experimental group scored lower (0,75) than the control group (1,5) at the *before*-test suggests that the subjects of the experimental group learned slightly more than the control group. However, within the experimental group, there is no tendency towards a higher score for those most motivated by the exclusively experimental reward features, suggesting that these features caused little or no positive effect at the subjects' ability to learn.

Also, there is a difference in perceived amount of kanji learned in both groups (see Figure 10). In the control group, the subjects believed in average that they had learned less kanji than they actually had. On the other hand, the experimental group believed in average the opposite. Looking at the individual subjects' answers however, a high variation in answers can be seen inside the groups, making it difficult to say for sure if these averages would remain would the amount of test subjects have been increased.

5 Conclusion

This chapter gives a summary of the results which is a lack of effect on motivation but instead a slight positive effect on learning. It is followed by a discussion of the potential value of audiovisual reward systems in e-learning, and ends in a discussion about future studies based on the analysis and conclusions of this study.

5.1 Summary of Results

The purpose of the study is to see if there are any effects on motivation when positive reinforcements (Skinner, 1953) in the form of audiovisual rewards are added in an e-learning environment.

The results of this study indicate that there is generally no effect on motivation when audiovisual rewards are added. The subjects who reported these rewards as the most motivating factor were, in fact, the least motivated subjects in the experimental group. However, the results do indicate that the subjects using the application with extra audiovisual rewards learned slightly more than the control group.

Another point of interest is that the control group generally believed to have learned *less* kanji than they actually had, while the experimental group believed the opposite – that they in fact had learned *more* kanji than they actually had. This might indicate that the application was indeed successful in increasing the self-efficacy (Bandura, 1994) in the experimental group.

5.2 Discussion

This study indicates that there is no measurable effect on general motivation when adding audiovisual rewards to reinforce positive behavior in the subject, at least not when comparing the two test groups with each other. However the results do suggest that there are very different users within the groups and that some of these users were motivated more by the rewards than anything else, while others were motivated more by actually learning. It is impossible to tell for sure from this study if the subjects who were motivated most by the rewards would feel less motivated in general if the rewards were not there, but it is possible that they would.

Assuming this is the case, and considering none of the subjects seemed in any way bothered by the audiovisual rewards (meaning they were not an obstacle), then one conclusion would be that designing an e-learning application with added audiovisual rewards could potentially motivate *more different kinds* of users to continue using it.

If this application is a web-based online service for which you would charge a subscription fee (see 3.2.2) then if being able to keep more customers (than those who are motivated purely by learning) using the product by adding a relatively simple audiovisual reward system, then it would probably be worth the production cost in the end as long as the system is easy and fast to produce.

However, if the goal is to create an application focusing on only teaching those that are motivated by new knowledge, then the extra rewards would seem to be without effect and thus unnecessary.

5.3 Future Studies

This study can obviously be improved by for example gathering more test subjects as well as having more content, and tweaking other different variables in the testing

procedure. However, the study does open up a few branches on which more focused studies could be made.

5.3.1 In-depth Study on Motivation and Sub-groups

After having analyzed the results, a conclusion would be that the two biggest problems with this study was the *length of the test session* (the amount of time the test subjects were given with their version of the e-learning application) in relation to the amount of content (amount of kanji lessons) in the application and the *amount of test subjects* in each group.

The length of the test session was probably too long compared to the amount of content which increased the risk of the ceiling effect that occurs when a subject considers himself "done" (for example after having seen all the kanji lessons). The initial fear in this study was that giving too *little* time would prevent some test subjects from "getting into" the application, and that giving the subjects too *much* time would cause many to feel "done" before the time had run out. Instead of changing the length of the sessions, the best choice would probably be to inject much more content into the application.

Also, as the study indicated that there were two rather distinct groups (see 4.3.1) within the experimental group, there is nothing to say that there can't be even more. Performing another study with many more subjects could prove to more clearly identify these groups, and also find out whether there are , as well as give a more reliable picture of how motivation is affected.

Another very important step in further observation on motivation would be to perform these tests over a much longer period of time to see if any changes in motivation persists and how motivation is affected over time. Will the user come back to the e-learning application in a week? Or a month? Would the user feel motivated enough to pay a subscription fee in order to keep using it?

5.3.2 Study on Learning

Because the results indicate that the experimental group learned slightly more than the control group, it would be interesting to study further this phenomenon and measure exactly how much more they learn. For this, the study would primarily need more content (Japanese kanji) and the test sessions would need to be longer. This way, any difference in amount of learned kanji between the two groups would stand out more, and the larger amount of kanji would mean more required effort in order to remember their meaning. A ceiling effect due to a subject "seeing them all" in a study on *learning* is however probably of less risk of contaminating the results than when studying *motivation to continue* as long as there are many kanji. This is because in a study on learning, it doesn't matter if the subject has had time to see them all, what matters is how many he has learned.

Also, such a study would need to test the participants' knowledge over time as well in order to be of much interest as a study in learning quality and the amount of sustained knowledge. The subjects would need to perform a knowledge test one month, for example, after the initial test to see which group have retained most knowledge.

5.3.3 Professional vs. Casual Learners

Another potential future study would be to actively seek out two groups of test subjects that both want to learn Japanese kanji, but where one group primarily wants

to learn for professional reasons (it is needed for them in order to progress in their career or studies), and where one group primarily wants to learn because of personal non-professional interests ("it would be really fun to learn, and that's it").

Both groups are then to be divided into two more groups. One professional group and one casual group are then to perform the control test similar to that used in this study, and the other professional and casual group are to perform the experimental test. The results gathered can then be compared in different ways to see, for example:

- Are there differences in motivation (and/or learning) between the control version and experimental version in general?
- Are there differences in motivation (and/or learning) between the professional and casual control groups? Or the professional and casual experimental groups?
- Are there differences in motivation (and/or learning) between the casual control group and casual experimental group? Or the professional control group and professional experimental group?

References

Adobe Flash CS4 Professional (Version: 10.0) (2008) [Computer software] Adobe Systems Inc.

Backlund, P., Engström, H., Johannesson, M., Lebram, M. and Sjödén, B. (2008) Designing for self-efficacy in a game based simulator: An experimental study and its implications for serious games design. *In the proceedings of the International Conference Visualisation (Viz08)*, July 9-11, London, United Kingdom.

Bandura, A. (1994), *Self-Efficacy*. [Electronic version] Available at Internet: http://www.des.emory.edu/mfp/BanEncy.html [Accessed 2010-02-09]

Diablo II (2000) [Computer game] Blizzard Entertainment.

Parke, J. & Griffiths, M. (2004) *Addiction Research & Theory*. (October 2004, Vol. 12 Issue 5, page 407-411) Taylor & Francis Ltd.

Peggle Deluxe (2007) [Computer game] PopCap Games, Inc.

Sjödén, B. (2008), *Designing for self-efficacy in a driving simulator: A pilot study.* Master thesis. Lund University.

Skinner, B. F. (1953) *Science and Human Behavior*. The B.F. Skinner Foundation.

Stockley, D. (2010), *What is e-learning?* [Electronic version] Available at Internet: http://derekstockley.com.au/eindex2b.html [Accessed 2010-02-09]

Wikipedia (2010), *Kanji.* Wikipedia Foundation, Inc. Available at Internet: http://en.wikipedia.org/wiki/Kanji [Accessed 2010-06-11]