WIP: Evaluating the Impact on a User's Motivation To Improve Their Sketching Ability Due to the Gamification of a User Interface

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Abstract

Sketching skills are developed over time through practice, requiring students to stay motivated to continue improving. Gamification has been shown to be helpful in keeping users motivated, so this work seeks to investigate the impact of gamification on the user's motivation to practice sketching skills in the intelligent tutoring system, SketchTivity. Specifically, this work will evaluate the impact of gamified elements including achievement banners, star ratings, and performance statistics to give users feedback about their level of success after a sketching lesson. This concept will be explored through within-subjects focus group testing where participants will interact with each version of the interface, describe their experiences in a think-aloud fashion, and discuss their preferences in a post-interview. The motivational impact of the gamified elements will be synthesized through thematic analysis of the think-aloud comments and interview data as well as statistical analysis of performance differences in terms of SketchTivity's sketch quality metrics.

Keywords

Gamification, user interface, sketching, informal education

1. Introduction

Sketching is a skill that requires practice and motivation to continue to improve. In informal education environments, this motivation can be difficult for students to muster on their own. Students face numerous challenges when attempting to learn sketching techniques such as low self-confidence, discouragement, and lack of desire to continue. [1]. User interfaces, specifically gamified interfaces, however, can aid in supplementing this missing motivation. The process of embedding aspects of games into a non-gaming platform is called gamification and has been implemented in the past for the exact purpose of creating motivation. This study will be conducted in order to draw conclusions on the impacts of gamified user interfaces on a user's motivation to improve their sketching skills in an informal education environment. In order to facilitate this research study, an intelligent tutoring system called SketchTivity will be utilized. The application allows students to complete tutorials on design sketching fundamentals and receive real-time feedback on their sketches [2]. True learning is thought to occur more often when the person is actively involved with the teaching device [3]. The addition of real-time feedback and game elements to the SketchTivity platform was done in order to foster this true learning experience. The importance of these engaging elements is elevated by the nature of the informal education environment since teaching is done in a non-traditional manner, without a physical teacher present, and therefore a higher degree of self-discipline from the students is required [4, 5]. Gamified interfaces may serve to increase motivation, and thus be successful within the informal learning spheres, in particular, with the SketchTivity application in teaching its users sketching techniques.

2. Related Work

2.1. Gamification in Interface Design

The design of an interface directly correlates with the purpose of the application that it is being created for. Dating back to the 20th century, there have been games designed with a "serious purpose", in particular, with military, educational, or business motivations [6]. The idea of "serious games" is presented by Ritterfeld, et. al, which describes such applications that build on the intrinsically fun nature of games and add on a more thoughtful layer of education [7]. Adding these fun elements of games is the basis of the gamification of a user interface. Those aspects can include a dashboard, progress bar, levels, points, and others [3, 8]. As time goes on, users are becoming increasingly comfortable with technology and the norms of interfaces, including the game elements and what they mean [9]. This knowledge base of users can be leveraged when designing interfaces and understanding how each

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element will effect the user. When studying and designing interfaces, the impacts can be categorized as one of three specific types: motivational affordance, psychological outcomes, and behavioral outcomes and should be implemented with these in mind [8].

2.2. Gamification in Education

Gamification is a common approach to education. One such study that explored this idea was conducted by Rahayu, et. al. In his study, twenty two students were studied with three primary goals in mind: 1) understand the behavioral change due to e-learning with gamification, 2) examine different gamification elements and their impacts on students' motivation and engagement, and 3) investigate if "population characteristics" play a role in influencing the motivation and engagement. Some of the gamification elements examined in this research were also focused on in this study, such as points and badges. Rahayu, et. al, discovered through their research that both points and badges positively influenced the students' motivation to continue learning and get better at the assigned material. Badges provided a more personalized experience that motivated students to continue on. Points were less impactful since students simply needed to earn a passing score for their assignment to have credit [10]. Another relevant study that focused on gamification was conducted in a formal learning environment through an online learning platform. The research questions that drove this study were 1) "How does gamification affect learner motivation?" and 2)"How do individual learner characteristics influence the impact of each game element on their motivation?". These questions are similar to those driving my research. In the conclusions, it was noted that different elements of gamification benefited different students. The benefits were not uniform across all students, but overall, the majority of participants in this study preferred the gamified learning platform over the non-feedback version [11].

This work focuses on the design and evaluation of a gamified interface for an intelligent tutoring system for teaching sketching skills, SketchTivity [1, 12]. Specifically, this work seeks to understand the impact of the feedback provided by gamified design on the users' motivation to practice sketching.

3. Methodology

To assess the impact of gamified elements on a user's motivation to practice sketching, this research will conduct a within-subjects user study with two variations of the SketchTivity intelligent tutoring system.

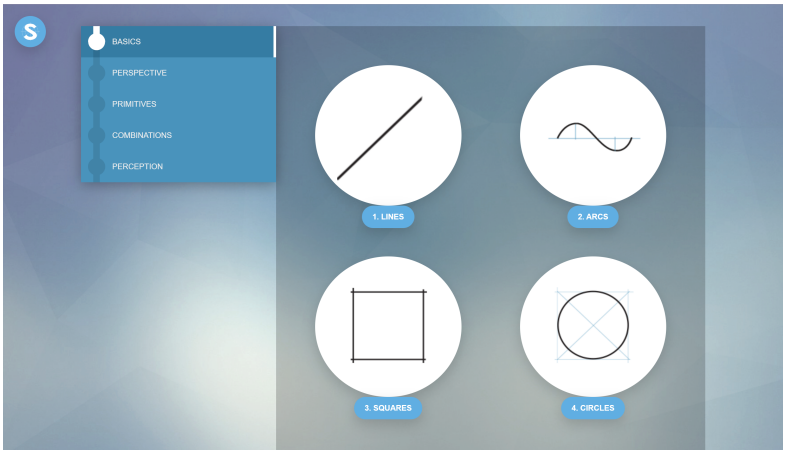
3.1. SketchTivity Interface

SketchTivity is a web-based application that is designed for students to practice and receive feedback on their sketching ability. It focuses on training fundamental sketching skills, guiding users through basics, perspective, and primitives, as shown in the lesson categories in Figure 1a. Lesson types include lines, arcs, squares, circles, planes, ellipses, cubes, cones, cylinders, and spheres. When a user starts a lesson, they are given eight exercises with randomized prompts to provide variety. Each exercise provides a prompt with appropriate scaffolding; an example of a Cube lesson is given in Figure 1b. Sketch recognition algorithms are used to automatically assess the quality of the sketch in terms of precision, smoothness, and speed. Precision refers to the accuracy to the prompt in terms of average deviation. Deviation is calculated as sum of the best match distances to the prompt for each point in the drawn stroke. Smoothness refers to how straight or consistent the drawn strokes are. This aspect is quantified by calculating the change in angle between points in the stroke. The more the angle changes, the more jittery the line and the lower the smoothness. Speed refers to the average speed of the pen in terms of pixels over time. Both precision and smoothness are normalized to be scores out of 100 where 100 indicates a perfect match to the prompt with perfectly smooth strokes. After completing an exercise, feedback on prompt accuracy is shown by highlighting the deviation in red. At the completion of a full lesson, the user is shown a results page containing a tip for what the user should focus on to improve their performance and a summary of their performance given by a bar graph visualizing their average precision, smoothness, and speed.

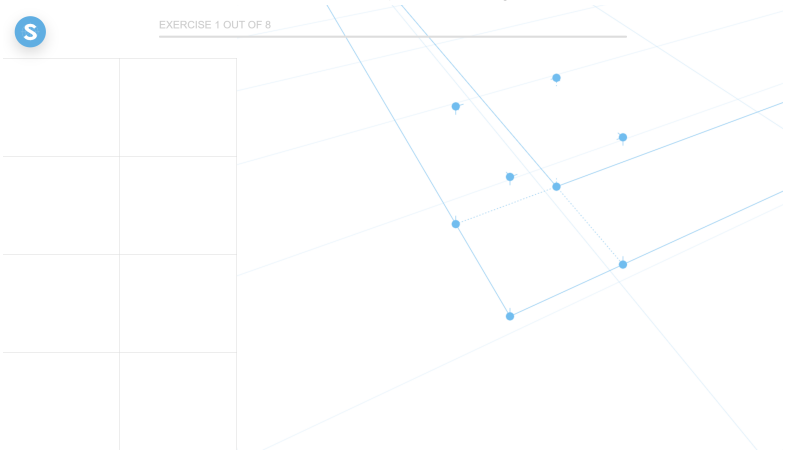
Two variations of the Sketchtivity interface will be used during the motivation experiment: gamified and no-feedback. The gamified version will add a star rating system to the results page as well as banners to the lessons page to give additional feedback and reinforcement of where the user is doing well; these elements are shown in Figure 2. The no-feedback version will remove the results page containing the summary feedback, replacing it with an end card that says “All Done!” to signal the end of the lesson. Additionally, the no-feedback version will remove the precision feedback after each exercise.

3.2. Experiment Design

A within-subjects user study will be used to measure differences in motivation between the two variations of the SketchTivity interface. This design allows for each participant to give feedback on the interface both with and without gamified elements and identify which variation they prefer. To avoid presentation bias, the order of



(a) Sketchtivity Lessons Page



(b) Example Sketching Canvas for Cube Lesson

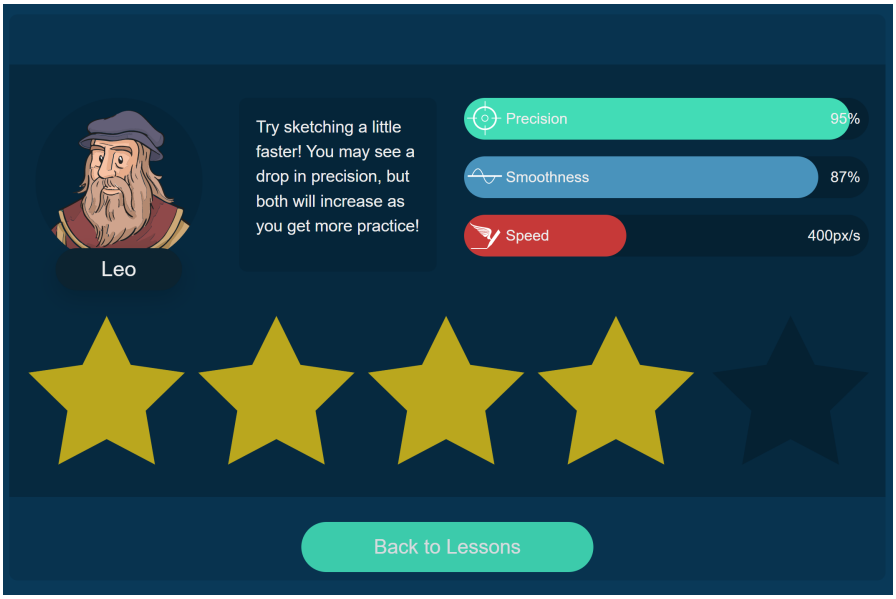
Figure 1: SketchTivity General User Interface

exposure to the interfaces will be counter balanced, i.e., Group One will interact with the non-feedback version first, whereas Group Two will see the gamified version first.

A focus group testing model will be utilized for this research where participants will interact with both interfaces in one sitting. Each person will receive a pre-study handout that asks demographic questions and has a list of statements in a Lickert-scale format. The pre-survey will be used to identify the user's experience with tablets, sketching, and their confidence in using the tablets to sketch. Then, participants will each be given a tablet that displays the SketchTivity interface and will sign in with an ID number. The participants will be tasked with exploring the application and completing as many, or as few, sketching tutorials as they wish. The researcher will answer questions about the interface but will not make suggestions to avoid biasing the participants' choices during the study. They will be strongly encouraged to speak aloud their thoughts and make comments on the interface as they interact with it. Time for comments and a break will be given before transitioning to the next interface variation. The study will follow the same format of interface exploration followed by discussion. The last assignment of the group will be to complete the post-study handout. The purpose of this survey is to obtain written opinions on the users' preference between the non-feedback and gamified interface.

4. Next Steps

The next steps for this research include conducting the user study and analyzing the collected data to draw conclusions about the impact of the gamified elements on the



(a) Results page with performance summary

(b) Precision Banner (c) Smoothness Banner (d) Speed Banner

Figure 2: Gamified Design Elements

user's motivation. Both quantitative and qualitative analysis will be used to derive insights from the participants' actions and comments during the study. The statistics gathered from the SketchTivity platform itself will be quantitative in nature. Those data values include the number of attempts taken per lesson, the scores for precision, accuracy, and speed for each attempt, and lastly, the number of lessons completed. Analysis techniques for this data will include confidence intervals and the two sample t-test. Qualitative data will take the form of the answers written on the pre-study and post-study surveys and the commentary transcripts during the focus testing. Thematic analysis will be conducted on the responses gathered to extract common sentiments and observations about the interface variations and the gamified elements. Overall, we expect to see an increase in motivation to practice sketching skills when using the gamified version.

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