Animation as Instructional Manual: The Effects of Representational and Motivational Animation on Usability

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Acknowledgement

Great thanks go to my supervisor Dr. Joyce Karreman and Prf.Dr.Menno de Jong for their patient guidance both in study and life, especially for the gradational thesis. I have learnt a lot during this process and I think this will not only benefit my research but also ways of thinking throughout my life. I also thank my parents for their support. Moreover, I want to thank all my friends, my teammates and my coaches from Drienerlo, who made the one-year life in Netherland a wonderful time.

Abstract

Purpose: The purpose of this research is to determine the effect of representational and decorational animation on the usability of instructional manual. An experiment was conducted to investigate the effect of manuals with one of these two types of animations compared to that without animations on usability.

Method: Three versions of instructional manuals, namely static version, representational version and decorational version, were created. The representational animation carries stepwise and detailed information while the decorational animation were used to motivate users. Sixty-two participants with an academic degree with their age ranging from 18 to 45 have volunteered to participate in the experiment. Randomly divided into three groups, participants from each group used web page manuals with non-animated pictures, with decorational animated graphics and representational animated graphics. They were asked to first finish a task with the assigned instructional manual to measure the effectiveness and efficiency, fill in an online questionnaire to measure the motivation, satisfaction and self-efficacy and then repeat the first task without the manual to measure their knowledge transfer.

Results: The results show that animated instructional manuals had advantages in effectiveness, efficiency and learnability over non-animated manuals. Representational animated version prevails non-animated version in improving task efficiency. Both animated version showed advantage over non-animated manual in learnability. No significant differences were found in participants' satisfaction, motivation and self-efficacy.

Conclusion: This research shows that animated element has some effect on effectiveness and efficiency of users' performance. No significant effects were found on other aspects of usability.

Keywords: instructions; animated elements; decorational; representational

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1. Introduction

Users usually scan the instructional manual or use it as reference (Schriver, 1997). Therefore, supporting the users by providing an instructional manual with good usability seems extremely important since it will benefit the users as well as the product company. As a natural sequence of the increasing demands on usability and user experience, various strategies have been implied in instructional manuals either to facilitate users' doing or their learning. Over the years, animation elements, as one of the strategies, are also broadly applied in assisting users in manipulating interfaces as well as learning (Palmiter, 1991).

Plenty of studies have been done to investigate the effect of animation on instructing and learning. Nathan, Kintsch, and Young (1992) designed an animated interactive program to help students to comprehend algebra word problems. Kieras (1992) did an investigation on the effects of animated and static graphics on students comprehending of energy systems. In a recent research carried out by Ercan, Bilen, and Bulut (2014) to determine the effect of educational animation content on 7th grade students academic achievement and attitudes in science and technology, there was a difference in favor of the group with animation content in academic achievement but no significance in their attitudes.

Apart from all the studies mentioned above, few investigations have been done on animation's effect on the usability of instructional manuals. To bridge the gap, this research will investigate the effect of animations on the usability of instructional manuals of software learning with the question: is it possible to improve the usability of a manual with animation? Sixty two participants of academic degree participated in the experiment to investigate the effect of two types of animated and a non-animated manual on usability. Comparisons were made among three groups to tell if there are any differences between two types of animated versions and to test if there is difference between animated and static version. With the comparison, it is possible to investigate if animation per se is beneficial in improving the usability of instructional manual.

The next chapter of this thesis, an introduction on the theoretical background and a review of related literature will be given. Following the theoretical framework, a detailed explanation on the design and conduction of the experiment as well as the analysis of the collected data will be introduced. At last the result will be presented and discussed on each aspect that were related, followed by discussion, limitation of the research and suggestions for future studies.

2. Theoretical Framework

In this chapter previous studies and theories on usability of instructional manuals and different types of animation applied in learning environments will be discussed. Based on the previous theories and studies, hypothesis of this study will be presented.

2.1. Usability of Instructional Manuals

Usability is defined by the International Organization of Standardization International (1998) as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." According to ISO (1998) effectiveness refers to the accuracy and completeness with which users achieve specified goals. Efficiency is the resources expended related to effectiveness. Satisfaction is the degree of freedom from discomfort and positive attitude from the product. However, according to Nielsen (1994), in some aspects learnability, easy to learn, is the most fundamental usability attribute. Other scholars also argue that learnability is a characteristic of usability (Dix, Finlay, Abowd, & Beale, 1993; Jones, 1997; Nielsen, 1994). As a matter of fact, learnability contains effectiveness and efficiency. For an instructional manual, to be easy to learn means that its content can be easily understood by users, its steps can be carried out with less mistakes and afterwards the knowledge on the manual can be transferred easily. In all, an instructional manual should be constructed to allow for the four aspects of the definition in order to improve its usability.

For years technical writers have been paying enormous effort to improve the usability of the instructional manual. For example, scholars have differentiated types of information including procedural, principal, motivational information etc., and evaluated their effect on usability of instructional manuals(Eiriksdottir & Catrambone, 2011). Studies indicate that specific instructions are beneficial to initial performance while general instruction help with learning and transfer.(Eiriksdottir & Catrambone, 2011; Nicole Loorbach, Karreman, & Steehouder, 2007). Declarative information is beneficial to faster performance for correctly completed tasks, while adding motivational elements can release users' nerves and enhance users' appreciation for the manual (N. Loorbach, 2006). Besides the differentiation of information types, researchers have also combined the traditional text instruction with other multimedia materials. Screen captures, videos and even virtual reality are all among those approaches(Gellevij & Van Der Meij, 2004; Regian, Shebilske, & Monk, 1992; van der Meij & van der Meij, 2014) that have been proved to be benificial to users in different ways.

As users refer to manual when they get stuck(Jansen & Balijon, 2001; Schriver, 1997), technical writers should strive hard to design instructions that can motivate users to stick to their goals(Nicole Loorbach et al., 2007). A manual of good usability will benefit users by reducing time and ease their nerves in resolving those problems. Especially for software manipulation, people who lack expertise on certain kind of software will feel intimidated when they are using it for the very first time. By easing the nerves of users, their confidence might be improved. Besides, referring to the manual to solve their problems, will not only benefit users themselves but also save the cost of helpdesk for a company. Users do not need to call the helpline or even visit the chain store to solve their problem if they are willing to and can do it easily all on their

own.

Is it possible to improve the usability of a manual by adding animated instruction?

2.2. Animation vs Static Graphic?

Compared with written instructions, animation is characterized as more directly containing procedural information about the interface, which is beneficial in improving the initial learning(Palmiter, 1991). However, the result on whether animation is beneficial to learning is quite contradictory. Many researchers found that animations show no significant benefit when compared with static graphics (Bétrancourt & Tversky, 2000; Reed, 1985; Tversky, Morrison, & Betrancourt, 2002). According to the experiment of Narayanan and Hegarty (2002), two hypermedia instructions were designed and compared with two printed versions of instruction. Both hypermedia involved animated graphics, with one cognitively designed and the other commercial-available. No differences in comprehension and rating were found between the cognitively designed animation and the printed version. Contradictorily, according to the meta-analysis of Höffler and Leutner (2007) found an overall superiority of animations over static pictures. Few researches distinguished the effect of animation within an instructional manual.

According to the cognitive load theory, there are three types of cognitive load, namely: extraneous, intrinsic and germane cognitive load (Carlson, Chandler, & Sweller, 2003; Chandler & Sweller, 1991; Sweller & Chandler, 1994). Thus, the instructional format (e.g.,animations or static pictures) might influence the learning efficiency of a learning environment (Höffler & Leutner, 2007). Whether the information is presented as static or animated may have an influence on the learning efficiency. Applying animation as instructional material may benefit efficiency and effectiveness since animation can help users mentally visualize the procedure of a task, reducing the cognitive load of users when compared to using static graphic or text materials (Mayer, 2008). A manual with static graphics requires users to process all the information and build the mental models by themselves because the information contained in a static graphic is limited. According to Eiriksdottir and Catrambone (2011), the result of initial performance is affected by the completeness and detail of stepwise instructions. It is reasonable to believe that detailed and reperesentational animation can improve the effectiveness of task performance and reduce time that are spent on carrying out tasks.

It is already known that static graphics are more effective when combined with a verbal explanation (Mayer & Sims, 1994). Animations are supposed to help learners to imagine processes properly and thus to be able to build up adequate mental representations. In the experiment of Byrne, Catrambone, and Stasko (1999), they argued that it is predictions rather than animation per se that are beneficial in learning of students. While according to Mayer and Moreno (2002) retention tasks or tasks that requires deep thinking and ability to solve problems may benefit from animation. Contradictive results on learnability were founded by previous studies (Catrambone &

Seay, 2002; Large, 1997; Nerdel, 2003; Wright, Milroy, & Lickorish, 1999).

Some evidence from the experiment of Kehoe and Stasko (1996) indicates that many students prefer to learn with animation in the process. While other studies show that no change of attitude towards animations were found (Ercan et al., 2014). Adding motivational elements can enhance users' appreciation of the manual. With motivational elements, users can perform better in doing tasks and will persist in the task when confronted with challenges (Nicole Loorbach et al., 2007). Animated instructions will not only teach but also entertain users. According to the study of Hong, Thong, and Tam (2004), animation can better attract users attention. Moving symbols against a static background can make the moving information prominent. When animation are representational, the instruction are more concrete and related to users' goal. Users will feel that it is easier to carry do the task by reducing the cognitive efforts with animation. Decorational animation can also be used to motivate users and enhance users' confidence over performing tasks. As a consequence, users' motivation and satisfaction will be improved.

The previous studies need extension to distinguish the effect of different types of animation as well as distinguish if it is animation per se that is contributing to the usability.

2.3. Animation as Instructions

For decade's animations have been adapted as one of the strategies technical writers implement to improve the usability of instruction. Animations can attract users' attention and facilitate the quicker location of targeted items in a web environment (Hong et al., 2004). Animations with simple and explicit information are especially effective in education, human-computer interaction and psychology domain(Bétrancourt & Tversky, 2000). However, animation can also be distracting (Hong et al., 2004; Plaue & Stasko, 2007; Rieber, 1996) thus cause more cognitive load.

2.3.1 Video-based Animation and Computer-Based Animation

Betrancourt and Tversky (2000) defined computer animation as any application that generate predetermined sequential frames. In the experiment of Yang et al, they provided visual computer animations that shows he function of each part of flashlight when the button is clicked (Yang, Andre, Greenbowe, & Tibell, 2003). The effect of computer-based animation were inconsistent. Some researcher found positive effect of computer-based animation (Baek & Layne, 1988; Rieber, 1990), while others found no significant difference compared with static graphics (Peters & Daiker, 1982; Reed, 1985). Computer-based animation allows users more control over the instruction.

Video-based animations are inherently representational and realistic. With the help of video-based animations, users can easily learn to mimic the observed animation (van der Meij & van der Meij, 2014). But limits do exist in video-based animation. For example, Tversky et al stated that interactivity is a key factor to enhance its advantage

(2002). It is suggested by van der Meij (2013) that functional control over video and animation should be added. However, certain kind of control relies more or less on the player instead of the instruction itself. Even Swarts (2012) suggested to improve the navigation of video instruction by adding moving or still pictures and narration component. Providing navigation function in the instructional manual will allow users more control over the animations.

2.3.2 Representational and Decorational animation

The difference between representational and decorational animation lies in that the former display the topic to learn explicitly while the latter is used to motivate users (Carney & Levin, 2002). Representational animation conveys detailed and stepwise information. Other than representational animation, the main function of decorational animation is usually simply cosmetic or motivational. Despite from topic to be learned conveyed in representational animation, decorational animation elements serves as a role to motivate the users (Höffler & Leutner, 2007).

Additionally, adding positive decorational animation as motivation for users may stimulate them to strive for correct answers (Weiss, Knowlton, & Morrison, 2002). Especially when users are using the product that they have never used before, adding motivating elements will be more important so as to ease the nerves of users. The purpose of using animation in CBI (Computer-based instruction) include cosmetic function(also known as decorational function in Höffler's analysis), attention gaining function, motivation function, presentation function and clarification function (Weiss et al., 2002). While pure cosmetic use of animation, other than that of attention gaining use, may lead to distraction of users, redundant application of animation may also fail to catch users' attention and to be instructive (Large, 1997). This is in line with Keller(1983)'s conclusion that if deluged with novel, unusual will become common. According to the Cognitive Load Theory (Chandler & Sweller, 1991), when animations involve too many interactive information animations could distract users and impose cognitive load when

2.4. Hypotheses

Based on the previous studies and theories, following hypothesis concerning animation will be evaluated:

Effectiveness of task performance

H1. It is expected that participants with representational animation will be more effective and efficient in do tasks than that with non-animated ones.

Efficiency of task performance

H2. It is expected that users with representational animation will take less time in performing the provided tasks than that from decorational and non-animated ones.

Learnability

H3. It is expected that users with animated instructional manuals will finish more subtasks in the retention test than that with non-animated ones.

Motivation

H4. It is expected that users will be more motivated with both types of animated manual than non-animated ones.

Satisfaction

H5. It is expected that users of both animated groups will be more satisfied with the animated manuals than that with non-animated manuals.

Self-Efficacy

H6. It is expected that users of both animated groups will show higher self-efficacy than that with non-animated manuals.

3. Methodology

3.1. Experiment Design

The experiment consists of two tasks. The first task is aiming at investigating the effectiveness and efficiency of task performing while the second test is aiming at test the knowledge transfer. The independent variable was the presence and absence of animation. Participants were divided into three groups randomly and assigned with related instructional manuals. Pair-wise comparisons were done among three groups to compare the different effects. Users' motivation, satisfaction and self-efficacy were tested with an online questionnaire.

3.2. Experiment Instruments and Tasks

In this experiment, three versions of instructional manuals, an online questionnaire and two laptops were used. The three instructional manuals were made based on the official instruction of AXURE a prototype creating software. An online questionnaire was created aiming at revealing users' motivation, satisfaction and self-efficacy. All text information involved in this experiment were written in English.

A task on creating an interactive log in page was selected because it involves both elemental and advanced manipulation thus make it possible to distinguish the result of retention test. The task involves eight different subtasks.

3.2.1 Instructional Manuals

Based on the guidelines of previous theories (Gellevij & Van Der Meij, 2004; van der Meij & van der Meij, 2013; Weiss et al., 2002), one non-animated and two animated procedural instructional manuals on creating an interactive log in page with the software AXURE were designed. All the graphics in the manual, either animated or static were

set closely to the correlating text, which, according to the multimedia learning theory that spatial contiguity of text and animations has a positive effect on learning outcome (Moreno & Mayer, 1999). All of the animations included in animated manuals convey no audio information. All elements were made into gif with gif-creating software GIMP and screen record software Camtasia. In order to control the size and the look of three different manuals and provide more navigating options (see Figure 2) for users, HTML pages and animated pictures with an extension of ".gif" (graphic interchange format) were created. All the text information were written in English.

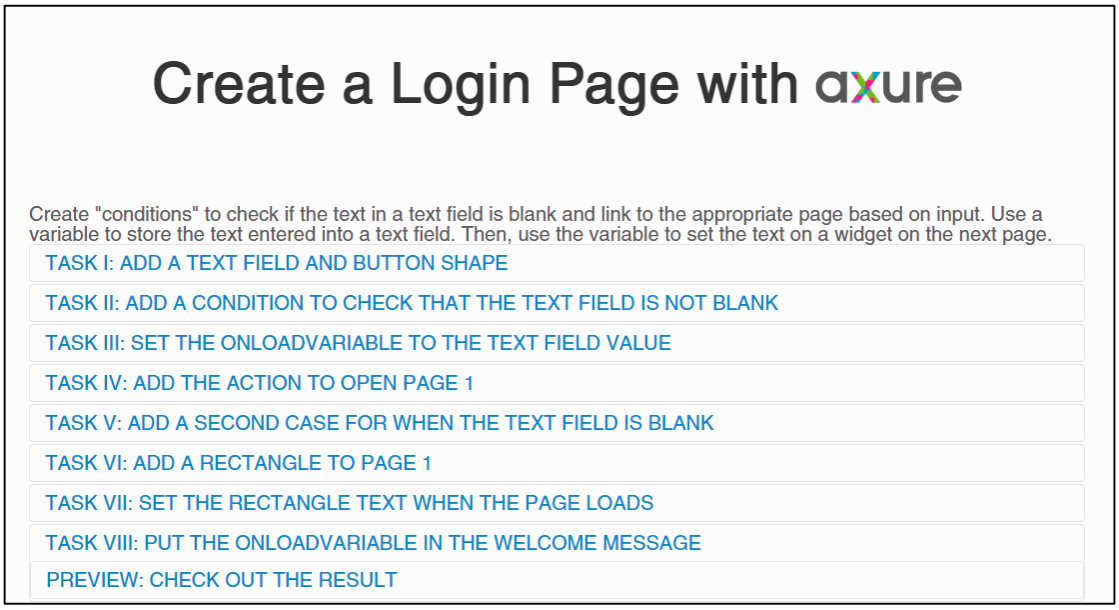

Figure 1 Navigation Bar

Non-animated Version

A non-animated version was created as control version (see Figure 3). The illustration of non-animated version was based on the screen captures of critical steps in finishing the tasks along with colored boxes indicating the location of the icon. The correlated text procedures were adapted from the official websites of AXURE. By eliminating animated elements, it was possible to test the effect of the effect of the animated elements from the other two versions.

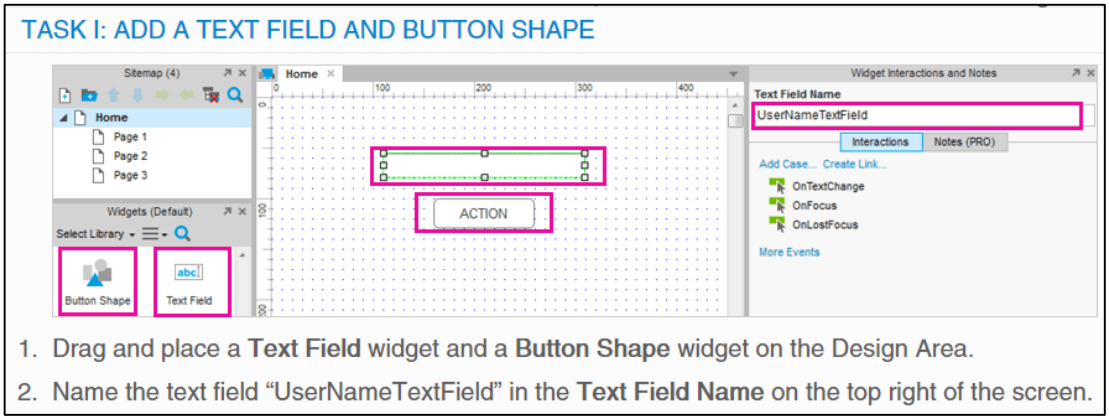

Figure 2 Static Version

Representational version

The representational version conveys stepwise representational information to demonstrate the manipulation of the software (see Figure 4). Based on the manipulation of the software, it was screen recorded and transferred into gif pictures.

1) All the gif animation were screen-sized in order to present the entire interface and clear manipulation.
2) All animation were in infinite loop.

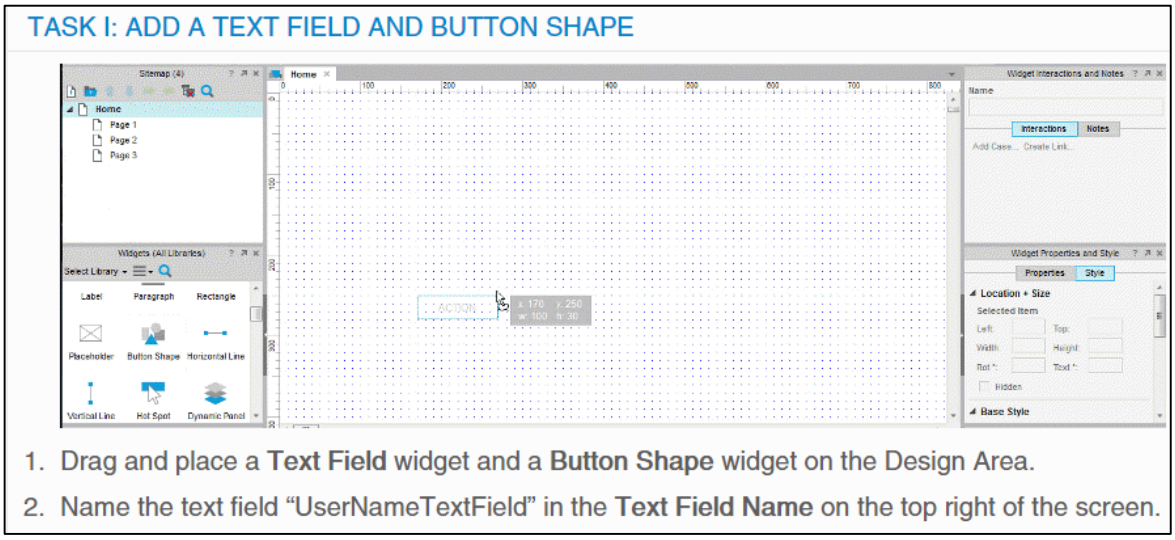

Figure 3 Representational Version

Decorational version

In the decorational version, decoational animation were added on the static background.

1) A static screen capture of current step was set as the background and decorational elements were set animated (See Figure 5 and Figure 6).
2) The decorational version added the procedural information by combining the step information and manipulation information (see Figure 5). The numbers at the right bottom corner represents the order of the manipulation.

3) All decorational elements show up in sequence in the manual and are in infinite loop.

Figure 4 Animated Elements in Decorational Version

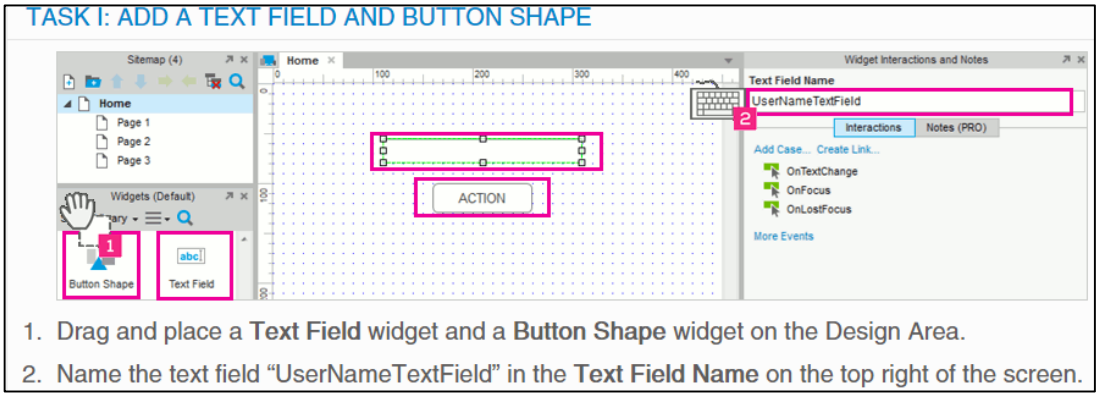

Figure 5 Decorational Version

3.2.2 Online Questionnaire

The questionnaire encloses 25 questions with 3 on geographical information, 12 for motivation, 5 for satisfaction scale, 4 for self-efficacy and an open question. The scale for motivation was adapted from Revised Instructional Manual Motivation Survey (RIIMMS)(Nicole Loorbach et al., 2007), which contains four constructs, namely Attention, Relevance, Confidence and Satisfaction (ARCS). Satisfaction scales were adapted from Nicole Loorbach et al. (2007). Self-efficacy was tested with four Likert-scale question asking participants how confident they were in accomplishing the listed four tasks which were similar but not all the same. All the questionnaires were written in English. Simple wording were used to make sure its comprehensiveness.

3.3. Procedure

In order to better display the instructional manual, two computers were used, with one displaying the manual and the other used to manipulate the software. Before the participant started experiment he/she will be asked to sign the consent form to make sure of the anonymous processing of recorded data and then he/she will be given an introduction of the experiment.

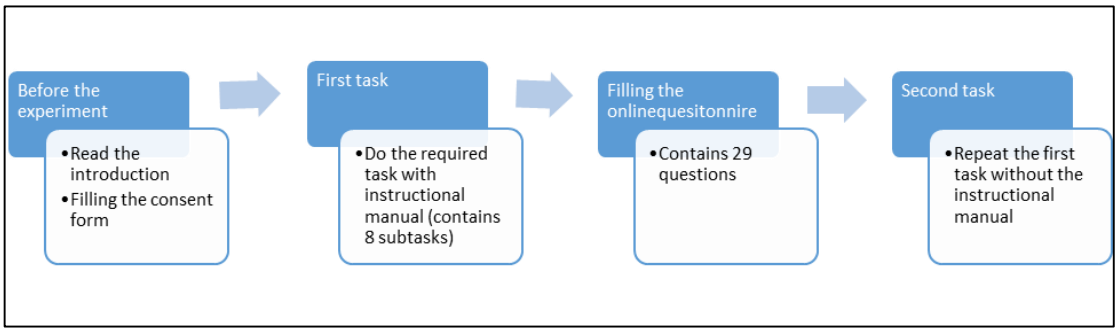

Figure 6 Experiment Process

Each participant was assigned to one of the three experiment conditions. The entire experiment contains three parts. In the first part the participant was required to finish all the tasks with assigned manual independently without interruption. Participants could start whenever they felt they are ready by clicking the record button at the right bottom of the screen, thus their manipulation of the software and their voices would be recorded. During this part of the experiment, time that the participants spent on the task and the switch between two screens were recorded. When participants finished the first parts, the screen record were also stopped and they were asked to fill in an online questionnaire in order to investigate their motivation and satisfaction toward the assigned manual. The estimated time spent on the questionnaire were 5-10 minutes. Following the questionnaire the participant was asked to repeat the exactly same task again without referring to the instructional manual being screen recorded. Time that participants spent on this part were also recorded. Participant were allowed to choose to stop the experiment whenever they feel that the task is too hard to proceed.

According to the pre-study, this part requires 20 minutes at most. However, no limit of time is set in order not to tense up the participants. Considering different participants have different reading speed, as long as the participants finished the task, their result would be marked as success. Whether the participant was able to finish the task, the errors they made and their switch of attention between two screens during the task were recorded. All the participants could choose to stop the experiment whenever they felt it was too hard to proceed. In the second part of experiment no time limit was set and whether they could successfully repeat the task and the steps they have successfully done was recorded. Participants were allowed to ask questions which were not contained in the manual. The whole process was screen recorded and voice recorded.

3.4. Participants

Sixty two participants volunteered to participate in this experiment, with 30 males and 32 females. Each was required to have no experience or limited experience with AXURE. All of the participants have an academic degree or are having equivalent education at the time. See the following two tables for the mean age and educational background information:

Table 1

Mean Age of Participants

Group	Non-animated	Representational	Decorational
Mean Age (St. d)	25.10 (5.93)	23.55 (2.91)	24.10 (5.57)

Table 2

Educational Background

Group	Non-animated		Representational		Decorational	
	Humanity and Social	Natural and Life	Humanity and Social	Natural and Life	Humanity and Social	Natural and Life
Female	5	5	9	2	9	1
Male	5	5	3	8	3	7
Total	10	10	12	10	12	8

3.5. Measurements

The independent variable in this study are the presence or absence of animation. In the representational version, the main function of the animation is to demonstrate the manipulation of the tasks stepwise. In the decorational version, animation will be mainly applied to motivate the users. It is expected that users will be more motivated to stick to the manual and have better performance in completing the task. It is also expected that users will show more appreciation to the manual after the task.

The dependent variables in this study are the users' effectiveness and efficiency in learning, their motivation and satisfaction, as well as their knowledge transfer. The effectiveness can be measured by the accuracy and completeness of the goal of the task (Bevan, 1995). For instance, if the target of the task included in the manual is to create a demo interface, accuracy of the task can be measured by examining whether the icon of the interface are correctly established, whether the logical reaction is applied when the icon is clicked, etc. In this experiment users' learning effectiveness will be measured by whether they can successfully finish the given tasks, the subtasks that were finished and the number of mistakes they made during the task. Eight tasks were included in the experiment (see Figure 2)

Participants that have successfully create the logical interaction of the buttons and pages

will be counted as “success” otherwise will be counted as “failure”. “Measure of efficiency related to the level of effectiveness achieved to the expenditure of resources (Bevan, 1995).” In term of the learning efficiency, time that users spent in finishing the tasks will be measured for success tasks. For failed tasks, time won’t count as an indicator. Users’ knowledge transfer will be measured by whether they can complete the task without consulting to the manual in the retention test. Furthermore, if users cannot finish the complete task, the number of subtasks that they successfully did should be counted as an indicator of effectiveness.

Users’ motivation was measured with RIMMS (Reduced Instructional Materials Motivation survey) containing 12 items scaled from 1(not true) to 5(very true). The four constructs of Keller’s ARCS motivational design, namely attention, relevance, confidence and satisfaction were examined. Satisfaction scales were adapted from Nicole Loorbach et al. (2007). Self-efficacy was tested with four Likert-scale question asking participants how confident they were in accomplishing the listed four tasks which were similar but not all the same.

By following the above measurements, the four aspects of usability (effectiveness, efficiency, motivation, satisfaction and learnability) and self-efficacy can be investigated respectively.

3.6. Pre-study

To guarantee the quality of the experiment, three pilot test were conducted with three students before the formal experiments were carried out. The instructional manuals were proved to be sufficient in terms of comprehensiveness, structure and wording.

The pilot task was identical as the formal task. Participants were asked to finish the required tasks with the assigned instructional manual. After participants finished the task, they were asked about their opinion on the manual. Each pilot test took the participants for 15 to 20 minutes.

3.7. Data Analysis

Before analyzing the collected data, they were pre-processed to ensure the quality. After being pre-processed, all the data were imported into SPSS to do a Cronbach’s Alpha test in order to test the reliability of scaled data. The data were Attention α= 0.80, Relevanceα= 0.75, Confidence α= 0.80, Satisfaction α= 0.90 and for Self-efficacy α= 0.95. With the Cronbach’s Alpha above 0.6, all of the data were used for proceeding analysis.

Analysis of Variance combined with a Tukey post Hoc test for scale and ordinal data were carried out to investigate whether there were significant differences and what the specific differences were. Nominal data were analyzed with Pearson’s Chi-square test, to find out whether there were significant differences among three groups. Fisher’s exact test were also applied when applicable.

The last open questions were taken as reference since they could not be tested. But suggestion made by users would be listed in the discussion part.

4. Results

4.1. Effectiveness

The effectiveness was measured by whether users can successfully complete the task and how many mistakes they made during the task. It was expected that amount of tasks performed with instructional manual with representational and decorational animation would be more than that of static version. In the second part of experiment, whether users could successfully finish the tasks and the subtasks that participants successfully finished were counted as the effectiveness of knowledge transfer. Because in the second part, not one participant had succeeded in finishing the task. Therefore the subtasks they successfully performed were counted.

Numbers of participants succeeded in finishing the complete task were 16 out of 20 for the non-animated group, 17 out of 20 for the decorational group and 22 out of 22 for the representational version group. Since 2 cells have expected count less than five, Fisher's exact test were taken to take a pairwise comparison. No significant difference was founded when comparing non-animated group and decorational group ($p = 0.68$). Significant difference was discovered when comparing non-animated and representational group with $p = 0.04$ There was also significant difference between representational and decorational group ($p = 0.03$).

The average mistakes made in each group were 2 (SD = 1.90) for non-animated group, 1.18(SD = 1.00) for representational group and 1.75 (SD = 1.21) for decorational version with $F (2, 59) =1.91$, $p = 0.16$ which was more than 0.05. Thus there was no significant difference among three groups in making mistakes during the first task.

4.2. Efficiency

In the first part of the experiment, efficiency was measured by the time that the participants spent on the tasks in each group. Participants that failed the tasks were excluded. The expectation that users from representational version and decorational version group would have better performance than that from non-animated group. According to the data, $F (2, 52) =5.10$ and $P=0.01$, indicating that there are significant differences among groups. The mean score for Non-animated version, Representational version and Decorational version group were 14'25"', 10'30" and 12'47" respectively.

Table 3

Mean of Times in First Task

	Mean (St. d)			F	Sig.
	Non-animated version	Representational version	Decorational version		

Time	14’25” (4’41”)	10’30” (2’50”)	12’47” (3’52”)	5.10	0.01

* The mean difference is significant at 0.05 level.

According to Post Hoc tests, there was a significant difference between non-animated group and representational group, p = 0.01, which is lower than 0.05. However, there was no significant difference between representational and decorational group p = 0.20, or non-animated and decorational group p = 0.40.

Since no users have succeeded in completing the entire task in the retention test, time spent in retention test was not calculated as indicator for efficiency.

4.3. Satisfaction

Satisfaction was measured by four aspects, interesting, understandable, good and pleasant to use. It is expected that users from representational version and decorational version group would show more satisfaction towards their manual than non-animated group since animation provides novelty and facilitates task performing. However, according to ANOVA, there was no significant difference among three groups, with F (2, 59) = 0.28 p =0.76. The mean score for non-animated version was 3.55 (SD = 0.94), representational version was 3.73 (SD = 0.87), and 3.55 (SD = 0.90) for decorational version.

Table 4

Means for Satisfaction

	Mean (St. d)			**F**	**Sig.**
	Non-animated version	**Representational version**	**Decorational version**		
Satisfaction	3.55 (0.94)	3.73(0.87)	3.55(0.90)	0.28	0.76

Note: This Data is measured by a 5-point Likert Scale, from “1=Not true” to “5=Very true” The mean difference is significant at 0.05 level.

4.4. Motivation

Motivation was measured by RIMMS which contains four components, i.e., Attention, Relevance, Confidence and Satisfaction. It was expected participants from animated group would feel more motivated in carrying out the tasks. However, according to the data there were no significant differences among three groups (attention F (2, 59) =1.03, p = 0.36, relevance F (2, 59) = 0.88, p = 0.42, confidence F (2, 59) =1.457, p = 0.24).

Table 5

Mean Scores for Motivation

	Mean (St. d)			**F**	**Sig.**
	Non-	**Representational**	**Decorational**		

	animated version	version	version		
Attention	3.77(0.83)	3.68(0.79)	3.38(1.03)	1.03	0.36
	Non-animated version	**Representational version**	**Decorational version**	**F**	**Sig.**
Relevance	3.65(1.00)	3.45(0.85)	3.26(0.90)	0.88	0.42
Confidence	3.35(1.17)	3.59(0.76)	3.05(1.13)	1.46	0.24
Satisfaction	3.35(1.15)	3.31(1.05)	3.2(1.14)	0.09	0.91
Motivation	3.53(0.96)	3.51(0.74)	3.22(0.93)	0.77	0.47

Note: This Data is measured by a 5-point Likert Scale, from "1=Not true" to "5=Very true" The mean difference is significant at 0.05 level.

Besides, time that participants willing to insist in doing second part of experiment were also taken into consideration as an indicator of their motivation. According to the result of ANOVA test, there were no significant difference among three groups, F (2, 59) =1.51, p = 0.23.

Table 6

Mean Time Spent in the Second Task

	Mean (St. d)			**F**	**Sig.**
	Static Version	**Representational version**	**Decorational version**		
Time	6'33"(5'31")	9'28"(6'38)	8'01"(3'48")	1.51	0.23

* The mean difference is significant at 0.05 level.

4.5. Self-efficacy

Self-efficacy was measured by a 10-piont self-efficacy scale. It was expected that participants from representational version and decorational version group would have higher self-efficacy than that from non-animated group. Because stepwise animation provide step-to-step manipulation to participants which will be easier for users to follow and carry out the same steps. Decorational animation were more eye-catching and novel, which might motivate the users to finish the task.

The mean score on self-efficacy for non-animated group was 6.89 (SD = 2.20), for representational version was 7.9 (SD =1.59) and for decorational version was7.4 (SD= 2.45) with F (2, 59) = 1.25 p= 0.30. Data indicated that there were no significant differences among all three groups.

Table 7

Means for Self-efficacy

	Mean (St. d)			**F**	**Sig.**
	Non-animated	**Representational version**	**Decorational version**		

	version				
Self-efficacy	6.89 (2.20)	7.9 (1.59)	7.4 (2.45)	1.25	0.3

Note: This Data is measured by a 10-point Likert Scale, from 1 to 10 representing the increasing of self-efficacy. The mean difference is significant at 0.05 level.

4.6. Knowledge Transfer

Knowledge transfer was measured by the effectiveness of the second task. Due to the fact that no participants succeeded in finishing the complete task in the retention test, numbers of subtasks that they successfully performed were counted as the indicator of knowledge transfer. The average number of successfully performed subtasks were 1.30 (SD = 1.13), 2.55 (SD= 1.60) and 2.30 (SD = 0.92) for non-animated, representational and decorational groups respectively. There was a significant difference among three groups with F (2, 59) = 5.62 and p = 0.01.

Table 8

Result of Finished Steps in Retention Test

	Mean (St. d)			**F**	**Sig.**
	Non-animated version	**Representational version**	**Decorational version**		
Finished Steps	1.30 (1.13)	2.55 (1.60)	2.30 (0.92)	5.62	0.01

* The mean difference is significant at 0.05 level.

According to the result of Tukey's test, there was a significant difference between non-animated version and representational version group (p = 0.01), as well as non-animated and decorational version group (p = 0.04). There was no significant between representational version and decorational version group (p = 0.80). This indicated that participants from representational version and decorational version groups finished more steps in the second part of experiment. This means that both animated version had advantage over non-animated manual in helping participants to remember the task.

4.7. Observation

Apart from the screen captures recorded, participants' switch of attention between the display screen and manipulating screen in the first part of experiment were also recorded. During the first part of the experiment, users could refer to instructional manuals on the other computer.

According to the ANOVA test, the mean times of switching attention for each group was 56.7 (SD = 17.79) for non-animated group, 45.91 (SD = 8.66) for representational group and 59.05 (SD = 21.40) for decorational group. There was significant difference among three groups with F (2, 59) = 3.781 P= 0.03. This means that participants from

Representational version group did least switch of attention during the experiment.

Table 9

Mean Score of Switch of Attention

	Mean (St. d)			F	Sig.
	Static Version	**Representational version**	**Decorational version**		
Switch of Attention (times)	56.70 (17.79)	45.90 (8.66)	59.05 (21.40)	3.781	0.03

*The mean difference is significant at 0.05 level.

Among all three groups, decorational version had the most switch of attention. There was a significant difference between representational version and decorational version group (p = 0.03). No significant differences were found between non-animated and decorational version (p = 0.90) and representational and non-animated version (p = 0.10)

According to the data analysis, the results of hypothesis was revealed (see Table 10).

Table 10

Result of Hypothesis

	Hypothesis	Result
Effectiveness	**H1.** It is expected that participants with representational animation will be more effective and efficient in do tasks than that with non-animated ones.	**Supported**
Efficiency	**H2.** It is expected that users with representational animation will take less time in performing the provided tasks than that from decorational and non-animated one	**Supported**
Learnability	**H3.** It is expected that users with animated instructional manuals will finish more subtasks in the retention test than that with non-animated ones.	**Supported**
Motivation	**H4.** It is expected that users will be more motivated with both types of animated manual than non-animated ones.	**Rejected**
Satisfaction	**H5.** It is expected that users of both animated groups will be more satisfied with the animated manuals than that with non-animated manuals.	**Rejected**
Self-efficacy	**H6.** It is expected that users of both animated groups will show higher self-	**Rejected**

	Hypothesis	Result
	efficacy than that with non-animated manuals.	

5. Discussion

5.1. Usability

Effectiveness

The first hypothesis was confirmed. Results indicate that instructional manuals with representational animation did have advantage over manuals with decorational animation and non-animated graphics. Comparing to non-animated and decorational versions, representational animation contains explicit and detailed demonstration. Users can follow the illustration and mimic the exact same steps. Static graphics carry less information for users to confirm their status. With the background in decorational animated group set as static it is comprehensible that the effective might be lower. Some participants complained that the blinking icons in decorational animation were distracting them when they were doing the tasks, which might have contributed to the result. Besides, the information in the decorational animation which contained the manipulation information was somehow ignored by all users. For example, the action click was illustrated with a mouse icon (see Figure 5) and the action drag was illustrated with a hand icon. This could be explained by the cognitive theory that too many interactive elements is causing intrinsic cognitive load to participants. Even if the decorational elements were designed with ordinal numbers in order to help users, not many users had really paid attention to those aspects. The result has largely confirmed the previous studies on animations' distracting effect (Hong et al., 2004; Plaue & Stasko, 2007; Rieber, 1996).

There were no significant difference in mistakes made by participants ($p = .16$). The mistakes that users made ranged from "fail to change the name of the button" to "fail to match the correct value". Sometimes these mistakes have different effects on users' entire task. If participants made a simple mistake like changing name of the button, there would be no effect on the load and link of the final page. However, if users made mistakes by filling the wrong value, even if all the other steps were right, the final task will fail in the end. This is also due to the task itself depends heavily on logic.

Most of the participants expressed that it was hard to remember all the task since this was their very first time using this software. However, it is hard to deny the fact that representational animation has positive effects on participants' effectiveness in doing tasks. In the second task, though no participants really succeeded in finishing the entire task, participants from animation groups did more correct steps than that from static version group. From these two factors, it is safe to say that animated elements has a positive effect on the effectiveness of the instructional manual.

Efficiency

The hypothesis on efficiency was confirmed. It is not surprising that results indicate that representational animation had positive effect on participants' efficiency in completing the tasks. Participants from both animated group took less time in finishing the first task than the static version, though significant difference exists only between representational group and non-animated group. When confronted with written manual with static graphics, users need to process the external text surface information and visual images with two channel and then combine these coding to build a mental model(Paivio, 1991). Static graphics intrinsically carry less information and therefore requires more mental effort when combined with text. During the task when users need to filling related variables, they got extremely confused because the result would only show up after they finished related manipulation. For representational group, participants only need to follow the animation step by step and do exactly the same manipulation.

The observation has also yielded interesting results. Participants from static group switched more times between two screens than from representational groups while doing the task. This might be because they need to compare the two screens to locate the icons and verify the results of their manipulation. Since the graphic in the static only displayed the result when a manipulation was done, it is not surprising that users need more time to make check their manipulation. Static group had less switch of attention than decorational group, which could also be explained by the cognitive load caused by the animated element, since the only difference of the two group.

Learnability

The hypothesis on learnability According to the data, representational animated elements has an overall positive effect on learnability of the instructional manual. The second hypothesis was confirmed. Since learnability were measured by how easy the knowledge is for users to learn (effectiveness, efficiency) and the knowledge transfer of users, all three aspects were taken into consideration when analyzing. Significant differences were found in the effectiveness and efficiency in the first task. Though no participant has successfully finished the retention test, the steps they finished, however, was more than that of static group. According to the active processing theory of (Wittrock, 2010) , by actively combining the stimuli with memory meaningful learning will be generated. Though users may passively rely on the demonstration, however, the selected tasks involved logic which require continuous thinking.

"**Explanation of each subtask should be added so that I can understand what this step means**" as some of the participants said. This concerns with how the principles are used in instructional manual. "The presence and amount of other types of instructions could be important for determining whether principles are helpful.(Eiriksdottir & Catrambone, 2011)" The experiment of Duff and Barnard (1990) reported that the beneficial effects on knowledge transfer depends on how many procedures are in a manual. In this experiment, the explanation of each subtask were the title itself, which were somehow neglected by almost all users. It could be because that the task title were

all capitalized, that users thought they were not principle information but just a title. Another possible explanation is that the title is also contained in the navigation bar, with involves the interactivity. The cognitive load made user neglect the content. Different subtasks involves similar interfaces (for example setting cases and page load event) and manipulation. Only when users really understand what the logic is behind the settings can they carry out errorless task. This may suggest a separation between function related elements and information related elements in designing an interactive manual.

Satisfaction

Hypothesis 5 on satisfaction was rejected. With respect to satisfaction of ISO 9211 – 41 (1998), it was expected that users from both animated groups would show higher satisfaction towards the manual. Data indicate that animated elements did not yield better result than non-animated group. Therefore, the fifth hypothesis was rejected. This could be explained by the fact that users were not familiar with the selected software and the tasks were relatively hard. Some participants reported that the icons in decorational version group were distracting them a lot because they were blinking all the time at a fast speed. Some users also suggested to lower the speed for representational animation so that they can better follow the steps, which might be another reason.

5.2. Motivation

The fourth hypothesis had to be rejected. It was expected that participants from animated group would feel more motivated to persist in the task. The result indicated that animated elements had no significant effect on participants' motivation. No significant difference existed among three groups on attention, relevance, confidence and satisfaction. Therefore, Hypothesis 5 was rejected.

Participants' lack of motivation could be explained in many ways. First of all, all participants were not familiar with the chosen software, whose interface was different from popular. It was harder for participants to link the information in the software manual to their previous knowledge on software. Besides, the task included several subtasks that involves similar steps. Especially when users are doing the second and the third task, they needed to set several values to check if the input value of the username text field is blank. There were several values that looks really similar. It was hard for users to remember all those values without previous knowledge or a mental model. Despite the above to issue, participants were intimidated when they first heard about the task since most of the participants had never heard of the software, nor had experience with making prototypes with it. Especially when users were attending the experiment after class or between classes, they wanted to finish the task as soon as possible. Therefore, in the second task they felt not willing to persist for very long time. However, other researchers had also had similar results even if when motivational strategies were applied (Nicole Loorbach et al., 2007). Therefore we should reflect on whether quantitative research is enough to reveal users' self-report motivation, satisfaction and self-efficacy.

5.3. Self-efficacy

Hypothesis on self-efficacy is not supported. No significant difference was discovered among three groups in self-efficacy.

This was not hard to imagine since data also indicate that users' confidence was not positively affected in RIMMS. Though participants from animated group spent less time finishing the tasks, there were still no difference in their self-efficacy level. The representational group only show a slightly higher mean score (M = 7.9, SD = 1.59). This could be explained by an overall high level of confidence. When users are doing the first task they were immersed in following the manual. It is easy for user to follow the manuals. However, the task itself was not very easy because users need to know the internal logic of all components if they want to successfully carry out the task without the manuals. No participants had really succeeded in the second task even if they chose higher level of confidence in the questionnaire. The average level of representational group, though no significant difference, was higher than those of the rest groups. Better result were seen in the second part of the experiment because they finished more subtasks. How could users perform better when they felt that they could not? This might be because their perceived self-efficacy was lower that their actual level when using a self-report method.

6. Conclusion

6.1. Limitations and Suggestions for Future Study

Manual

The manual was written with bootstrap (framework based on HTML/CSS etc.). It provided more interaction by allowing participants to click and check the content. However, there is also a compromise. By clicking current step, other content would all close up. The content of current step was displayed in the very middle. It meant that if current step contains too many sub steps, users needed to roll up to read from the first sub step. The entire manipulation process was linear. Besides, the navigation bar of the manual conveys the declarative information which were ignored by users. In future study more research can be done on how the arrange of HTML based manual can facilitate users.

Two participants suggested that explanation should be added to the steps. However, the information about what they were doing were actually the title of the tasks. Somehow participants ignored the tittles and just clicked the manual and did the task. In the future study researches may separate the fictional elements and information elements in designing an interactive manual. Further study may also be done about the difference in combining and separating those two elements.

In order to make sure the size of three manuals are the same, some steps in Static

Version and Decorational version versions were integrated (see Figure 2). Some users felt confused about the integrated interface. They thought their current interface were different from the ones in the manual and started to check other open dialogues. This is a compromise between the size of the document and clear illustration.

Animation

Both animated versions were made into gif pictures with infinite loop. Some users complained about the decorational elements were distracting their attention because it blinked all the time. While other users thought it was clear and indicating the location of icons. Regarding representational version, it was reported by users that the manipulation was fast. This was due to the animation was created from screen record, in which the software was manipulated faster in order to reduce the file size. Users also made comment that they preferred text before animation.

Participants

The participants were mostly with academic degree. Most of the participants aged from 18-35. Participants with a wider age range and educational backgrounds should be investigated to have a comprehensive image of the effect of animations' effect on usability.

6.2. Conclusion

According to the result of the experiment, animated elements did have effect on the effectiveness, efficiency and learnability of the instructional manual. Adding animated elements were especially beneficial to the efficiency of doing a task. Both versions of animated instruction showed higher efficiency when participants were doing the task. Animated elements also benefited users in helping them to remember the task procedure. Of all the six hypothesis, three were confirmed. More users succeeded in finishing the first task, spent less time in finishing the task and did more steps than the Static Version groups. The hypothesis on other aspect of usability were rejected. There was no difference among animated and non-animated group in satisfaction, users' motivation or their self-efficacy. It could be concluded that basically adding animation, especially representational animation in instructional manual is beneficial to the usability of instructional manuals.

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Appendix

Appendix I: Three Versions of Instructions

Appendix II: Satisfaction Scale

1. The instructional manual is interesting.
2. The instructional manual is understandable.
3. The instructional manual is good.
4. It is pleasant to use the instructional manual.
5. Completing the tasks gave me a satisfying feeling.

Appendix III: Motivational Scale (RIMMS)

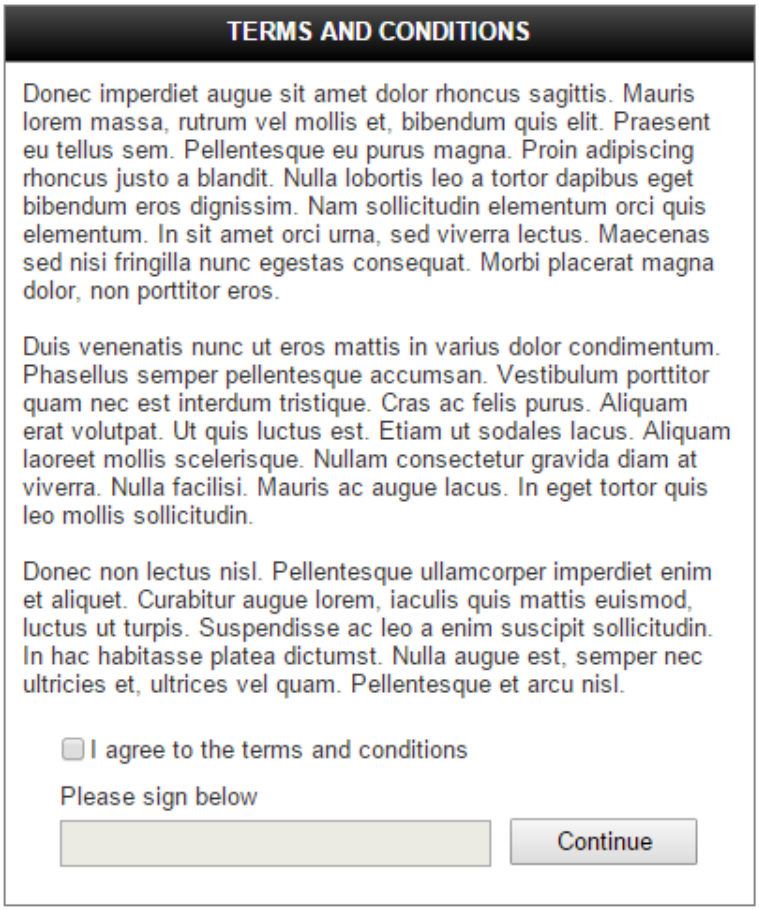
1. It is clear to me how the content of this instruction manual is related to things I already know.
2. The quality of the text helped to hold my attention.
3. As I worked with this instruction manual, I was confident that I could learn how to use Axure.
4. I enjoyed working with this instruction manual so much that I was stimulated to keep on working.
5. The way the information is arranged on the pages helped keep my attention.
6. I really enjoyed working with this instruction manual.
7. The content and style of writing in this instruction manual convey the impression that being able to work with Axure is worth it.
8. After working with this instruction manual for a while, I was confident that I would be able to complete exercises with Axure.
9. The variety of reading passages, exercises, illustrations, etc., helped keep my attention on the instruction manual.
10. The content of this instruction manual will be useful to me.
11. The good organization of the content helped me to be confident that I would learn to use Axure.
12. It was a pleasure to work with such a well-designed instruction manual.

Appendix IV: Self-efficacy Scale

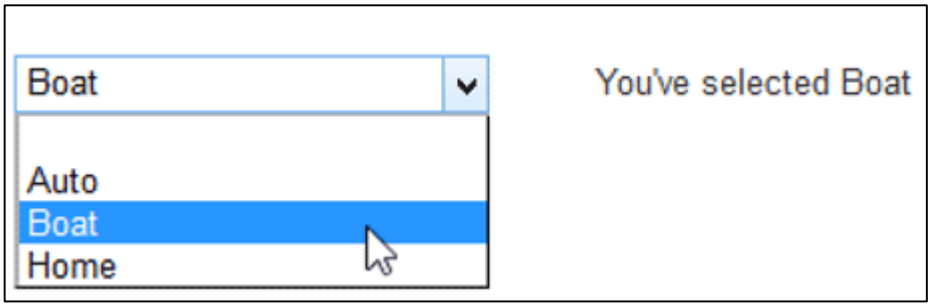
How certain are you that you can successfully perform the actions described below, and if you wish, with the help of the decorational animated instruction?

1. Create an account login prototype

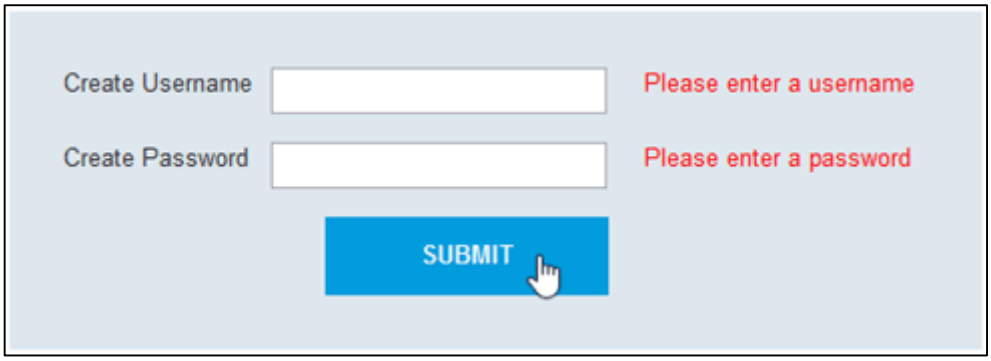
2. Create a terms and conditions prototype



3. Create a drop list prototype



4. Create a required field prototype



Do you have any comments or suggestions for this manual?

Appendix V: Open Question

Do you have any comments or suggestions for this manual?