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Developing the user experience of a simulator for professional drivers

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Abstract

The focus of the research was how to develop the user experience of a logistic simulator that is used in professional driver education. The research objectives were to analyse the user experience through pre-selected simulation exercises performed by users, how the length, difficulty level, feedback, or instructions affects the user experience and how to develop more user-friendly exercises based on the results.

The research was based on the research methods of user experience and the survey was conducted for Creanex simulator users. The questions of the survey were created in cooperation with the author and Creanex Oy. All the participants of the survey were vocational education and training providers in Finland. All the participants did three different exercises and answered the survey after every exercise.

The analyse of the results revealed that the participants were from different age groups. Less than half of the users did play video games more often than weekly or daily and it did not affect their perception of the simulator training. Most of the users read and understood the instructions for the exercises. The duration and the difficulty level were experienced suitable. Most of the users read and understood the feedback and does not want any feedback simultaneously from the simulator or instructor.

The user experience of the simulator can be developed by improving different options on how the instructions are presented to the user. Different learning difficulties must be acknowledged and reducing cognitive load improves learning results. The user should be able to use different options for receiving feedback and to increase motivation of the user, different reward from exercises would be suitable.

Keywords
user experience, simulation, simulator, development, logistics, usability, learning, feedback, professional driver

CONTENTS

1 INTRODUCTION

Simulation is based on parts of the real world and gives an insight into results that are accomplished by actions made by the user. A computer simulation is no different from other simulations excluding that simulation is created by programming. The popularity of computer simulation has been increasing because hardware and software are more and more powerful and enable more complicated simulations. The computer simulation includes statistical analytics which used data gathered during simulation. Analytics is used in decision-making to avoid problems in real-life actions. (McHaney, 2014, p. 1.) One key factor is also the authenticity of the simulation and how the simulator imitates a real-world environment (Salakari, 2010, p. 14).

Accordingly, Salakari (2010, p. 14) mentions multiple benefits of simulation-based training. A few to mention are cost saving, learning work-related skills, exercises easily repeated, improved learning results, steep learning curve, safety, etc. Simulator teaches not only theoretical knowledge but also practical knowledge, making the user more ready for a real-world working environment.

A good example of the use of simulations is Emergency Services Academy Finland which uses all kinds of simulations when training firefighters. One of many simulations is a smoke diving simulator that is used to train smoke diving techniques and student testing. Modular walls and other elements in the room can be filled with smoke to simulate a real apartment fire with zero visibility. (Emergency Services Academy Finland, n.d..) The main concept of simulation is to create an environment where users can practice and learn needed skills without causing any harm or damage when doing mistakes (Karlsaune et al., 2023, p. 8).

Creating a computer simulation program is expensive. Therefore, before programming specific simulations for solving a problem or forecasting actions, the necessity of simulation can be evaluated by Table 1. (McHaney, 2014, p. 11.)

Table 1. A situation where to use computer simulation (McHaney, 2014, p. 11).

General Situation	Examples
Real system does not yet exist and building a prototype is cost prohibitive, time-consuming or hazardous.	Aircraft, Production System, Nuclear Reactor
System is impossible to build.	National Economy, Biological System
Real system exists but experimentation is too expensive, hazardous or disruptive to conduct.	Proposed Changes to a Materials Handling System, Military Unit, Transportation System, Airport Baggage Handling System
Forecasting is required to analyze long time periods in a compressed format.	Population Growth, Forest Fire Spread, Urbanization Studies, Pandemic Flu Spread
Mathematical modeling has no practical analytical or numeric solution.	Stochastic Problems, Nonlinear Differential Equations

Even common opinion is that computer simulations do not match the real world, most users do not deny that computer simulations are useful in learning, especially at the beginning. Computer simulation can be effective especially when learning paths are designed to match real-world situations and skills learned in the exercises can be executed in a real-world environment.

It is necessary to separate different actors in educational simulations when it comes to the user experience. Educational simulations are purchased by the management, learning is designed by the teachers or instructors, and simulation is used by the end-users like students. This creates three different views of the user experience of the simulation. Despite the three views of the user experience, the most important is the end-user experience, the one that is meant to gain knowledge or skills through simulation training.

1.1 Simulators in driver training

A driving simulator creates an artificial environment of the driving situation for a vehicle (Arioui & Nehaoua, 2013, p. 1). In education, driving simulators are usually used to teach the basics of driving. Learning theories have shown that simulators have advantages and disadvantages when they are used in teaching drivers. The technical quality of the simulator must be at an acceptable level before learning outcomes are possible to achieve. Also, the quality of exercise is an important factor to achieve the goals of simulator teaching and is chained to a learning path for the user. (Allen et al., 2011, Chapters 2–7; SWOV, 2010, p. 1.) In Finnish legislation, the use of simulators is also an accepted way of providing driving instruction (Ajokorttilaki 386/2011, Section 4).

Simulators have been existed and used in training since the 1960s but for decades these remained too expensive to use widely in training. The technical development in PCs, television, etc. has made these cheaper and adequate for creating driving simulators. Figure 1 explains the functional elements of a driving simulator. (Allen et al., 2011, Chapters 2–2; SWOV, 2010, p. 1.) It means that driving schools and vocational education and training providers can purchase driving simulators. Especially in professional driver education, the simulators are a cost-effective way to teach basics compared to real-world trucks and trailers.

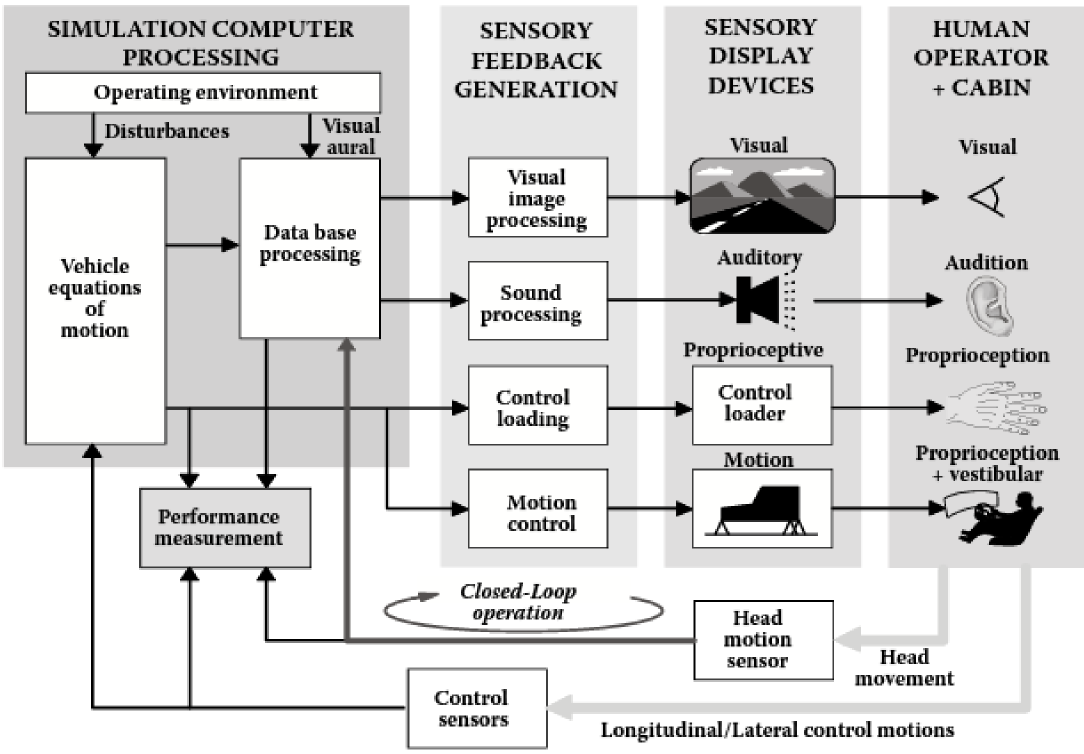

Figure 1. Functional elements of driving simulation (Allen et al., 2011, Chapters 2–2).

Accordingly, SWOV (2020, p. 1–2) the range is from low-end to high-end simulators. In Figures 2 and 3 is the Creanex driving simulator which is built in a movable frame that includes one to three screens, a pc, a steering wheel with controls, and two pedals. The simulator can also be equipped with a motion platform to increase authenticity. This simulator was manufactured in 2014 and was updated in 2020 and does not include the motion platform. There are available two software modules for professional driving education, the truck transportation module, and the timber truck transportation module. (Creanex Oy, n.d..)

Figure 2. The Creanex simulator from year 2014 and updated in 2020.

Figure 3. The control system of the Creanex simulator.

A driving simulator teaches the basic skills that are needed in driving. For example, vehicles' basic control systems are alike each other, learning the use of the pedals, handling the steering wheel, how to observe vehicles lines in the mirrors, where to focus on the different situations and handling the vehicle, how to reverse a truck with a trailer, etc. When the control systems are familiar from the simulator, it is faster to adapt to the real truck control systems and the user focus is not on the control systems but on what happens around the real truck.

1.2 Background information of research

There have been theses that have researched the user experience generally and what students think about the simulator training overall like theses from Järvenpää & Pälä (2013) about how to develop the simulator training by the student feedback and Kamppi et al. (2013) about development areas of the simulator training in the logistics and forest machine education. Those theses have been focused on how the teacher should plan a teaching event and how to give feedback. With the Creanex simulator, the feedback is built into the program which has changed the role of a teacher in simulator training.

The author has been teaching with the forest machine simulators since 2008 and with the Creanex logistic simulators since 2015. Therefore, the collaboration with Creanex Oy to do the research regarding the user experience was a reasonable choice.

The use of simulation training in education has increased through the 21st century and there are no signs that simulation teaching would start losing importance in education. The simulation training is also environment friendly especially when it decreases the use of the actual machines and trucks in education. Creanex Oy has created multiple simulation exercises for professional drivers, but there has not been any research regarding the user experience. Also, earlier mentioned theses are made almost a decade ago and the development of the simulators has been fast, especially in technical solutions. Therefore, research on the user experience of the simulator is welcome.

The questions to ask: How to develop the user experience in the logistics simulator? What kind of exercises there are for professional drivers? What do the users think of those exercises and the automatic feedback?

It will benefit Creanex Oy and other companies to have more knowledge about how the simulators are used by the customers and what kind of exercises would be suitable for the customers. Especially, information regarding the length of the exercises, the grading, and the feedback would help develop the simulator exercises. Also, understanding the role of the teacher in simulator training would improve.

1.3 Outline and research question

The research will be focused only on the users of the Creanex Oy simulators in Finland. The research includes the Creanex simulators for professional drivers and any other simulators from their product range are outlined outside of the research. The first phase of the research is to launch an inquiry related to the vocational education and training providers and if they are interested to participate in this kind of research. The focus is to research users' experiences of the simulator exercises, which are most probably students in secondary education.

The research question is:

- How to develop the user experience in a logistic simulator?

Research aim:

- How to improve the user experience of a logistic simulator?

Research Objectives:

1. Evaluate the user experience.
2. Analyse the exercises in terms of duration, difficulty level, feedback and grading.
3. Create proposals how to develop more user-friendly exercises.

The goal is to make suggestions and give ideas on how to improve the simulation exercises to improve the user experience and produce data that can be used in product development.

2 THEORETICAL FRAMEFORK

2.1 Conceptual framework

The different factors affecting the user experience shown in Figure 4. All these factors have their role in the user experience and how to develop it. The simulators are used as one teaching method in professional driver's education. In the centre is the user experience and the user, this is the focus of the research. The research is not about how the teachers affect the simulator training, but the role of the teachers needs to recognize as one of the factors affecting the user experience. Improving the user experience requires research data from the users. Also, the teachers usually are available and help the user to reflect on the feedback.

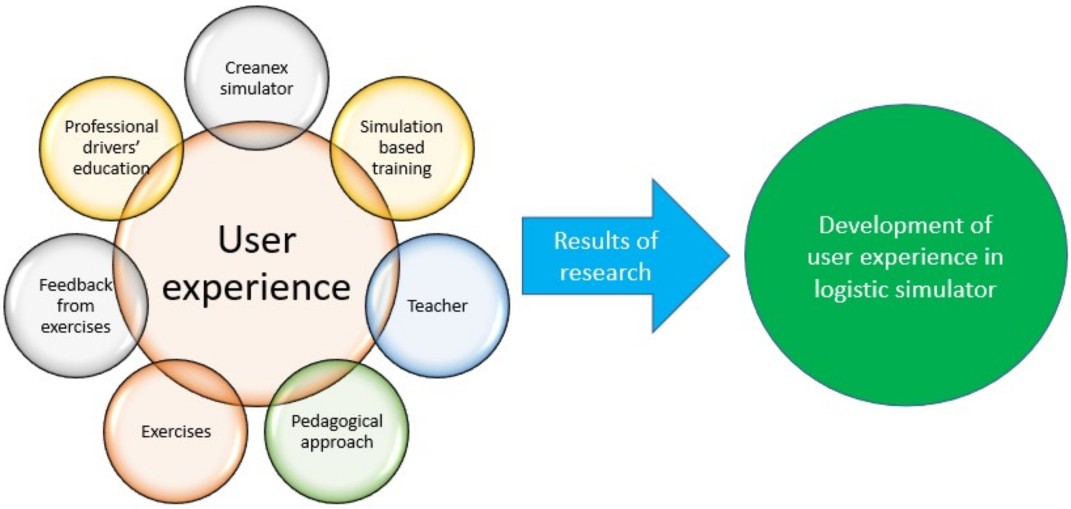

Figure 4. The conceptual framework

Simulation-based training is common in many professions, and it usually decreases the expenses of education, increases the safety of education, and smoothens the learning curve before practising with real trucks and machines. In professions that use fossil fuels in real-life training equipment, it is also environmentally friendly by decreasing pollution.

In the Creanex simulator, there are multiple exercises, and they are designed to increase the skills of the users step-by-step. The exercises use grading and feedback to help the user improve their skills. Every exercise has a minimum grade that you must pass to proceed to the next exercise. (Creanex Oy, n.d..) Some of the exercises are used as a tool for gathering the research data, but the research is not focused only to develop specific exercises.

When the goal is to learn new skills, it requires considering the pedagogical approach in the exercises and especially the meaning of feedback. The feedback should be simple enough to help the user reflect on taken actions in the exercises and improve them. For example, if the user does not pass the exercise, the feedback needs to be simple enough but so informative that the user can enhance the skills to pass the exercise.

After the research and analysing the results, there will be propositions on how to improve the user experience based on the research. The results will benefit simulator manufacturers and gives teachers a point of view about their role in teaching with a simulator.

2.2 Pedagogical point of view in simulation

Educational technology and programmed learning were discovered in the 20th century. B.F. Skinner was a psychologist who created behaviourism. It means that behaviours are learned from the environment and by rewarding the desired behaviour. After the animal experiences made with rats and pigeons, Skinner transferred theory to the school world because the behaviour is managed systematically in the school. In practice, it was implemented by building teaching machines. In those teaching machines were multiple-choice questions for the students. The right answer rewarded the student, and the wrong answer guided the student to review the subject. The learning machines gave feedback to the students immediately. The more developed learning machines were able to offer individual learning paths for the students. (Saari, 2021, pp. 145–146; The Editors of Encyclopaedia Britannica, n.d..)

The developers of programmed learning thought that the students are independent and individual learners and can manage their learning regardless of the teachers' or other students' requirements. Also, branching out the follow-up questions in the programs created a flexible learning environment that also took into consideration the capability of the student and gave instant feedback. The research of the learning technologies was versatile. Anyhow, the idea of education where every subject can be taken into smaller pieces and controlled by carefully managed and planned methods would create standardized methods. The use of learning technologies in teaching benefited especially from the standardized methods. (Saari, 2021, pp. 146–147; The Editors of Encyclopaedia Britannica, n.d..)

Modern learning technologies are still using methods of rewarding the desired behaviour. As a downside, it has led to a situation where learning technologies are offered as an easy technical solution for the complex challenges of education and society. (Saari, 2021, p. 148.)

Even if the student or learner would be an independent actor who does not need any kind of assistance from a teacher or an instructor, the complexity of the simulation defines the help needed. The exercises in the simulation environment usually start with simple exercises that focus to teach a specific skill to the user. At some point, these small pieces are put together in a more advanced exercise and the level of difficulty increases bit by bit. It is likely that it is also user-specific whether the feedback is more meaningful from the teacher or the simulator, which serves as a reward for the user.

Another learning theory that is connected to simulation learning is cognitive learning theory. In the cognitive learning theory, the student has an active role in learning, teaching is more like coaching, the teacher's task is preparatory work for learning and motivating the learner, and meaningful learning. It is the learner who creates one's knowledge and is controlling own learning path. (Jyväskylän yliopisto, n.d..)

Cognitive load theory is also good to acknowledge in the simulation training. When the working memory is handling new information, its capacity is very limited. All the new information vanishes in 20 seconds, except if the new information is refreshed by a rehearsal process. On the other hand, the knowledge retrieved into the working memory from the long-term memory does not disappear. Long-term memory exists as a cognitive architecture, including different categories of the complexity of knowledge. Expertise is stored and categorized in this archive and the working memory can retrieve it when needed. (Hattie & Yates, 2014, p. 146–147; Reedy, 2015.)

The cognitive load includes intrinsic load and extraneous load. Intrinsic load is the primary information and knowledge of the exercise and is desirable to learn from an exercise. The extraneous load comes from the learning environment and other parts of the exercise like the instructions. The extraneous load is something that should be minimized as much as possible because it also has an impact on the learning outcome. The extraneous load can be unnecessary instructions, the teacher talking too much, the peer learners trying to advise, etc. The extraneous load occurs when the exercises are getting more difficult with secondary information and if there is a lack of primary knowledge. In simulation, the extraneous load can be decreased by the design. (Hattie & Yates, 2014, p. 148–149; Reedy, 2015.)

It is good to acknowledge that computer simulation is one of many tools for learning. When designing the computer simulation, different learning theories and educational science research should also be taken into consideration. Knowledge of how the users learn and what affects the learning is valuable information when developing a simulation. The cognitive load theory forces the developers to consider what are the core of the exercise and the necessity of different factors in the exercise. Designing the exercise in a way that minimises the extraneous load on the user will create value to the user and improve learning performance.

2.3 Experiential Learning and Transformation of Experience

One way to create knowledge is through four stages of experiences. It is known as Kolb's Experiential Learning theory. Memorizing or a pool of ideas is not the same as learning because it does not add value to a learner. Learning happens when something new knowledge is generated from the experience. Learning occurs when a student creates new knowledge through experiences related to the environment. The concrete experience is all about hands in action. New knowledge is based on experience and is not only created by reading a theory. It concludes participating in the practical exercises. (Karlsaune et al., 2023, p. 8; Kurt, 2022; Salakari, 2010, p. 84.)

Kolb's Learning Cycle is described in Figure 5. Reflective observation is followed, where learners can ask questions, have conversations with peer-students about what they have experienced and have they notice any inconsistencies between experience and understanding. The third step is Abstract conceptualization. In this step, the learner is trying to make conclusions from a reflection of experiences and reasoning all events that occurred. Learner compares new knowledge to present knowledge reforming old concepts of knowledge or creating new concepts of knowledge. The last stage is Active experimentation. This is a stage where learners can apply in practice the knowledge and are able to solve different problems based on their earlier conclusions. (Kurt, 2022.)

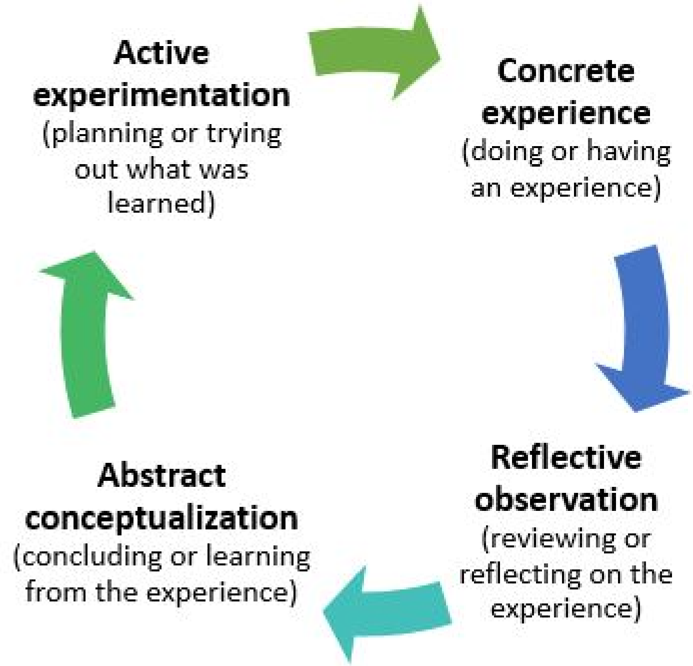

Figure 5. Kolb’s Learning Cycle (Kurt, 2022).

Transferring learned skills from a simulation environment can be categorized as positive learning, negative learning, and neutral learning. When the learner can transfer the skills learned in the simulation environment to a real-world environment, the result is positive. When the learner has learned the skills in the simulation environment that prevent practising skills in the real-world environment, the result is negative. When skills learned in a simulation environment do not matter in the real-world environment, the result is negative. Transferring skills from the simulation environment to the real-world environment can be enhanced by versatile and extensive experience. (Salakari, 2010, pp. 84–85.)

Learning by doing is a familiar concept from learning practical skills. Skills learned in a simulation are worth none if they cannot be transferred to the real-world environment. To help the users to learn, the simulation exercises should be tied together with the real-world exercises. When designing learning events, there should be a coherent plan for how to use the simulation events and the real-world events way that it creates value for a learner. For example, executing the same basic exercises in the simulation environment and repeating the same exercises in the real-world environment, helps the transfer of learned to become knowledge. In Figure 6 is an exercise that is the basic exercise in the Creanex logistic simulator. After mastering the crane control system in a simulator, the same exercise can be created in the real-world with a real crane.

Figure 6. Crane exercise from simulation environment created in real-world.

2.4 Feedback in learning

The role of feedback has been recognized since behavioural science was invented. But it is not the same thing as a reward which is more related to motivational concepts. The feedback is empowering factor for the learners and helps to achieve the next level of knowledge. From video games can learn how to show present knowledge and offer enough challenge for the player’s skills to improve and all this is done by feedback. (Hattie & Yates, 2014, p. 66–67.)

Accordingly, Hattie & Yates (2014, p. 68) and Vasalampi (2022, p. 72) feedback from a single performance that is accurate, genuine, and well-targeted, leads to a better result than general praise like a good job. Good, concrete, and positive feedback is something that benefits the learners, encouraging them to continue. That kind of feedback stays in mind. On the other hand, if positive feedback is given in a controlling form such as “you did as we wanted”, it has a negative result in learning because there is an exact end-result or behaviour requested from the learner. Positive feedback is targeted at the subject to learn, not at the capability of the learner. It is good to acknowledge that negative feedback is better than no feedback at all, even when it has decreasing effect on the learner’s motivation. On the other hand, negative feedback that includes accurate areas of improvement also benefits the learner. The worst to happen is to compare learners’ results with each other. (Vasalampi, 2022, pp. 72–74.)

Feedback is necessary to improve one’s performance. It is one of the most important factors in learning. Feedback enhances learning and helps a learner in self-reflection. The main question is, what is the role of a teacher in simulation-based learning? To improve, the learner also needs self-reflection but there are other ways to start that process than feedback from a teacher. The highly motivated learners will start the self-rection automatically after an exercise. The feedback have also influence on the learners motivation.

3 USER EXPERIENCE AND USABILITY

3.1 User Experience

Accordingly, de Voil (2020, p. 35) a user is an individual or group of people who interact with a product or software to benefit. User experience is a set of perceptions and psychological events experienced by a person. Those perceptions and psychological events are instantly available for the person but are subjective. If we can observe and analyse the user experience in an objective way, it will have a great difference in developing the user experience.

A user experience is a sum of different elements and with objective research, those elements can be improved. (de Voil, 2020, p. 33.) Goodman et al. (2012, p. 22) mention that a good experience of the product depends on a variety of users, but usability is the best starting point because the end-user experience is the key to success.

The key factor is fulfilling the user’s desires easily and effortlessly. The product should be simple to use and go beyond the user’s wishes for the product. The user experience is a sum of different factors like software design, user interface design, engineering, etc. (Norman & Nielsen, n.d..)

To create an excellent user experience with a simulation. All the factors must be balanced and serve a purpose for the user. Therefore, different parties in the development of the simulator must cooperate and find compromises between different factors to create a meaningful user experience.

According to (de Voil, 2020) there are five key elements in a user experience in Figure 7. The first is a person who is the user. The second is the product or the software application. The third is the user’s interaction with the system. The fourth is the experience and perception the users have when using the system. And fifth is the user’s responses to the used system.

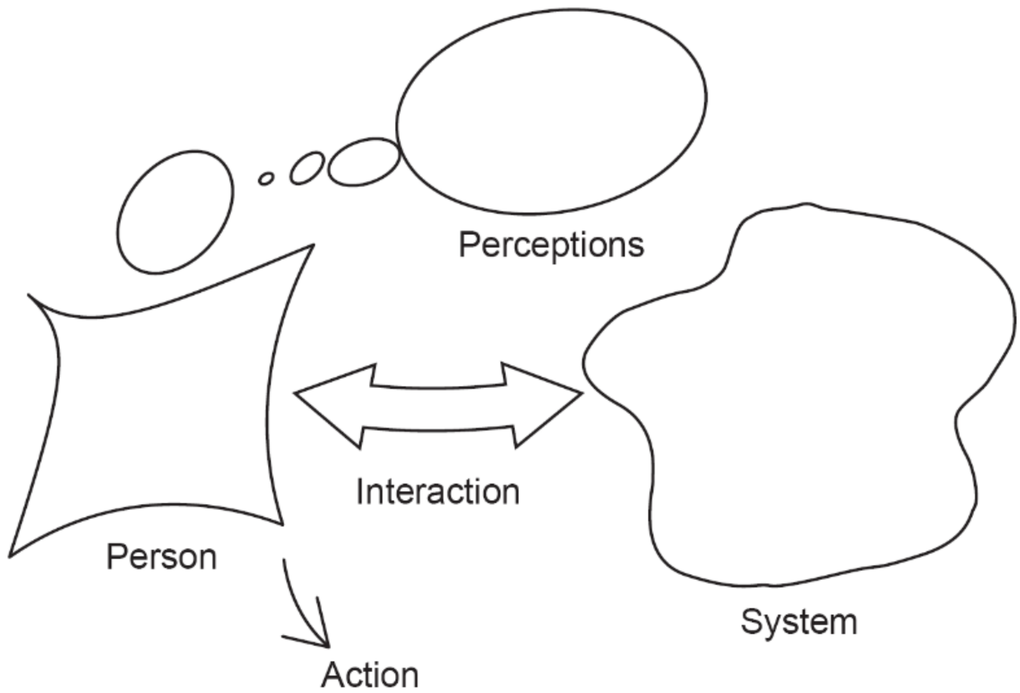

Figure 7. Elements of user experience (de Voil, 2020, p. 34)

When one is using a product, there is a purpose for its use. Interacting with the software can be seen as two actions the goals, and the tasks. The tasks are chained activities that must be done to achieve the goals of the user. Improving the system's usability cannot be done if you do not take into consideration the user's intentions, purposes, and goals. (de Voil, 2020, p. 34.)

The environment also might be quite different or vary from the environment that the software designer has thought. There are assumptions about where the software is going to be used, but all of them cannot be considered. It is possible that the user is not able to do motor or cognitive operations that are required by the software and the technical environment. Also, the social environment affects software usage. (de Voil, 2020, p. 35.)

The user of the simulation environment has a goal to achieve designed by the designer. But achieving the goal might not be the primary goal for the user. As mentioned in the introduction, there are three levels of user experience: management, teachers, and users. For example, the user's goal is to learn how to drive a timber truck and therefore apply to a vocational school to learn the necessary skills. The management and the teachers at vocational school have seen a logistic simulator as an appropriate way of learning. It can create a conflict between the user's perception of learning necessary skills if the user does not agree with this view. If the end-user needs to choose if the exercises are done with a real timber truck or in a simulation, the user would probably choose the real timber truck. Therefore, it is different from simulation known from gaming, where the users voluntarily purchase and use the simulation game.

3.2 Usability

Definition of usability: "The extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (de Voil, 2020, p. 92.) In Figure 8. there are three elements that are users, goals, and context of use and three concepts are effectiveness, efficiency, and satisfaction. Priority is not if the system functioned as designed. The priority is, did the user achieve the goal by using the system, even when the user did not use the system as it was designed to use. We can evaluate how users achieve their goals by asking next questions(de Voil, 2020, p. 93.):

1. How many users achieved the goal completely?
2. How many users achieved the goal accurately?
3. How many users achieved the goal completely and accurately?
4. If some users did not accomplish the goal completely, how far it was completed?
5. If some users did not accomplish the goal accurately, how bad were the inaccuracies?

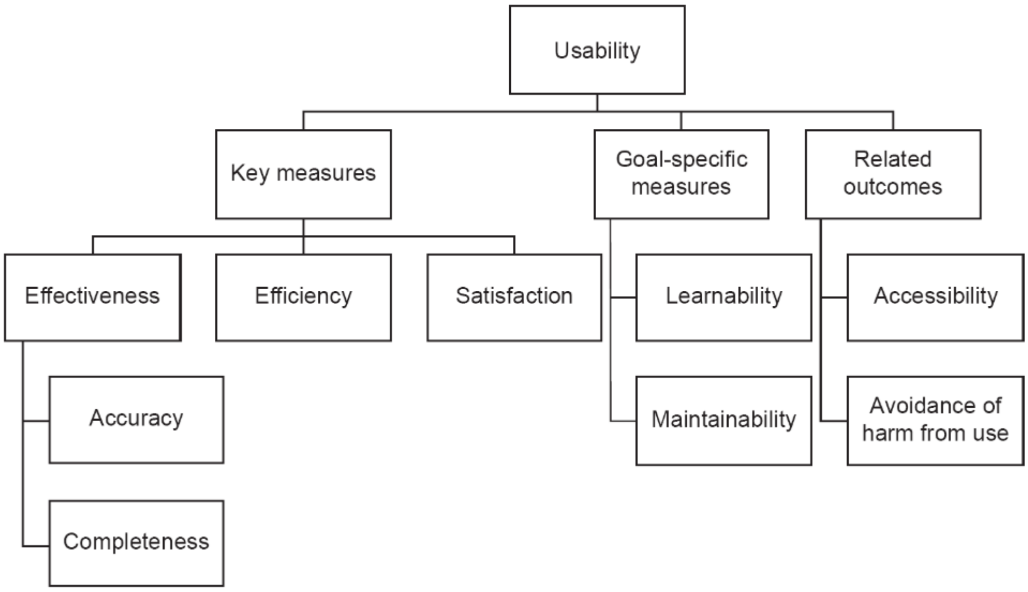

Figure 8. Measures of usability (de Voil, 2020, p. 95).

Nielsen (2012) defines usability by five quality factors.

1. Learnability: How easy it is for a user to do simple tasks when first time interacting with a product?
2. Efficiency: After a user knows how to use a product, how fast they can complete tasks?
3. Memorability: How easy to continue using the product after a long pause in use?
4. Errors: Can a user recover from errors made easily or are they too fatal to stop using the product?
5. Satisfaction: Is a user enjoying the use of a product?

Designing the usability of the simulator includes a control system and programming. When designing usability, it is important to keep in mind the end-user but nevertheless, the teacher or the instructor cannot be forgotten. End-user is the one to use the simulator but usually, the teacher is connected to usability and guides the user into using the simulator. In the Creanex simulator teacher also makes decisions about what exercises are available for the user, are the exercises using a platform game-style where you need to successfully complete the exercises before proceeding to the next or can the user choose freely what exercise to be done based on the individual learning goals.

3.3 Usability testing

The goals of usability testing depend on a product and what kind of information is desired. Most likely there are included factors presented in Figure 9. There are no user experience designers who could improve the usability of a product just based on their knowledge. Therefore, usability testing and research is the only way to gather information for improving a product. The three core factors of testing are the facilitators who give the instructions through the process, tasks that are authentic and imitate the real-world situation and the participant who would use the product that has been researched. (Moran, 2019.)

Figure 9. Why Usability Test? (Moran, 2019)

There are two kinds of usability testing, formative and summative. Most usability testing is formative. In formative testing, the output is feedback, which is used to improve system design. Summative testing is finding out if the system will meet the predefined requirements. In an unmoderated usability test, users are given instructions to complete the test in their own time. The negative side of this kind of unmoderated test is that spontaneous reactions are excluded. When using this kind of testing method, the best result comes when the researcher is testing a specific area of design. (de Voil, 2020, p. 145.)

Accordingly, de Voil (2020, p. 145-146) when implementing a usability test, there are seven steps to follow:

1. Identify research questions that need to be answered.
2. Identify and recruit some test participants.
3. Devise test tasks and scenarios that will answer the questions.
4. Prepare the environment for running the test.
5. Moderate the test.
6. Record the findings.
7. Prioritize the issues.

When the developer of the simulator is interested is the simulator performing as designed, the buyer, like an education provider, is more interested in cost saving and the teachers how can it be used to achieve the desired learning results. Therefore, usability testing can be done from different points of views like technical performance, user interface experience, achieved learning results, etc.

3.4 How to identify research questions

This research was done in a later period when the simulator from Creanex has been in production and used for a few years. Therefore, research questions are focusing on how to improve user experience by further development of exercises. Research is focusing on understanding the task and exercises, the length of exercises and especially how the user experiences feedback given by the simulator and how it should be improved. (de Voil, 2020, p. 147). The ability to create different scenarios and exercises for improving user skills is essential (Allen et al., 2011, Chapters 2–7).

Usually, when testing a user experience, more is better. But in this case, there is a limited pool of users and all of them are vocational education providers in Finland. Accordingly, de Voil (2020, p. 147) it is better in a formative testing test more frequently than involving a large group of participants. In this kind of research, five participants can be considered to be the minimum for the reliability of the research. To benefit most of the research, it needs to be targeted at the most important features of a product (Goodman et al., 2012, p. 49).

On the other hand, Nielsen (2000) claims that the maximum of five users is better than desired 15 users. There should be smaller tests for the five users, and it would be better to have the five users do the three tasks than 15 users do one task. The goal of usability testing is to improve a design, not only find the errors in the product. Testing only with one user is unreliable.

When the goal of the survey is clear, the research will benefit from brainstorming the questions by one or with a group. Descriptive and explanatory are two different goals in a survey. The first aims to profile the users and the second aims to explain users' behaviours and beliefs and how these are connected. (Goodman et al., 2012, p. 331.)

Creanex Oy had some specific points of view they wanted to be researched. Long history in simulator manufacturing and having informal feedback from the buyers through past years gave guidelines for some of the questions. They had also some assumptions about the factors affecting the user experience of the simulator. Based on a discussion with product manager Miikka Laaja, the issues are the difficulty of the exercises, does the user understand what is required to pass the exercise and what the user thinks about the feedback that the program gives after an exercise.

When the group of users are known, like in this case, a survey is an excellent way to do the research. In a survey, there are questions which are structured in a way that gives information about the product but also about the users and their interests. If the survey is executed with caution and carefully, the reliability is greater than in qualitative research methods. On other hand, the survey can also go wrong, and the researcher might ask the wrong questions from the wrong group. It will lead to biased answers and suppositions. (Goodman et al., 2012, p. 328.)

In this research, because of the narrow group of the users, there was no fear that participants are not related to the user experience. Also, the exercises related to the questions, were selected in cooperation with Creanex Oy.

4 EXECUTION OF RESEARCH

For the research method was used formative usability research guidelines, excluding the spontaneous reactions of the participant. They are most suitable when there is specific area of design to be researched.

The Microsoft Forms application from Microsoft Office 365 was chosen as a tool to execute the survey. It provided all the necessary question types and analytic tools. Creating individual survey paths was especially important for the survey. Depending on the user's answers, the follow-up questions varied. The survey was carried out in Autumn 2022 from week 41 to end of the week 45. The original plan was to carry out the survey during October, but because all the participants were students in vocational education from the different locations in Finland, there were also one-week lasting Autumn vacations during weeks 41 to 43, depending on the location in Finland. The survey was created in Finnish and the questions was translated to English for this thesis.

To keep the survey at a reasonable level, only three exercises were chosen for the survey. Two of the exercises were the truck handling exercises from the road transportation module and the third exercise was the loading exercise from the timber truck transportation module. The chosen exercises were based on the long experience of the product development and needs of Creanex Oy and the author's long experience of simulator teaching. The chosen exercises represented different difficulty levels and different levels of complexity regarding the instructions and the feedback. The survey was anonymous, and the users cannot be identified by any means from the answers.

4.1 Questions of the survey and participants

The questions (Appendix 3) were produced as a joint effort with Product Manager Miikka Laaja. The survey was divided into general questions, the common claims related to simulator training, the instructions for exercises, the level of difficulty and the feedback. The survey also aimed to find out whether the user's experience of playing video games had a positive impact on the experience of using the simulator. For the purposes of the survey, passing or failing the exercises was not relevant or measured.

Product Manager Miikka Laaja also provided a list of contacts who used similar models of simulators with the road transportation module and the timber truck transportation module. All the contacts were vocational teachers in different vocational education and training providers located in Finland. The teacher’s role was to implement the survey in their school. It is correct to assume that all the users who answered the survey were students.

4.2 Instructions for survey and cover letter

One challenge of the survey was that executing the survey was in hands of the teachers. It would be an impossible and time-consuming task to travel around Finland to execute the surveys. Therefore, it was important to create simple instructions (Appendix 2) for the teachers. One concern was that the survey must be done after every exercise. If the user would do all three exercises in a row and after the exercise’s answers in three surveys in a row, the data would be compromised. Also, the possibility of making the wrong exercise was possible, therefore all the users must confirm that they had made the right exercise.

A cover letter (Appendix 1) was sent to the contacts to inquire about their interest to participate in the survey. Only two contacts out of six answered and after the kind reminder, the result was the same. Therefore, personal phone calls were made to the contacts who had not answered the email and after all, five out of six contacts promised to participate in the survey.

The instruction for executing the user survey was sent in week 41 of 2022 by email. Because of the long answering time and Autumn vacations, the contacts had kind reminders by email at the beginning of every week until week 45.

5 RESULTS OF RESEARCH AND ANALYSIS

The survey was executed in Finnish and the questions were translated into English. Thirteen users answered the survey regarding the three different exercises. The users executed exercises 4. and 8. which were part of the road transportation module and included handling the truck. Third was exercise 3. from the timber transportation module that was loading a timber truck. All the exercises were based on a real-world environment.

In the first question of the survey the users needed to confirm that they had done the right exercise. In Figure 10. the result was the same for all three exercises.

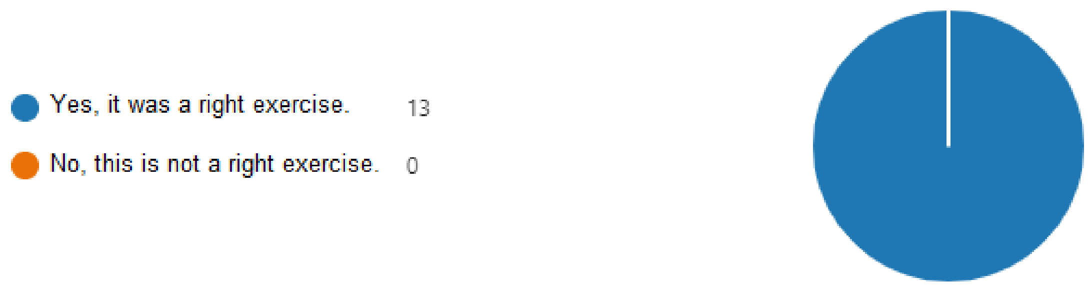

Figure 10. Question 1.: Confirm that you have done the right exercise.

5.1 General questions

In Figure 11. is the age profile of users. Because there were thirteen users who participated in the survey, the age profile is the same in all three exercises. In percentages, there were 38 % of 15-19 years old, 31 % of 30 years old or older, 23 % of 20-24 years old and 25-29 years old 8 %.

Figure 11. Question 2.: What is your age?

In Figure 12. is a question regarding playing video games in their free time. This question was important to Creanex Oy for learning if gaming in a user's free time affects the attitude towards simulator training. The users who played videogames daily belong to the age group 20-24 years and the users who played video games weekly belong to the age group 15-19 years. Most of the users who did not play videogames at all belong to the age group 30 years or older.

Figure 12. Question 3.: How often do you play video games?

5.2 Claims related to simulator learning and attitude toward simulator

In Figure 13., Figure 14. and Figure 15. are results related to user's attitude towards simulator training and the teacher's role in interpreting the feedback of the exercises. The answers vary depending on which one of the three exercises was completed. It is good to acknowledge for the reader that the user can view the feedback after completing the exercise.

The first claim was "Exercise helps you learn important skills.". In Figure 14. and 15. the combined results for "Strongly Agree" and "Agree" are 100%. Both exercises were exercises to learn the basic skills required for handling a truck. The only difference was that exercise 8. was executed in the traffic environment. On the other hand, advanced exercise 3. in Figure 13. was also an authentic exercise compared to the real-world but 15,4% disagree and 7,7% strongly disagreed that the exercise helps in learning important skills.

The second claim was “I want to use simulator more during training.”. The question divided the answers and there was a slight difference depending on the exercise. In combined average -% the results were Strongly Agree 5%, Agree 51,3%, Disagree 33,4% and Strongly disagree 10,3%. More than half are ready to use more often a simulator in training.

The third claim was “I felt frustration when I was doing exercise.”. Some frustration might be an ongoing force for the user and gets to trying harder to succeed. Nevertheless, if the frustration is continuous and is getting worse, it will lead to a decrease in motivation. In combined average -% was Strongly agree 28.2%, Agree 35,9%, Disagree 15,4% and Strongly disagree 20,5%. The reasons causing the frustration have not been researched so the factors that can lead to a feeling of frustration remain unknown. It can be related to usability, exercise design, lack of needed skills in the exercise etc.

The fourth claim was “I could have used a teacher’s help interpreting the feedback.”. This was one of the most important questions to research the user’s perspective of the teacher’s role. In Figure 13. and 12. 7.7% Strongly agree and 15,4% Agree that they would need the help of the teacher to interpret the feedback in Figure 14. the per cent was zero. It means that most users did not need a teacher to interpret the feedback.

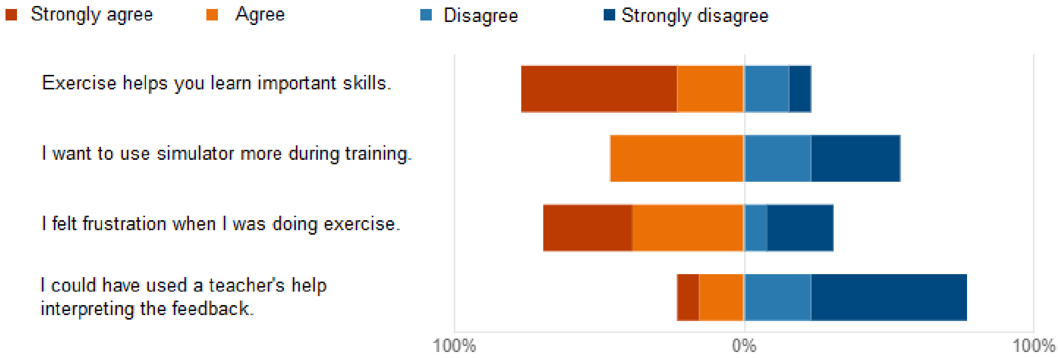

Figure 13. Question 4.: Claims regarding simulator training and feedback. Exercise 3.

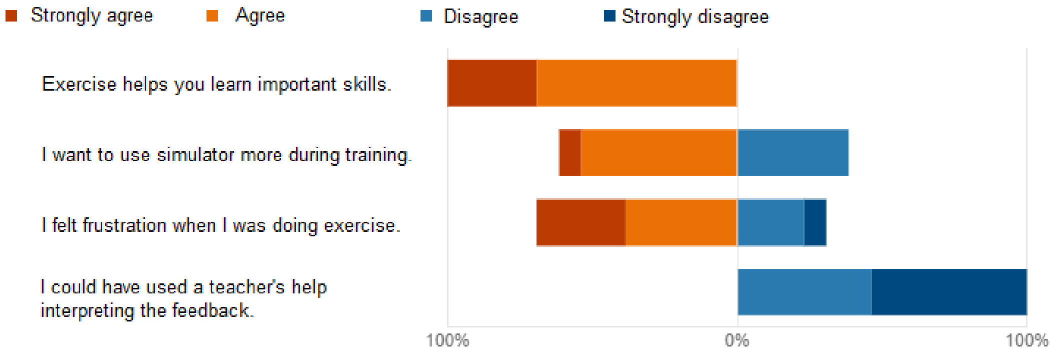

Figure 14. Question 4.: Claims regarding simulator training and feedback. Exercise 4.

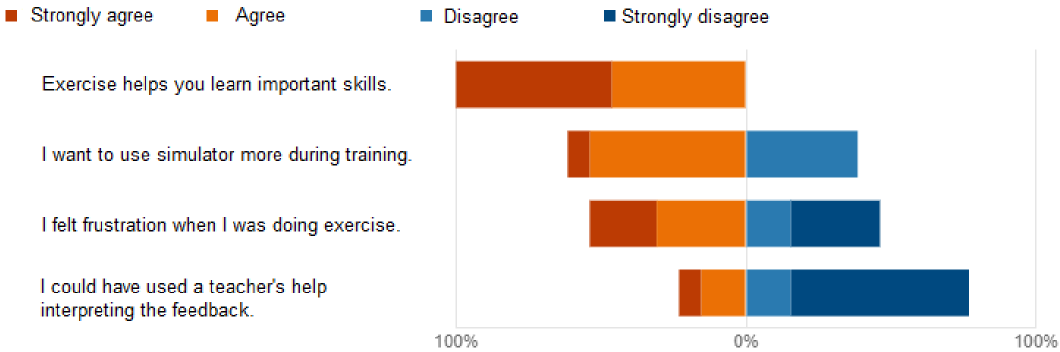

Figure 15. Question 4.: Claims regarding simulator training and feedback. Exercise 8.

5.3 Instructions of exercises

Every exercise includes a detailed description, instructions, and goals. It is important that the user read and understand the instructions and goals of the exercises before starting the exercise.

In Figure 16., Figure 17. and Figure 18. shows differences between different exercises related to the user's understanding of instructions and goals. Most of the users read the instructions and understood the goals of the exercises.

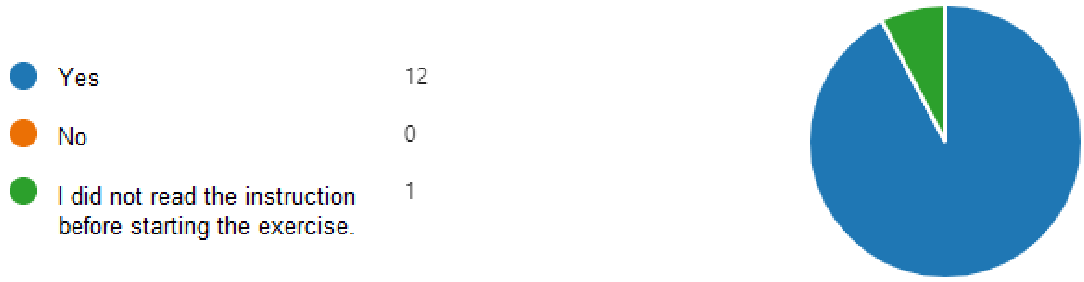

Figure 16. Question 5.: Were instructions of exercise clear and did you understand goals of exercise? Exercise 3.

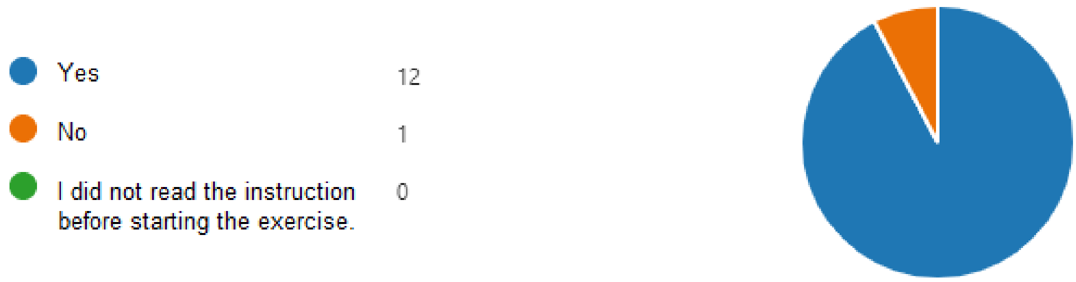

Figure 17. Question 5.: Were instructions of exercise clear and did you understand goals of exercise? Exercise 4.

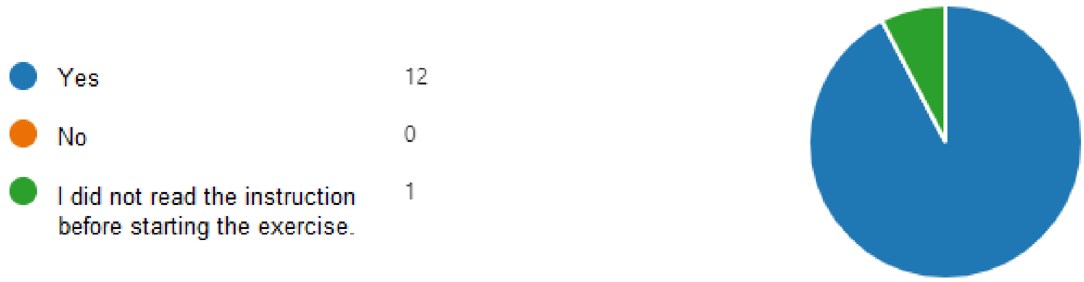

Figure 18. Question 5.: Were instructions of exercise clear and did you understand goals of exercise? Exercise 8.

If the user answered "No" to question 5., the user was directed to question 6. "What was unclear in the instructions or goals of exercise?". This was an open question where the users could give an exact answer regarding the unclear instructions and goals. One user answered "No" to question 5. felt that in exercise 4. the handling track was from time to time hard to perceive.

If the user answered question 5. “No, I did not read the instructions before starting the exercise.”, the user was directed to answer question 7. “Did you read the instructions during the exercise?” which was “Yes” and “No” question. In Figure 19. it is made clear that the users who did not read the instructions before the exercise, did not read the instructions during the exercise.

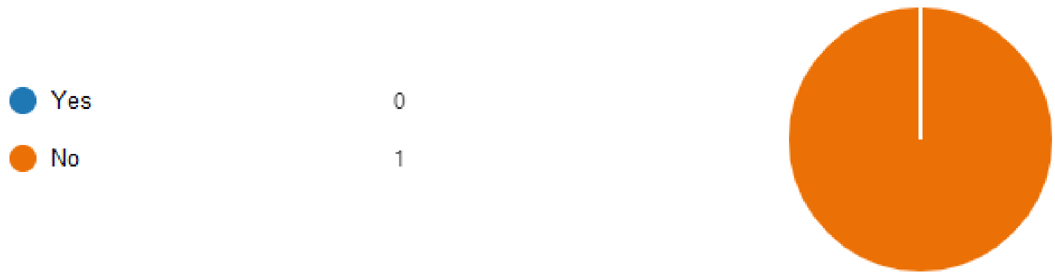

Figure 19. Question 7.: Did you read the instructions during the exercise? Exercises 3. and 8.

5.4 Level of difficulty and duration of exercises

The Creanex simulator modules include exercises with different levels of difficulty starting from beginner and ending in hard. The level of difficulty was different in all three exercises. Exercise 4. can be described as a beginner level, exercise 8. as a normal level and exercise 3. as a hard level. In Figure 20., Figure 21. and Figure 22. There is data about how the users have felt the level of difficulty of different exercises. It is interesting that only one user in one exercise felt it was easy. Most of the users felt that the difficulty level of exercises was normal, except in Figure 20. where five users felt it was hard. It is in line because it is an advanced exercise, and it should feel harder than basic exercises.

Figure 20. Question 8.: How difficult was the exercise? Exercise 3.

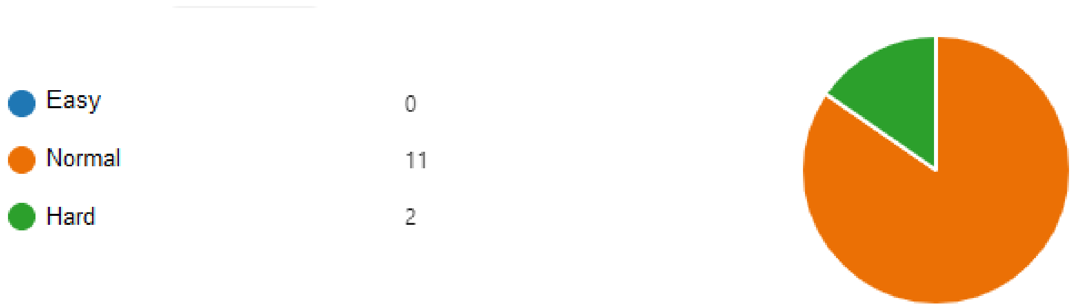

Figure 21. Question 8.: How difficult was the exercise? Exercise 4.

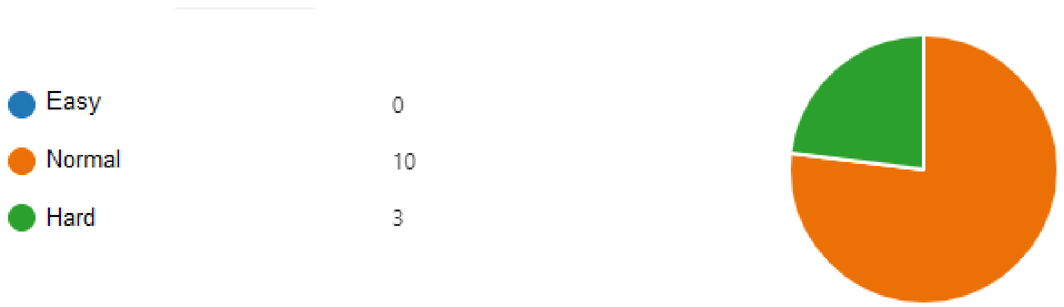

Figure 22. Question 8.: How difficult was the exercise? Exercise 8.

There were two follow-up questions depending on the answer “Easy” or “Hard”. The meaning of both follow-up questions was to figure out what made the exercise “Easy” or “Hard”? These were open questions, so the users could answer freely.

In exercise 4. the level of difficulty was experienced as “Hard” by two users. The first user wrote that it was hard to figure out the line when turning the truck. The second user wrote there was a lack of visibility.

In exercise 8. the level of difficulty was experienced as “Hard” by three users. The first user wrote that the parallel parking was meant to be done in so small space that with a real truck they would not even try. The second user wrote that multiple measurements and interpreting distances in the exercise were hard and different compared to real-life situations. The third user wrote that it was hard to interpret the car behind the truck and the space for parallel parking was small.

In exercise 3. the level of difficulty was experienced as “Easy” by one user and “Hard” by five users. The user who found exercises “Easy” wrote that it was just loading the truck and it did not matter how the logs were loaded in the truck. Two of the users who answered “Hard” wrote that the path of the crane was limited, one wrote that interpreting the distances is difficult to compare in the real life and one was not familiar with the controls of the crane.

The duration of the exercise was found to be mostly perfect. In Figure 23., Figure 24. and Figure 25. are compared to how the users felt about the duration of the exercises.

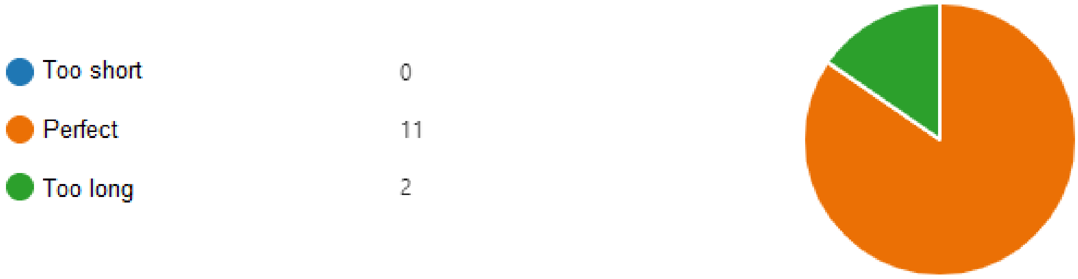

Figure 23. Question 11.: How was the duration of the exercise? Exercise 3.

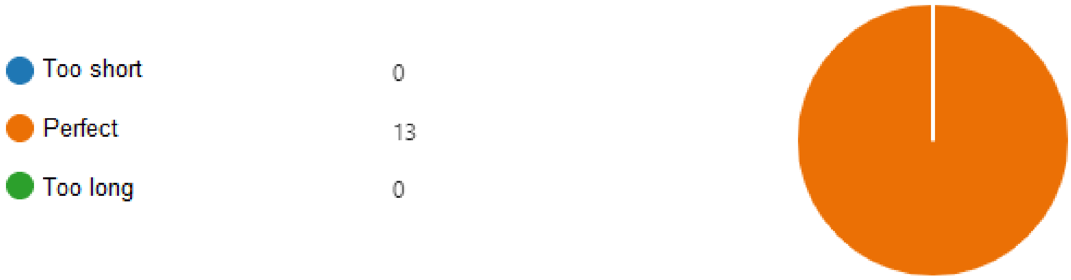

Figure 24. Question 11.: How was the duration of the exercise? Exercise 4.

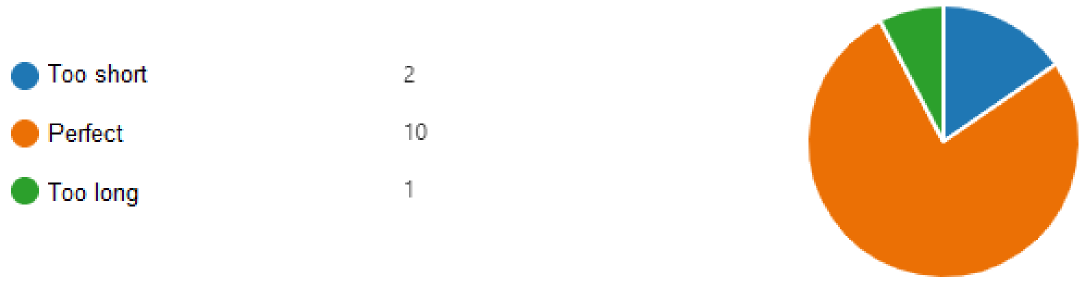

Figure 25. Question 11.: How was the duration of the exercise? Exercise 8.

5.5 Feedback of the exercises

When the exercise is done, it will give the users automatic feedback on performance. The goal of the feedback is to help the user to improve knowledge and skills regardless of has the user passed or failed the exercise. In Figure 26. is data if the users did read the feedback they had after the exercise. In this survey, 85 % of the users read the feedback in all exercises.

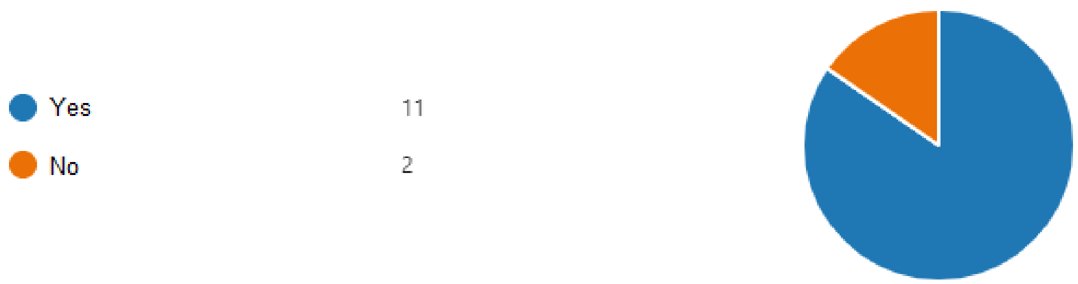

Figure 26. Question 12.: Did you read the feedback after exercise? All exercises.

If the answer was “Yes”, the user had a follow-up question 13. “Did you understand the content of the feedback? If the answer was “No”, the user had a follow-up question 16. “Why did you not read the feedback?”. Data in Figure 27. shows that in exercises 4. and 8. the users who read the feedback, also understood the content of the feedback.

On the other hand, data in Figure 28. shows that two users did not understand the content of the feedback in exercise 3. For those users, there was a follow-up question 14. “What was unclear in the feedback?”. One of the users who did not understand the feedback wrote that they did not understand technical terms in the feedback and wished that the content of the feedback clearly would list the mistakes made.

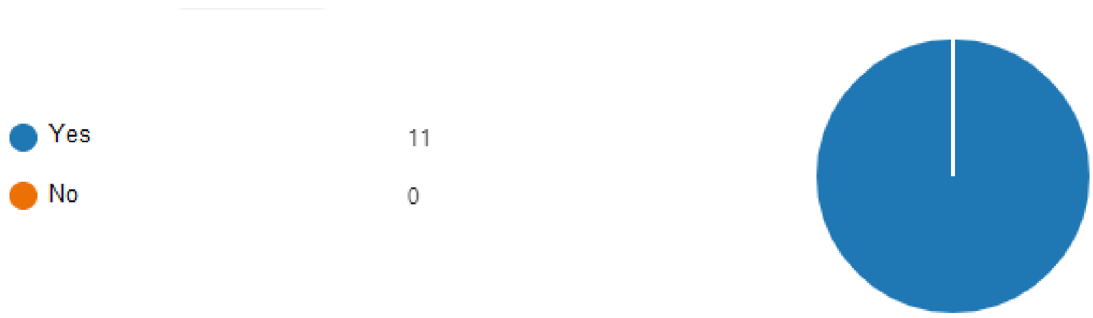

Figure 27. Question 13.: Did you understand the content of the feedback? Exercises 4. and 8.

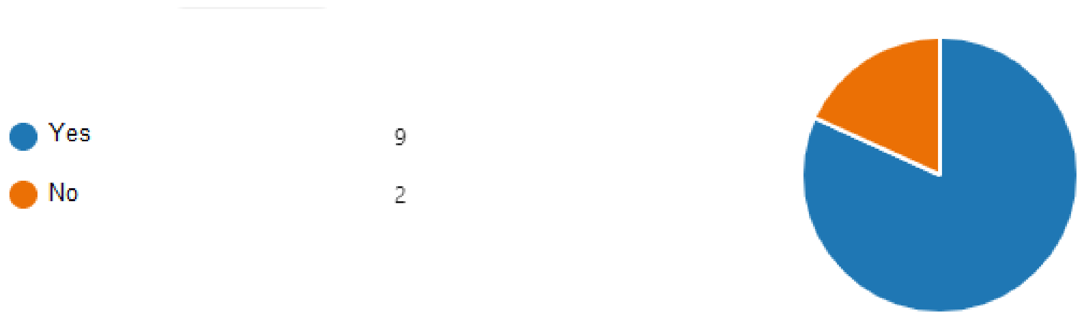

Figure 28. Question 13.: Did you understand content of the feedback? Exercise 3.

If the answer was “Yes” in question 13., there was a follow-up question 15. “Did the feedback help you to improve?” with the options “Yes” and “No”. Data in Figure 29., Figure 30. and Figure 31. shows the differences between the exercises.

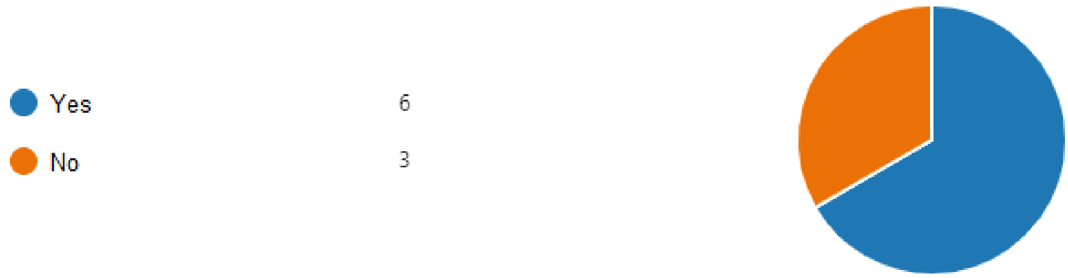

Figure 29. Question 15.: Did the feedback help you to improve? Exercise 3.

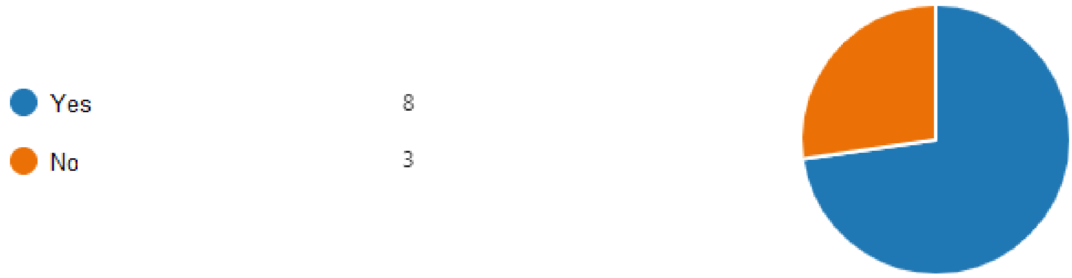

Figure 30. Question 15.: Did the feedback help you to improve? Exercise 4.

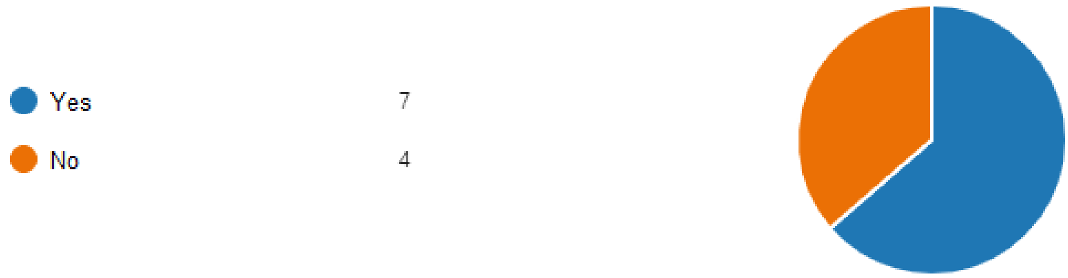

Figure 31. Question 15.: Did the feedback help you to improve? Exercise 8.

When the answer was “Yes” to question 15., there was a follow-up question 17. “How the feedback helped you to improve?”. If the answer was “No”, there was a follow-up question 18. “Why did the feedback not help you to improve?”. Both were open questions to answer.

The answers in exercise 3. show clearly that the feedback helped the users to understand how to improve the use of a crane, especially two of the users noticed from the feedback that they are pushing constantly against the limits of the crane movement. Three of the users could not specify why the feedback did not help them to improve.

The answer in exercise 4. shows that the users got detailed feedback and knew exactly how to improve. The users could see driving over the cones, how many times they had changed the direction from reverse to forward, the use of the mirrors etc. On the other hand, one of the users wrote that there was not enough information and one of the users could not see the possibility of improvement because the exercise was done only once. In exercise 8. the answers were like in exercise 4. One observation was that one of the users could not assimilate the content of the feedback and therefore could not improve.

The users who did not read the feedback were asked question 16. “Why did you not read the feedback?” Most of these users did not feel the necessity to read the feedback or they did not bother to read it. One of the users could see from the screen the mistake and that is why they did not read the feedback.

The last question was question 19. “Would you like to have feedback during the exercise?” There were three options to answer and as data in Figure 32, Figure 33. and Figure 34. shows the answers varied between different exercises. Figure 32. shows that in the advanced exercise, the four users would like to have feedback from the teacher during the exercise.

On the other hand, in the basic exercises feedback from the simulator during the exercise would also be welcome. Slightly over half of the users do not want feedback during the exercise. There is a possibility that the users could feel that as an increase of cognitive load.

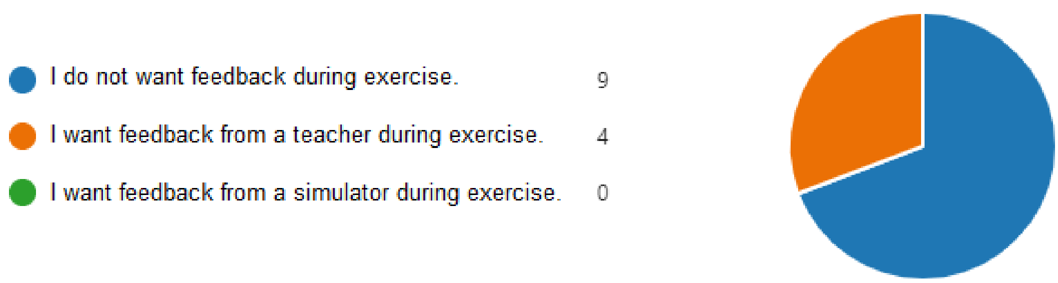

Figure 32. Question 19.: Would you like to have feedback during the exercise? Exercise 3.

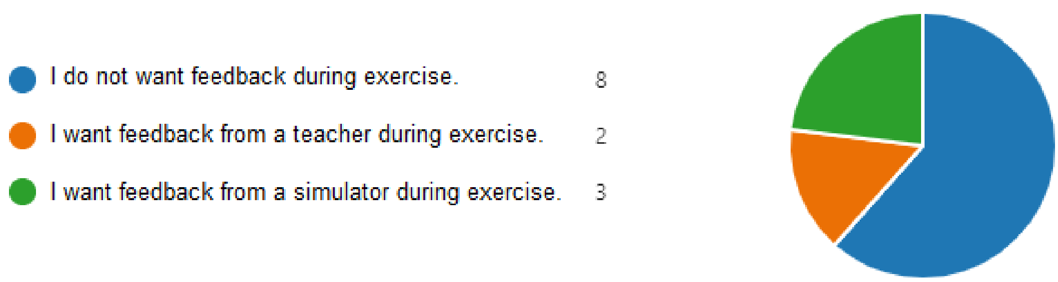

Figure 33. Question 19.: Would you like to have feedback during the exercise? Exercise 4.

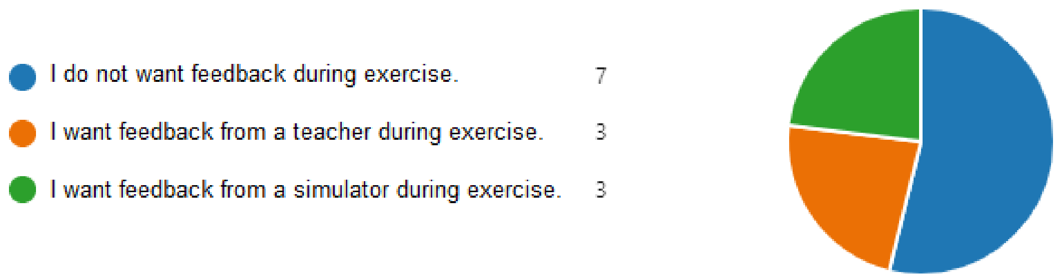

Figure 34. Question 19.: Would you like to have feedback during the exercise? Exercise 8.

6 CONCLUSIONS

The research question was “How to develop the user experience in a logistic simulator?”. The survey was categorized into five categories, general questions, claims related to simulator learning and attitude towards simulator, instructions of exercises, level of difficulty and duration of the exercises and feedback of the exercises.

Creanex Oy can benefit from using the results in their development process of a logistic simulator. Nevertheless, the general questions provide information regarding the common questions related to the simulator and can be used in other research. Because all the results of the research are available to the public, other simulator manufacturers, especially logistic simulator manufacturers are able to use the results in their development process.

Instructions for the exercises were given by the simulator in written form. Most of the users understood the content and goals. Nevertheless, the written form of the instructions can create problems in understanding depending on the learner and the learning difficulties. Offering optional video instruction would help users with different cultural heritage or users with learning difficulties and improve the accessibility.

A simulator was seen as a useful way to learn important skills, especially in basic exercises. All the exercises used in the research took under 30 minutes to complete including answering the survey. The length of the exercises varied between 5 to 15 minutes. Most of the users thought the length of the exercises was perfect.

One purpose was to find out if the users who played video games had more positive impact regarding using the simulators in training. The results revealed that two out of five of the users who played video games regularly would like to use the simulators more often in training. For the users who rarely played video games or did not play at all, the result was that six out of eight would like to use the simulator more often in training. The increasing use of the simulators in training was dividing the answers approximately half and half. An interpretation can be made that playing video games does not correlate with the positive experience of the simulator training.

One research objective was to find out the user's experiences regarding the feedback of the exercises. Most of the users did not need a teacher or an instructor to interpret the feedback of the exercises.

One research objective was to find out does the user want feedback during the exercise. In the advanced exercise, four out of nine would like to have feedback from the teacher during the exercise. In the basic exercises, slightly over half of users would not like to have feedback during the exercise. The users who would like feedback during the exercise, half of them would like it from the teacher and half from the simulator.

6.1 How to develop user experience

When improving the user experience of logistic simulators, it is important to keep the length of exercises short in a constructed simulation environment and create exercises that help the users to create the knowledge bit by bit. Also, in an exercise where the users load the timber onto the truck, half of the users did not experience it to improve the important skills. The transfer of the learned skills creates value for the user and the simulation should support the users in this subject.

If the instruction is in written form, it might not be accessible to the user. Therefore, an instruction given in different forms like text, voice or video would increase accessibility. Only offering a screen reader would be useful for the user with a learning difficulty.

A simulator is a technical product including hardware, software, and user experience design. But focusing on the technical part of the simulator leads to less attention to the pedagogical meaning of the simulation. In the simulator development process, the technical part and the pedagogical part should be balanced. Focusing on how to control a cognitive load is necessary. Feedback given during the exercise, regardless of the source, might add an extraneous load for the user. Therefore, it should be optional for the user.

Receiving a reward for the successful accomplishment of the exercise could increase the motivation of the user. Badges could be used to prove skills achieved.

6.2 Future research

There is a discussion about should the computer simulation environment be more like a gaming-style environment. Some of the features of gaming could make the simulation exercises more appealing. How can somebody play a farming simulation voluntarily for hours but cannot do more than half an hour of simulation exercises? Researching the factors from gaming adapted to simulation environments would be useful. For example, creating avatars for users they could upgrade by completing exercises would be an interesting topic.

Researching the cognitive load in simulator training and how to adjust it would be a good research topic. Especially research focused on extraneous load would benefit the users.

Because of the diversity of the users and the problems caused by different learning difficulties of the users. Researching how to improve the accessibility on the logistic simulator would benefit the users.

6.3 The reliability of the research

The five users can be considered the minimum number of participants to have a reliable result. For the research, there were thirteen participants and there are no indicators that there would be any problems in executing the research. Therefore, there have been enough participants and the results are reliable.

Nevertheless, the research is executed with the specific simulator model from Creanex Oy. Therefore, executing the same research with other manufacturer simulator models can provide different answers and even executing the same research with a different simulator model from Creanex Oy can provide different answers.

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APPENDIX 1: COVER LETTER

Hei,

Minun nimeni on Juha Hämäläinen ja opiskelen logistiikkainsinööriksi Satakunnan ammattikorkeakoulussa. Olen tekemässä opinnäytetyötä Creanex Oy:lle simulaattorien käyttäjäkokemuksesta. Opinnäytetyössä on tarkoitus selvittää kyselytutkimuksella käyttäjäkokemusta liittyen harjoitusten toteutukseen ja palautteeseen. Tavoitteena on tuottaa tietoa ja ehdotuksia Creanex Oy:lle käyttäjäkokemuksen parantamiseksi.
Kyselytutkimus toteutetaan Microsoft Forms ohjelmalla. Simulaattorin käyttäjä tekee ennalta määrätyt harjoitukset. Jokaisen harjoituksen jälkeen hän vastaa välittömästi kyselytutkimukseen. Tarkemmat ohjeet ja vastauslinkit toimitetaan tutkimukseen osallistuville.
Pyydän ystävällisesti ilmoittamaan osallistumisesta kyselytutkimukseen vastaamalla tähän sähköpostiin syyskuun loppuun mennessä. Tutkimus on tarkoitus tehdä lokakuun 2022 aikana. Jos et enää käytä työssäsi Creanexin simulaattoreita, ole hyvä ja välitä viesti eteenpäin sopivalle henkilölle.
Opinnäytetyö on englanninkielinen, mutta kyselytutkimus toteutetaan suomen kielellä. Lisätietoja saat minulta sähköpostilla tai p. XXX-XXXX XXX.

Kiitos ajastasi!

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APPENDIX 2: INSTRUCTIONS FOR EXECUTION OF THE RESEARCH

Creanex Oy:n logistiikkasimulaattorien käyttäjäkokemuksen kehittämisen tutkimuskysely syksyllä 2022.

Taustatiedot
Opinnäytetyön tilaaja: Creanex Oy, Rieväkatu 14, Tampere.
Tutkimuskyselyn toteuttaja: Juha Hämäläinen, Satakunnan ammattikorkeakoulu,
logistiikan opiskelija. Puhelin XXX-XXXX XXX, sähköposti juha.hamalainen@student.samk.fi
Tutkimuksen ajankohta: Viikko 41–45 / 2022.
Tämän kyselyn tiedot kerätään anonyymisti ja vastaajilta ei kysytä henkilötietoja tai tallenneta niitä. Vastauksia käytetään opinnäytetyön materiaalina.

Ohjeet tutkimuksen toteuttamiseen
Logistiikkasimulaattorilla tehdään ennalta määrätyt kolme harjoitusta per käyttäjä. Käyttäjillä tarkoitetaan opiskelijoita. Tutkimuksen kannalta ei ole merkityksellistä onko käyttäjällä aiempaa kokemusta samoista tehtävistä vai ei. Jokaisen harjoituksen jälkeen täytetään Forms -kyselykaavake, kysymysten määrä riippuu vastauksista. Kyselyyn vastaamiseen kuluu aikaa noin viisi minuuttia / per kysely.

Käyttäjän tulee olla perehtynyt simulaattorin hallintalaitteisiin ennalta. Käyttäjä tekee jokaisen ennalta määrätyn harjoituksen vain kerran. Ainoastaan teknisten ongelmien keskeyttäessä harjoituksen, sama harjoitus voidaan aloittaa uudelleen. Opettaja tai ohjaaja toimii avustajana varmistaen, että käyttäjä tekee oikeat tehtävät ja vastaa oikeaan kyselyyn. Käyttäjää ei saa avustaa tai neuvoa harjoituksen suorittamisen aikana harjoituksen suorittamiseen liittyen eikä auttaa tulkitsemaan tehtävän ohjeistuksia tai harjoituksen antamaa palautetta tai antaa muuta palautetta suorituksesta. Harjoituksen tekemisen ja kyselyn jälkeen suosittelen pitämään lyhyen tauon ennen seuraavaa harjoitusta ja kyselyä.

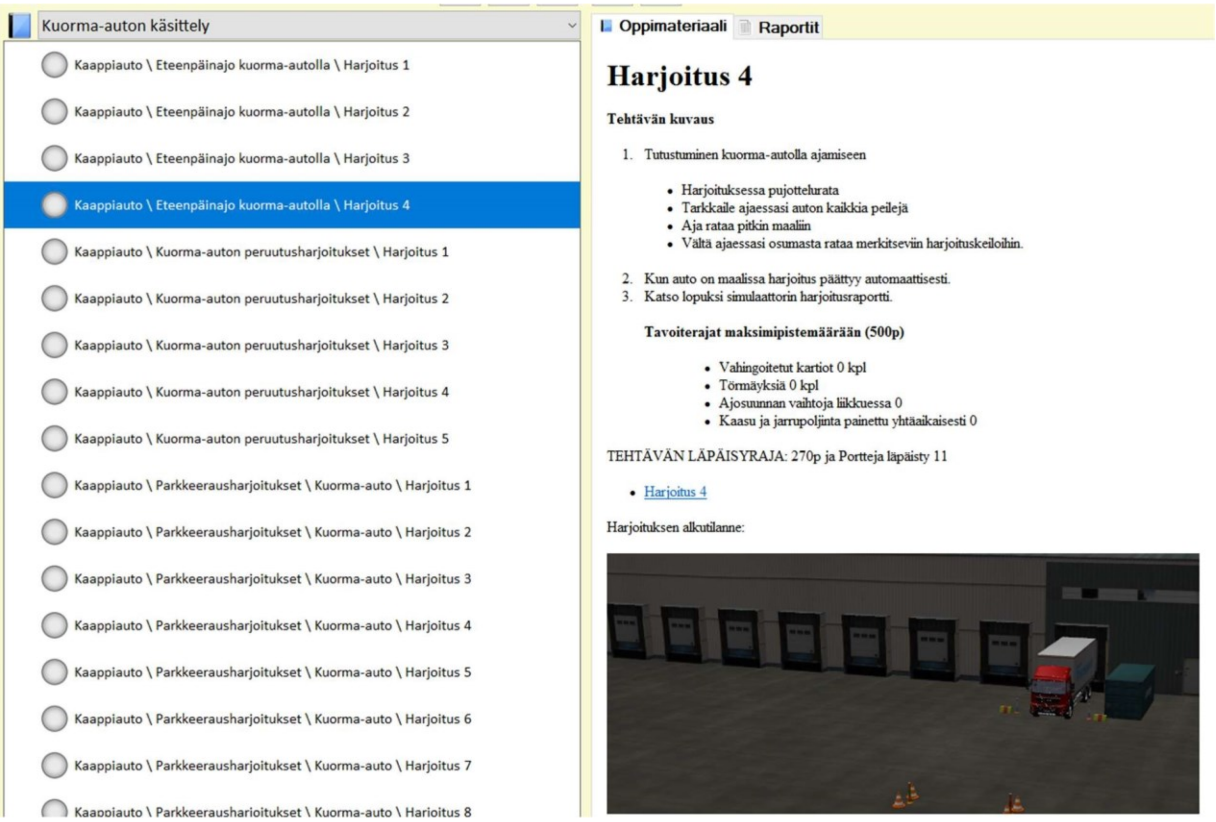
Korostan vielä, että harjoitusta koskevaan kyselylinkkiin vastataan välittömästi harjoituksen tekemisen jälkeen. Mikäli harjoitustehtävät tehdään yhteen menoon ja vasta sen jälkeen vastataan kyselyihin, se vääristää huomattavasti vastauksia ja ne eivät ole käyttökelpoisia tutkimusmateriaalina.

Tässä ohjeessa on myös kuvakaappaukset ja tiedostopolut jokaiseen harjoitukseen liittyen sekä jokaiselle harjoitukselle yksilöity kyselylinkki.

Harjoitus 4.

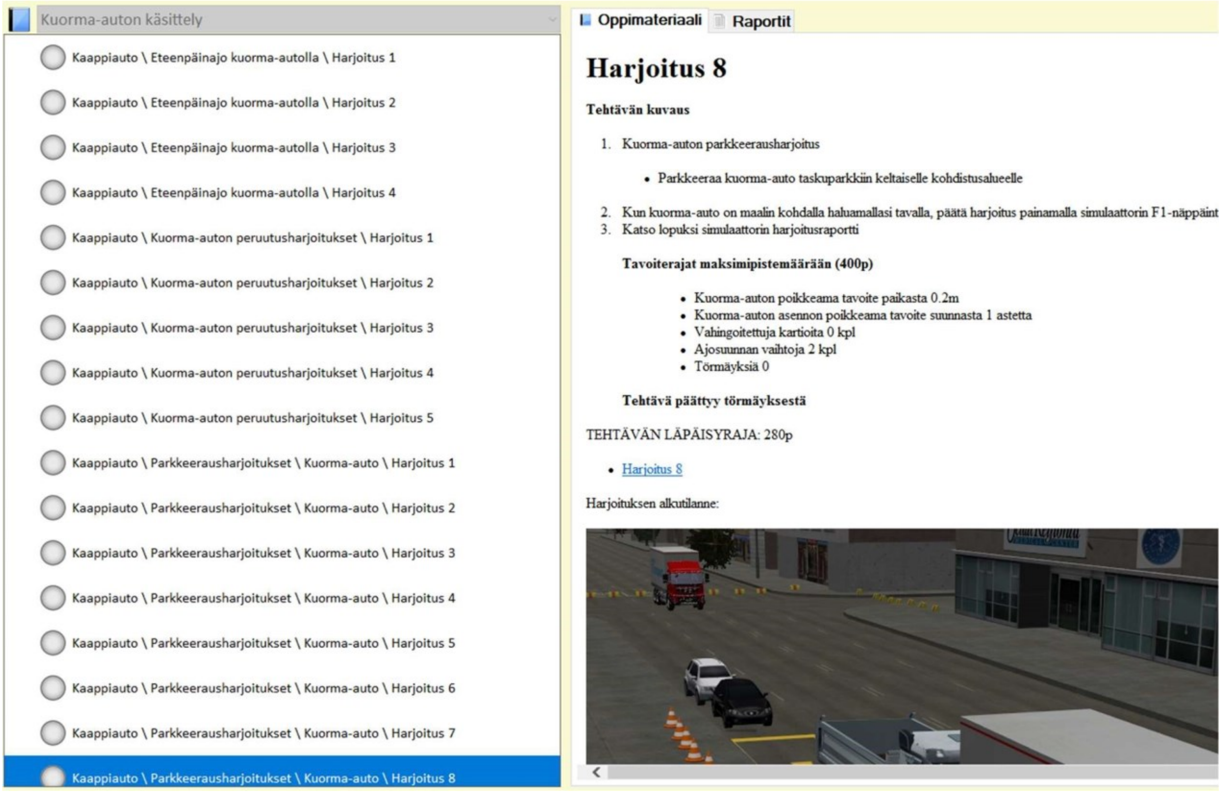
Tiedostopolku harjoitukseen ohjelmassa: Kaappiauto \ Eteenpäinajo kuorma-autolla \ Harjoitus 4

Kyselylinkki: https://forms.office.com/r/yHNKq5P3Tk



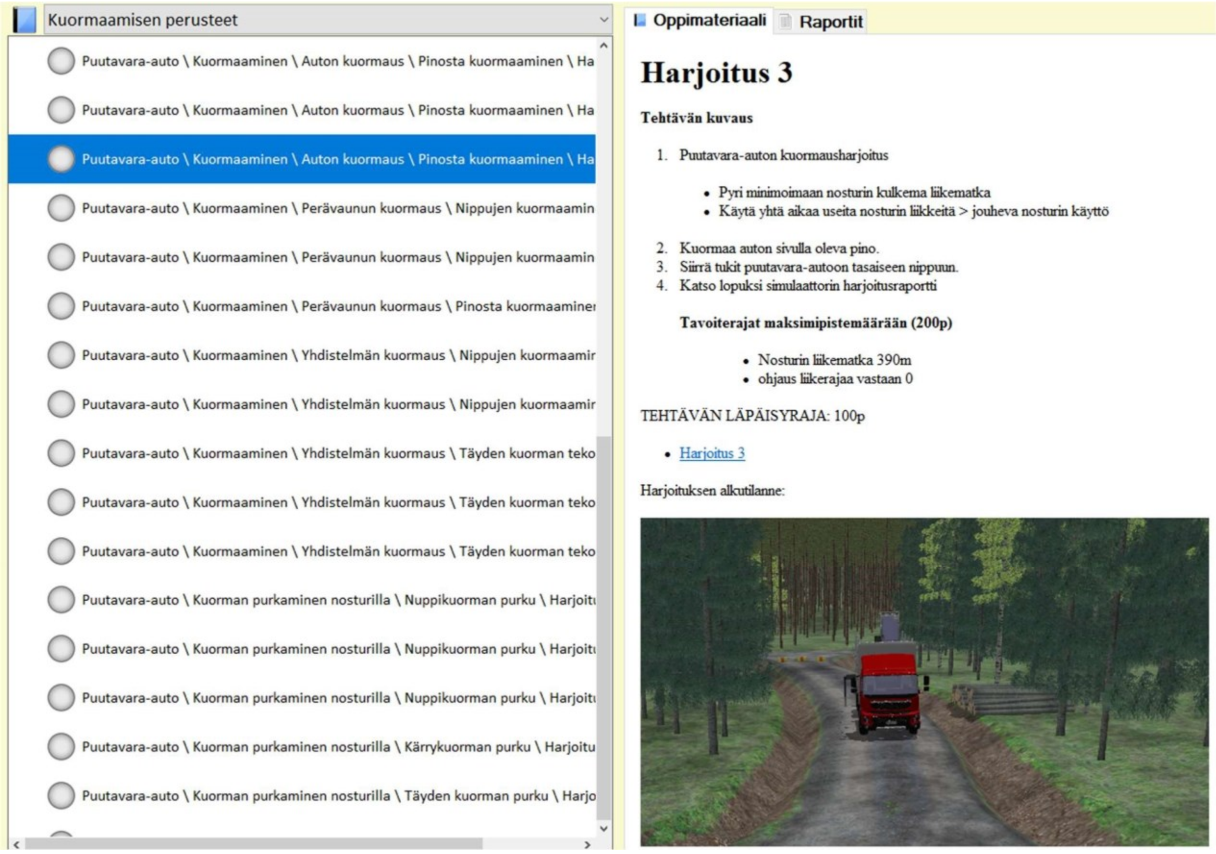
Harjoitus 8.
Tiedostopolku harjoitukseen ohjelmassa: Kaappiauto \ Parkkeerausharjoitukset \ Kuorma-auto \ Harjoitus 8

Kyselylinkki: https://forms.office.com/r/9Vd1eCvvXg



Harjoitus 3.
Tiedostopolku harjoitukseen ohjelmassa: Puutavara-auto \ Kuormaaminen \ Auton kuormaus \ Pinosta kuormaaminen \ Harjoitus 3

Kyselylinkki: https://forms.office.com/r/8MMefu7DUp



APPENDIX 3: SURVEY QUESTIONS

1. Vahvista, että olet tehnyt kyselyä varten harjoituksen 3. *

- ◯ Kyllä, tein tämän harjoituksen. Siirry Seuraava
- ◯ Ei, tämä ei ole oikea harjoitus. Siirry Seuraava

2. Minkä ikäinen olet? *

- ◯ 15-19 vuotta
- ◯ 20-24 vuotta
- ◯ 25-29 vuotta
- ◯ 30 vuotta tai vanhempi

3. Harrastatko videopelaamista vapaa-ajallasi? *

- ◯ En lainkaan
- ◯ Kuukausittain
- ◯ Viikoittain
- ◯ Päivittäin

4. Seuraavaksi sinulle esitetään väittämiä liittyen simulaattoriin ja tekemääsi harjoitukseen. *

	Täysin samaa mieltä	Osittain samaa mieltä	Osittain eri mieltä	Täysin eri mieltä
Harjoitus auttaa tärkeiden taitojen oppimisessa.	◯	◯	◯	◯
Haluan käyttää simulaattoria enemmän koulutuksen aikana.	◯	◯	◯	◯
Koin turhautumista tehdessäni harjoitusta.	◯	◯	◯	◯
Olisin tarvinnut opettajan apua palautteen tulkitsemisessa.	◯	◯	◯	◯

5. Oliko harjoituksen ohjeistus selkeä ja ymmärsit harjoituksen tavoitteen? *

◯ Kyllä	Siirry 8. Harjoituksen vaikeustaso oli mielestäni
◯ Ei	Siirry 6. Mikä jäi epäselväksi harjoituksen ohje...
◯ En lukenut ohjeistusta ennen harjoituksen aloittamista.	Siirry 7. Luitko ohjeen kesken harjoituksen te...

6. Mikä jäi epäselväksi harjoituksen ohjeistuksessa tai tavoitteessa? *

Kirjoita vastaus

Siirry 8. Harjoituksen vaikeustaso oli mielestäni

7. Luitko ohjeen kesken harjoituksen tekemisen? *

◯ Kyllä

◯ Ei

8. Harjoituksen vaikeustaso oli mielestäni *

◯ helppo.	Siirry 9. Mikä teki harjoituksesta helpon?
◯ normaali.	Siirry 11. Harjoituksen kesto oli
◯ vaikea.	Siirry 10. Mikä teki harjoituksesta vaikean?

9. Mikä teki harjoituksesta helpon? *

Kirjoita vastaus

Siirry 11. Harjoituksen kesto oli

10. Mikä teki harjoituksesta vaikean? *

Kirjoita vastaus

11. Harjoituksen kesto oli *

- liian lyhyt.
- sopiva.
- liian pitkä.

12. Luin harjoituksen jälkeen saamani palautteen. *

- Kyllä — Siirry 13. Ymmärsitkö palautteen sisällön?
- En — Siirry 16. Miksi et lukenut palautetta?

13. Ymmärsitkö palautteen sisällön? *

- Kyllä — Siirry 15. Auttoiko palaute sinua kehittymään?
- En — Siirry 14. Mitä jäi epäselväksi palautteessa?

14. Mitä jäi epäselväksi palautteessa? *

Kirjoita vastaus

Siirry 19. Haluaisitko saada suorituksestasi pal...

15. Auttoiko palaute sinua kehittymään? *

- Kyllä — Siirry 17. Miten palaute auttoi sinua kehittym...
- Ei — Siirry 18. Miksi palaute ei auttanut sinua kehit...

16. Miksi et lukenut palautetta? *

Kirjoita vastaus

Siirry 19. Haluaisitko saada suorituksestasi pal...

17. Miten palaute auttoi sinua kehittymään? *

Kirjoita vastaus

Siirry 19. Haluaisitko saada suorituksestasi pal...

18. Miksi palaute ei auttanut sinua kehittymään? *

Kirjoita vastaus

19. Haluaisitko saada suorituksestasi palautetta samanaikaisesti, kun teet harjoitustehtävää? *

- ◯ En halua palautetta samanaikaisesti.
- ◯ Haluan palautetta opettajalta samanaikaisesti.
- ◯ Haluan palautetta ohjelmalta samanaikaisesti.