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Master Thesis Human-Computer Interaction

Enhancing the user onboarding of teachers within an educational tool for practicing communication skills

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Preface

This master's thesis has been written from November to July to fulfill my graduation from the master's program Human-Computer Interaction at the University of Utrecht.

At the start, the research field I had in mind was the usability of digital products. Also, I wanted to gain experience at a company to widen my scope. Therefore, my supervisor and I contacted a company called TrainTool for the possibility of writing my thesis there. Coincidentally, they were planning to redesign their tool in which teachers assess students on online role-plays for practicing communication skills. After doing the onboarding of the tool, I came up with the idea of switching the topic of my thesis to the design of onboarding systems since little research has been done on this. As a result, the topic of my master's thesis is more focused and full of new challenges.

During my master's thesis, I wanted to learn new skills. I wanted to gain experience in coding a working product since I did not have enough time during courses to master this. I achieved this by programming an onboarding checklist in HTML, CSS, and JavaScript (a new programming language for me), and by creating onboarding videos myself. Besides, I enjoyed doing my research at TrainTool. I gained more experience in applying skills I was already familiar with, such as conducting user experience research, and behind the scenes, I also learned about assessing the usability of the tool and making it more user-friendly by creating new designs for the tool. I grew in the field of communication as well by presenting my results at the company.

Looking back at the process, I am proud that I managed to keep to my schedule. This ensured that I enjoyed writing my thesis and could always look critically at my work after the first versions to take it to the next level.

My supervisors have supported me in this. Therefore, I would like to thank my supervisors Dr. Christof van Nimwegen and Hadewich Hoekstra for their guidance and support during my thesis project. I also want to thank them for the good communication, you always responded quickly and critically when I had questions. Your views gave me new insights that have contributed to my learning process. Besides, I want to thank my colleagues at the company who ensured a pleasant working atmosphere during the week. Finally, I want to thank my fellow students, family, and friends who supported me during the process.

Enjoy reading my thesis!
Mirre Dona, Utrecht, July 4, 2024

Abstract

To contribute to the limited research in the field of user onboarding systems, this study investigated constructs for redesigning an onboarding system that guides first-time users in an online educational tool, called TrainTool. To investigate this, the onboarding as-is (version A, an interactive walk-through) has been compared with a revised onboarding system (version B, instructional videos within the tool). The main constructs of this study to measure the effectiveness of the onboarding manners are User Engagement and Cognitive Load.

Based on the insights from the literature research, the revised onboarding should increase user engagement by increasing the feeling of autonomy, and by making use of multimedia, the cognitive load should be reduced.

To compare the onboarding versions, a between-subjects study was conducted. This study used mixed methods. The time spent doing the onboarding, the clarity of the instructions, and the confidence after completing the onboarding were measured quantitatively. Besides, already existing quantitative scales were used: the NASA-TLX scale to measure mental workload and the UES-SF scale to measure user engagement. Qualitative data have been collected via semi-structured interviews.

While no significant difference was found in the main constructs (User Engagement and Mental Workload) between the onboarding versions, the results indicate that based on the following aspects, the revised onboarding is advised: to let people feel more successful in completing the onboarding and to increase the perceived usability. In addition, the qualitative results suggest a higher preference for onboarding videos instead of an interactive walk-through with written instructions. Companies implementing onboarding systems as well as future research could take these results into account.

Keywords:

Autonomy, Cognitive Load, Multimedia, User Engagement, User Onboarding.

Contents

Chapter 1

Introduction

Every time a user enters a new online tool, the user should learn how the tool works and become familiar with all the features the tool consists of to use the tool effectively. The learnability of a user interface is important for usability [19]. Generally, it can not be assumed that people read an instruction manual of an application to learn about the functionalities [49]. Instead of an instruction manual, user onboarding processes could help new users learn and understand the features of a product and could support effective adoption of the product [4, 52, 54, 46, 28]. Hence, most applications offer first-user guidance, called onboarding tutorials, to familiarize them with the features, interface navigation, and possible interactions with the elements within the application [28].

The onboarding process is important for the user experience, therefore, "many applications use onboarding task flows such as instructional text, just-in-time hints, or interactive tutorials to help new users learn the application's key benefits and guide new users toward meaningful engagement with those benefits..." [54]. Despite the importance of onboarding, according to the same study of Strahm et al. [54], there is still limited methodological and theoretical direction to guide design decisions involved in the onboarding process. Besides, they state there is limited user research, only guidelines for industry. Researching user onboarding could contribute to the Human-Computer Interaction (HCI) research field as it integrates research on learning from instructional design, user experience design, and psychological theories such as the cognitive load theory. Therefore, this research will contribute to the research field on onboarding systems, with the practical relevance of reviewing the onboarding system of a tool called TrainTool.

1.1 TrainTool

TrainTool is an online communication training tool used in education to practice communication skills through online video roleplaying. TrainTool can be used for all kinds of communication skills, such as negotiation, argumentation, or persuasion. One of the fields in which TrainTool is used is education. For instance, programs exist to practice bad-news conversations, presentation skills, persuasion techniques, or giving constructive feedback. Teachers can use the tool for their courses allowing students to apply the learning material with role-playing exercises outside of the classroom.

A student practices with videos of real or AI-generated actors. Different videos for different trainings are pre-recorded by TrainTool, as well as the criteria that a student needs to match while answering after watching the video.

From a student's perspective, TrainTool is used as follows: a student can log in to the program and then an instruction video will be shown to explain some theory. After, the students can apply this theory with online video roleplays. During a role-play, a video of an actor is shown as well as some background information. Then, a student needs to react to this actor. This reaction is recorded by a video. After, the student could see their own video and could give or receive feedback about whether the conversation criteria are applied. There are four forms of feedback; students can provide feedback to themselves (self-assessment), students can ask fellow students for feedback (peer feedback), the TrainTool AI coach Alix can provide automatically generated feedback, or the teacher can provide feedback within TrainTool.

To work with TrainTool, three types of accounts can be created. When someone is a student, they will receive a trainee's account. A student in this account is capable of practicing with role-plays, doing self-assessments, doing tests, giving feedback to peers, and having overviews of their progress and results. Also, the student could receive feedback from their teachers, peers, or automatic feedback from an AI-enabled agent called Alix.

When someone is a teacher who is in direct contact with the students, a coach account will be provided to them. A teacher in this account is responsible for inviting students to programs within TrainTool, giving feedback to practice role-plays and assessments to students, and seeing the results of their students within TrainTool.

Next to the trainee and coach accounts, there is also an admin role. Admins are mostly program coordinators at an education institute. They are responsible for managing TrainTool programs, which includes preparing the programs, setting deadlines, and configuring how feedback could be given (peer feedback, coach feedback, self-

assessment, or via AI). Also, the admin is responsible for managing coach accounts, which means that teachers with a coach account can be invited and can be linked to a group and admins can see the progress of their teachers. In Table 1.1, a short overview of the responsibilities of each account type (trainee, coach, admin) is given with its corresponding roles.

Table 1.1: An overview of the responsibilities and tasks of each account type within TrainTool.

Account	Role	Responsibilities within TrainTool
Trainee	Student	1. Practice with role-plays 2. Receive and give peer-feedback 3. Overview of own progress and results
Coach	Teacher	1. Invite students for programs 2. Give feedback to students on assessments and exercises 3. Insight in the progress of their students
Admin	Program coordinator	1. Manage programs (assemble them and see progress) 2. Invite teachers for programs 3. Link teachers to teacher groups

TrainTool is planning to reorganize from a training agency on a project basis to a software as a service product, a tool that educational institutes can buy. TrainTool is iteratively designed to meet teachers in terms of specific wishes and needs. That resulted in a tool with many features, but no optimal user flow, for instance for becoming familiar with the tool. The number of teachers using TrainTool is expanding. This raises the necessity to review the onboarding process for users to become more efficient for new users and therefore also less time-consuming for TrainTool employees that help new users integrate TrainTool within their educational program. So new users should be guided in using the tool within their educational institute in an efficient, user-friendly manner. Then, a lot of time could be saved in implementing the tool for both stakeholders. To accomplish this, research needs to be conducted about what onboarding systems or guidelines will work best and what theories can be used to gain more insight into how the onboarding within the tool can be most effective for new users. Therefore, this research will focus on how the onboarding process in an online educational tool can be improved to enhance the user experience, with the outcome of making the tool more efficient and engaging to use.

During this thesis, the tool as-is will be analyzed. Besides, literature research will be done about existing onboarding systems as well as principles for an interface

design to enhance the user experience. Then, the current onboarding systems will be compared with a revised onboarding system. A questionnaire and interview will be held to test user engagement, cognitive load, and comprehension after completing the onboarding. Based on this data, designs will be compared.

1.2 Onboarding as-is

In the current situation, when someone at an educational institute (who has one of the previously described roles, see Figure 1.1) wants to use TrainTool, a physical meeting will be planned with that person. Within this meeting, an introduction to the possibilities of the tool is given. Also, the version of the tool for every role (trainee, coach, and admin) will be explained. Afterward, every teacher and admin who will be using TrainTool at that institute will receive a demo version, called technical introduction, in which the tool will be shown with an integrated online onboarding software, called UserGuiding. The student account does not consist of an onboarding so that account will be disregarded from here on. All teachers will receive the teacher onboarding and when someone becomes an admin, they will receive the admin onboarding as well. When someone completes (both of) the onboarding(s), then someone could create a personal coach or admin account, depending on the role. To narrow the scope, this thesis will only focus on teachers with coach accounts, since there are more TrainTool users with the teacher role than admins with the program coordinator role.

The current onboarding system consists of a demo environment of the tool, in which a teacher can simulate the possible tasks within TrainTool. UserGuiding is implemented in this demo version. As can be seen in Figure 1.1, UserGuiding consists of a checklist in the bottom right corner of the screen. The five tasks of the coaching checklist are: sending assessments, giving feedback, reviewing the reports of trainees, gaining insight into the progress of the trainees, and asking for help. When a teacher clicks on a task, step-by-step guidance follows as can be seen in Figure 1.2. When a task has been completed, the progress bar in the checklist is updated (see Figure 1.3).

Next to the onboarding environment, there is a video with the explanation of the teacher and admin environment [1].

[1]Via this link, the video with the explanation of the teacher and admin environment could be found: `https://support.traintool.com/nl/hc/nl/articles/8392640890001-video-met-uitleg-coach-en-beheerdersomgeving`

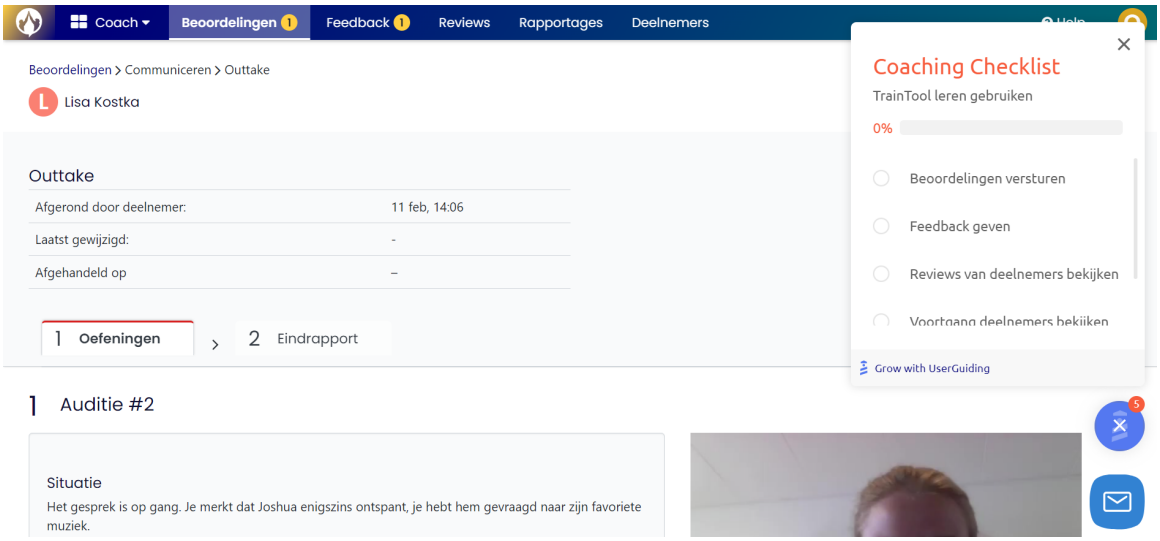

Figure 1.1: A screenshot of the current teacher onboarding system with the checklist of UserGuiding on the right.

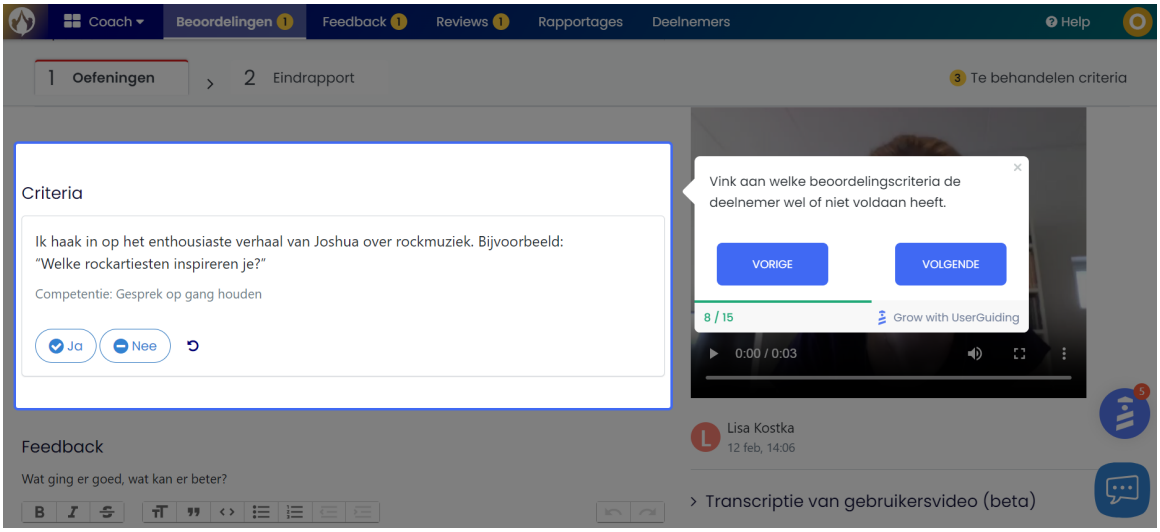

Figure 1.2: A screenshot of a task from UserGuiding within the current teacher onboarding. The UserGuiding highlights the relevant part of the webpage while providing instruction and navigation on the side.

The current implementation of the tool ensures that every new teacher or admin starts exploring the tool since they need to complete the technical introduction before being able to create an account. This demo version, called technical introduc-

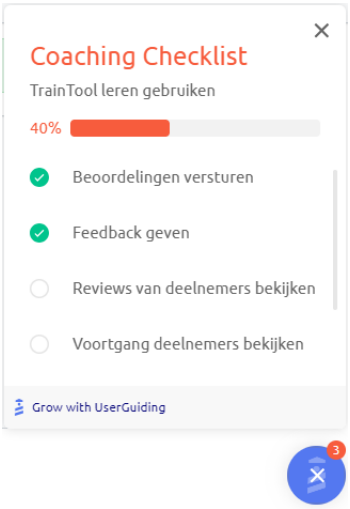

Figure 1.3: A screenshot of the coaching checklist and progress bar within the current teacher onboarding.

tion, ensures a “safe environment" in which new users can try out TrainTool without modifying content or settings. However, a downside of this technical introduction is that a lot of information is given which could be overwhelming/challenging and in turn could result in questions from users. In such cases, this results in a burden for the company. Also, the implementation process takes a lot of time since after, new accounts should be created.

To make the tool more scalable and easy to use for new users, the onboarding for teacher and admin roles will be revised. The onboarding process will be reconsidered to create a more user-friendly onboarding process with less information provided at a time and to streamline the differences between the teacher and admin roles. The goal of the onboarding is to make new users excited about implementing the tool with the confidence of a successful start. The company aims to reduce the number of questions from users through a clear tool and onboarding process.

1.3 Research aim

In summary, TrainTool is reorganizing and because of this reorganization as well as the goal of scaling up, the onboarding process needs to be efficient and users should be engaged while using the product for the first time. It is generally assumed that when an online product has a clear value proposition and it seems easy and clear how

to use the product early on, engagement and customer retention could significantly be enhanced [48]. Therefore, this study aims to design and evaluate a revised onboarding system to enhance new customer engagement and comprehension and reduce mental workload through effective user onboarding within an online communication training tool. This leads to the following main research question:

> RQ: How can user onboarding for first-time users be enhanced to be more effective?

With the following sub-questions:

1. What design features can enhance the user engagement of first-time users during onboarding?
2. What design features induce higher cognitive load during onboarding?
3. What design features can enhance the comprehension of an application for first-time users during onboarding?

To answer these questions, literature research will first be conducted to discuss already existing onboarding systems, as well as what theoretical constructs can be used to enhance the first-time user experience. Based on the literature research, a revised onboarding system will be implemented and evaluated.

1.4 Overview

In the next sections, first, already existing literature will be discussed including those principles and onboarding systems. Then, based on the literature, initial guidelines for a revised onboarding system will be presented and the revised onboarding system will be implemented. After, the method will be presented to answer the research question. Then, the results of the study follow, and to conclude a discussion and conclusion will be drawn.

Chapter 2

Related work

In this chapter, first, prior studies about onboarding systems will be discussed. After, relevant theoretical concepts will be described resulting in the theoretical framework of this study.

2.1 Existing onboarding systems

In this section, several manners of implementation of onboarding systems will be discussed to gain insight into what onboarding systems already exist. A distinction will be made between internal and external onboarding systems. With internal onboarding systems, the onboarding will be inside the corresponding system, and with external onboarding systems, guidelines can be found outside of this. Internal onboarding systems make use of in-app guidance which means guiding the user within the system, for instance via an interactive walkthrough, instructional overlays, tooltips, gamified onboarding, or integrated chatbots. External onboarding systems make use of external guidance to help the user navigate within or use the system. External onboarding could, for instance, be an external manual, external videos/demos, or an external chatbot.

2.1.1 Internal onboarding

Another term for internal onboarding systems is a user guide. A user guide is a virtual documentation with step-by-step guidance for users to demonstrate how to execute a task within a tool [42]. The aim is to provide an overview of the software resulting in faster user adoption, which could in turn increase user satisfaction, user

engagement, and confidence in using the product [42, 58]. According to Olmstead [42], user guides consist of a product introduction with an overview of what to expect in the guide, then step-by-step explanations of the installation and setup, an overview of the features of the product, tips on how to solve errors, frequently asked questions and a list with terms of that specific product (a glossary). Guided activities could enhance essential and generative processing by giving guidance for cognitive processing during the integration of new information [37].

Interactive walk-through

One form of user guide is an interactive walk-through. An interactive walk-through lets the user perform tasks within a tool to show step-by-step the features and possible tasks, it teaches the users by doing [58]. For instance, via a directed path with the key functionalities, and the user should perform the requested tasks. An example of an interactive product tour is that of Gladly[1] (Figure 2.1).

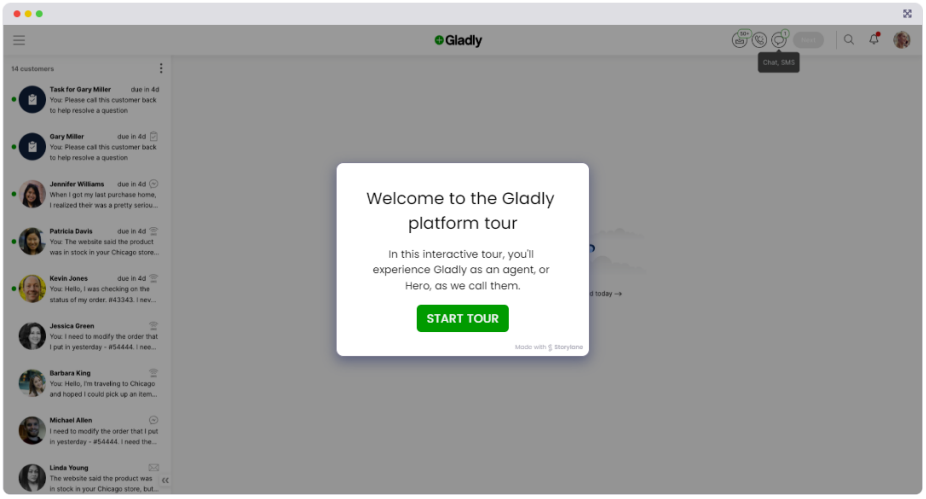

Figure 2.1: Interactive product tour of Gladly.

Tooltips

Also, tooltips could be used within onboarding software. These are also called instructional overlays. Tooltips or instructional overlays are hints integrated within the

[1]Demo product tour of Gladly, accessed on 05-02-2024, from `https://www.gladly.com/product-tour/`.

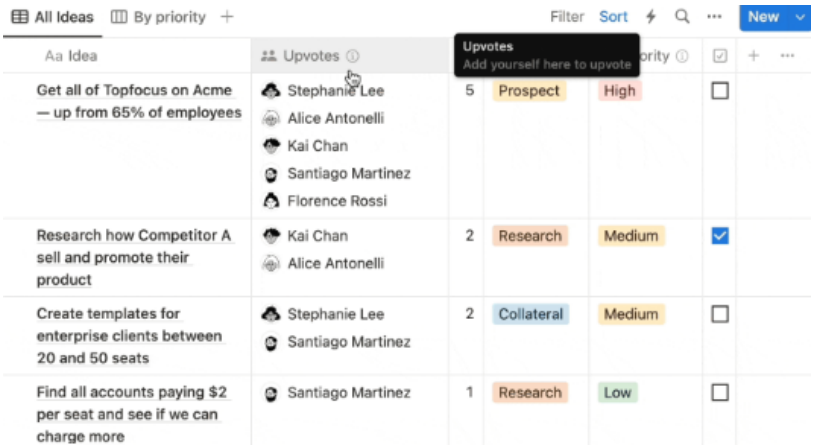

Figure 2.2: An example of a tooltip within Notion.

user interface when users enter an application for the first time [20]. It gives users information about a button or feature, for instance, when the user hovers over it with their mouse [4]. Important features will be highlighted. Tooltips could support the users' feature adoption within the product [58]. In Figure 2.2 an example of a tooltip within Notion is shown.

Checklists and progress indicator

Moreover, checklists could help the user to use the product and perform all important tasks within the digital product. With the help of a progress indicator, the user gets feedback about what tasks they have already completed and what tasks could still be discovered. Checklists are effective for the onboarding of new users within a system since they could help users to get engaged in performing certain series of tasks [58]. To not overload new users, a checklist could best be limited to three up to five tasks [56]. An example has already been shown in the Introduction section (Figure 1.3).

Gamified onboarding

Besides, gamified onboarding could be used. For instructional software, gamification is used to support user engagement and motivation [38]. For example, Li et al. [31] created an interactive tutorial system called GamiCAD. The system consists of real-time feedback and progress indications, combining visual and auditory feedback. The study found that gamified onboarding increased user engagement resulting in faster completion of tasks [31].

Integrated chatbot

Also, an integrated chatbot could be used. For instance, to answer frequently asked questions. An example is Slackbot, an integrated chatbot within the workplace communication tool Slack. No scientific research has been found about integrated chatbots, but a possible benefit could be that an immediate answer could be given to a user at every time, regardless of the availability of a support desk. However, from experience, chatbots do not interact the same way as humans yet, which could lead to confusing situations. That could be tricky for onboarding systems since the first impression may be crucial.

Integrated video tutorials

Last, integrated video tutorials could help the user get familiar with the functionalities of a tool. Research of Stoiber et al. [53] found that video tutorials with voice-over were most effective for the introduction of new interaction techniques, compared to *scrolly-telling* (an interactive textual visualization via scrolling), and feedback on step-by-step guidance with textual instructions.

2.1.2 External onboarding

Besides internal onboarding, also external onboarding tools could be used. External onboarding tools are other, external tools helping to introduce the tool at stake, in which the user is operating.

Demo videos

For instance, external demo videos could show how the tool could be used and where the features can be found. "In instructional videos users watch the content, extract relevant information, and then try to apply what they have learned within the software" [38]. Nevertheless, Naglé et al. state that instruction videos do not include user feedback on task performance [38]. An example of an external demo video is one of the NS app [2] (Figure 2.3).

[2]Demo video of the NS app, achieved on 11-01-2024, from `https://www.ns.nl/reisinformatie/ns-app`

Figure 2.3: A screenshot of the demo video with an assistant who shows and explains how to use the NS application.

Help documentation

Another form is text-based help systems which are often used to improve the understandability of features or tasks, for instance, in the form of frequently asked questions (FAQ). Nevertheless, for complex tasks or features, visual demonstrations could be needed to explain functionalities to the user [19]. An example of help documentation that also includes static visualization is that of Canvas[3] (Figure 2.4).

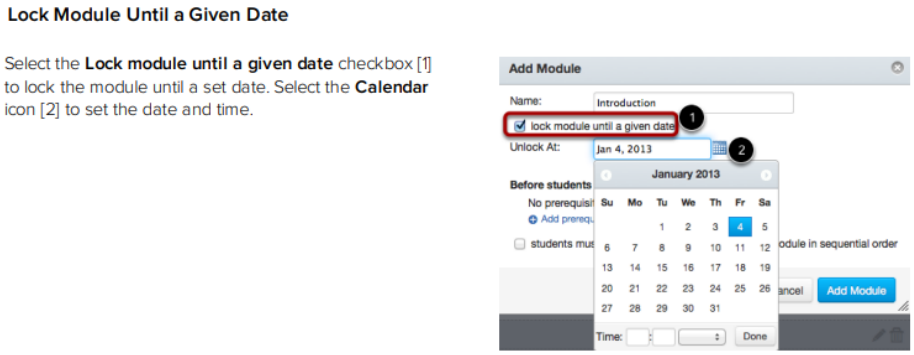

Figure 2.4: A screenshot of the Canvas Instructor Quickstart Guide as documentation with both visual and textual explanations of the possible tasks within Canvas.

[3]Documentation of Canvas, achieved on 04-02-2024, from `https://www.law.upenn.edu/live/files/11939-unmasking-coded-bias`.

External chatbot

Last, a study by Jain et al. [24] compared an interactive user manual with a traditionally documented user manual. The interactive user manual was a rule-based chatbot with instructions via Natural Language Processing. According to the results of observing ten participants while using both methods, the interactive tool is more interactive and user-friendly compared to the documented manual. Besides, the interactive manual was less time-consuming and preferred by most of the users [24].

2.2 Theoretical concepts

Various theories relate to instructional design and subsequently, to familiarize users with online tools. This thesis mainly focuses on User Engagement, the Self-Determination Theory, the Cognitive Load Theory, and the Dual-Coding Theory.

2.2.1 User engagement

Engagement is defined as "a quality of user experience characterized by attributes of challenge, positive affect, endurability, aesthetic and sensory appeal, attention, feedback, variety/novelty, interactivity, and perceived user control" [41]. In short, user engagement entails the level of involvement in someone's interaction with a system. This involvement can be cognitive, temporal, or emotional [39]. User onboarding plays an important role in user engagement on online platforms [9]. It ties in with what is called the "aha moment". This is the moment the user realizes the benefits of the product [48]. An onboarding process could help guide users to this moment more effectively, because, via onboarding, the purpose and added value of an application could be explained to the user so that a user does not have to invest effort in finding it themselves [54]. Subsequently, the user flow design, interactions, and user interface elements are crucial for first-time user experience and retention [9]. Besides, user engagement has a positive effect on motivation, which positively enhances learning [38].

O'Brien and Toms [41] created a conceptual model of user engagement as a process that is important during interaction within an application while completing tasks. The conceptual model of user engagement consists of four stages: "point of engagement, period of sustained engagement, disengagement, and re-engagement." [41] (Figure 2.5).

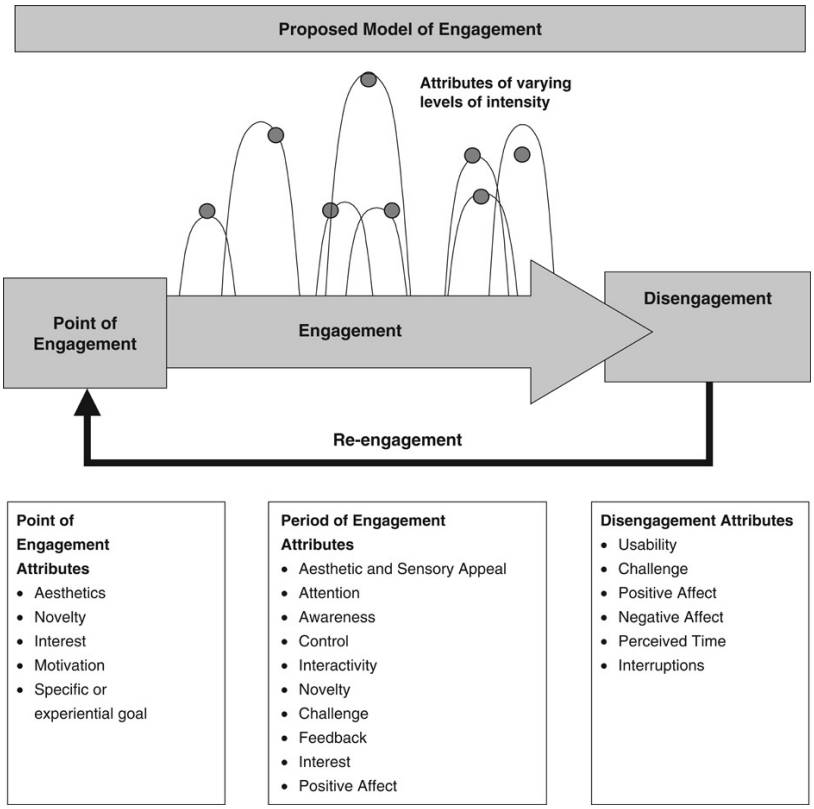

Figure 2.5: Proposed model of engagement and its attributes of O'Brien and Toms [41].

According to O'Brien and Toms [41], the point of engagement begins with an aesthetic appeal. Also, the motivations and interests of the user are important as well as the perceived ability, and novelty. When the user maintains their interest and attention together with positive emotions, user engagement remains. To be able to retain interest and attention, users want to be able to adjust the interface to personal needs and want to receive feedback from the application when they are stuck. Besides, users want to lose track of time during interactions and want to be aware of other users when engagement is enhanced by social interaction. In the end, users could also be disengaged. This could be due to the usability of the technology (interactivity), the lack of or too much challenge, negative or positive emotions, perceived time, or interruptions [41]. Engagement during this process operates as a continuum and re-engagement is also a possibility [41]. Re-engagement entails prompting users who have not used the platform for a while to use the platform again by point of engagement

attributes actively [46].

A comprehensive and well-structured onboarding process gives a higher chance of user exploration, engagement, and adoption of the product [56]. The onboarding process entails a sequence of instructions and interactions to support first-time users of a product with their user experience [49]. A study of Cardoso [9] states that there are five stages within the onboarding process. The first stage is the purpose statement in which first-time users of a website discover their relevance. The second stage consists of the registration of a user. Then, informational scaffolding takes place. In this third phase, new users will be guided through the website via instructions on how to use the platform. This can for instance be implemented through demos, tooltips, or tours. After, the conversion phase follows in which users can contribute after they have acquired the necessary abilities to accomplish tasks without facing difficulties. The last phase is the re-engagement phase in which users need to be kept engaged to remain using the platform [9]. Cardoso [9] found that inferior user experience could lead to the abandonment of the system by the user. This is mainly an important factor during the registration phase. To persuade a user to register, abandonment of the system needs to be avoided for which it is important to request the appropriate quantity of details at the right time.

To improve user engagement and satisfaction within a digital product interface, for instance, task-focused design could help to support cognitive processes associated with the learning experience [49]. Task-focused design entails instructions that guide users to the core functionalities. This helps users discover the product while interacting with it. Also, help resources could best be integrated within the interface of a tool to ensure a cohesive and consistent learning journey [49]. In line with this, Kwon and Lee [30] found that interactive learning resulted in better results and engagement of the participants compared to static learning in the context of data visualization education. Besides, learning by doing is found effective for learning [37]. Using interactive multimedia within computer-mediated learning environments could attain user engagement because of learning by doing [39]. On the other hand, an approach with various stimuli that contain active learning helps create a mental presentation that could enhance the learning process to be more effective in comparison with passively consuming information [30]. Furthermore, demo videos or textual instruction could be used as onboarding when no physical meeting takes place before the user onboarding. Otherwise, an interactive onboarding could be implemented within the system [15].

Self-Determination Theory

Next to user engagement, motivation is an important aspect of learning and could potentially help make an onboarding system more effective. Intrinsic motivation is necessary for self-determined behavior, and intrinsic motivation is influenced by experiences with surroundings [13]. A study by Peter et al. [45], uses the Self-Determination Theory as the core element to design for well-being within Human-Computer Interaction. The self-determination theory consists of three basic needs: autonomy, competence, and relatedness. It originates from Deci and Ryan [14]. Autonomy is the feeling of agency, competence stands for the need to have confidence in the ability to complete a task, and relatedness is the need to feel connected to related others [33, 45].

Peter et al. [45] introduced a model called Motivation, Engagement, and Thriving in User Experience (METUX). The model describes how technology design could increase motivation and engagement when looking at psychological needs to enhance user well-being: "If you increase autonomy then engagement will improve, if you increase competence then motivation will increase, and if you increase relatedness then well-being will be enhanced–these needs become the controllers we tweak and adjust to iterate on and improve experience." [45]. Besides, Lohrenz et al. [33] found thirteen mechanisms that guide the design of successful platforms connected to each of those constructs. A well-designed user onboarding helps to drag in and maintain new users by increasing the competence of new users within a system [33]. This could be done by enlightening the functions of a platform. Examples of onboarding, a participant of the study gave, were a help desk with frequently asked questions, a blog with tips and tricks, tutorials, and small videos about the registration processes and functionalities. Also, instructions and checklists could be given to help the user with the onboarding [33].

To help design a user onboarding that addresses the needs of the Self-Determination Theory, there are some strategies to increase the intrinsic motivation of new users [56]. The first one is making use of a virtual tour guide, such as tooltips. Also, the value for the user of the product needs to be stated, this means showcasing the advantages of the product and how the product can be implemented in real life. Besides, it is important to show the users' progress. This helps with the goal-setting of the user. For this, a progress bar or a checklist can be used. The Zeigarnik Effect can be taken into account for this, which is the effect that people want to complete tasks they started with. In addition, Zeigarnik showed that people remember uncompleted tasks two times better than finished tasks [61]. Within user onboarding, this can be

activated by not giving all information at once to keep the user curious about other possibilities within a product [56].

2.2.2 Cognitive Load Theory

A Graphical User Interface (GUI) is a suitable manner to increase the awareness of features for users. Nevertheless, it is not feasible to make the user aware of all features within a rich interface [19]. It should be taken into account that people have a limited capacity for attention [23], while senses are constantly stimulated by stimuli from the environment. When selective attention is used, attention is focused on specific elements that need to be processed and kept, other input will be ignored [23]. The average capacity of people for processing information is seven (plus or minus two) items [36]. If an application provides too much information, it can overwhelm the user, leading to a slower response time in identifying the correct actions [60]. According to research [59], people first focus on the center, then the attention goes to the left, and at last, people focus on the right side of a system. Because of these varying levels of attention, cognitive overload could be the result when designing differently. For instance, nearly all interactive visualization tools are positioned on the right side and do not directly correlate with the content for enhancing knowledge acquisition [59].

The Cognitive Load Theory (CLT) is a framework on how to present information to encourage learning activities for optimal intellectual engagement [27]. In line with this, a study by Altinpulluk et al. [3] found a positive correlation between satisfaction and cognitive load for educational videos. The CLT is built on limited working memory that partly separates visual and auditory information to interact with long-term memory. The capacity of the working memory could be overloaded due to unsuitable presentation of content or learning activities, resulting in reduced problem-solving or learning ability [57]. Therefore, it is most effective and efficient for learning new material when redundant cognitive load is minimized.

There are three types of cognitive load. The first one is extraneous cognitive load. Extraneous cognitive load is the mental effort it takes to process information that does not contribute to learning and hinders the acquisition of knowledge [55]. Extraneous cognitive load is unwanted since it disrupts automating learning patterns [16]. Therefore, extraneous cognitive processing needs to be reduced and the motivation of learners to get engaged needs to be increased when designing an instructional system for learning [37]. Next to extraneous load, there is germane cognitive load.

Germane cognitive load improves learning because it leads to schema acquisition and automation [16]. So, for learning, it is recommended to transfer extraneous cognitive load to germane cognitive load [16]. Lastly, there is also intrinsic cognitive load. The intrinsic cognitive load is dependent on element interactivity [16], a complex task with high element interactivity demands on working memory. The intrinsic cognitive load can be decreased with the use of scaffolding [16]. Scaffolding is a method used for teaching to guide students until they are capable of doing the work independently [51]. Scaffolding can be related to onboarding since the learning objective is to accomplish real tasks with the assistance of visualizations which will slowly be reduced. It is similar to the worked example strategy. A worked example provides step-by-step guidance on how to solve a task with the aim of facilitating learning [55].

Research of Tuovinen and Sweller [57] compared work examples with exploratory learning. They concluded that offering more structure is more helpful for novice students within the subject area. For students with more knowledge within the specific area, the extra structure is less beneficial. Using worked examples is beneficial for novice users because the exploration condition takes much mental effort. However, such guided instructions could be ineffective for experienced learners since providing unnecessary guidance or redundant information could increase extraneous cognitive load [16]. This is called the expertise reversal effect [16]. Another method is pacing, when students can control the pace in which instructions are shown, this allows them to break down the information and therefore allows students to process the smaller parts of information in their working memory [37]. The cognitive load could then be reduced.

Taking into account that our short-term memory does not have a lot of capacity, during onboarding, it is best to focus on one interaction at once and not to show every possibility within the user interface at the same time or in one chain [20]. Because of people's limited cognitive load, users are not able to do tasks within a tool at the same time as reading overlay hints [20], which is one of the common onboarding manners. People first need to remember the given instructions before conducting the tasks. Besides, the level of mental effort, which is related to cognitive load, depends on users' skills and task difficulty. It could lead to boredom, engagement, or frustration of the user [43]. In addition, according to Chang et al. [10] there is a correlation between flow experiences and cognitive load within e-learning. When the extraneous and intrinsic cognitive load levels are lower, a higher flow experience was reported [10].

Other research found a correlation between cognitive load and user engagement

within a learning environment that uses virtual reality [8]. The learners' frustration and effort level significantly impacts engagement level, and consequently, their learning results [8]. Their research only focused on three aspects of the NASA-TLX scale, a scale with which mental effort could be measured.

Grossman et al. [19] state that the demonstration of tasks should be within the interface of the user and came up with the guideline to use multimedia content within the documentation for this demonstration.

Dual-Coding Theory

In line with using multimedia content, researcher Allan came up with the dual coding theory (DCT) [2]. This theory states that combining verbal and nonverbal representations of information works best for memory, language, and cognition. In addition, combining visual and verbal information reduces cognitive load and enhances learning [34, 32, 6] and recall of an object [2]. The physiological reason behind this is that verbal and nonverbal systems work independently, one system can function without the other, or they can work in parallel [2, 34]. An assumption is that the verbal and nonverbal information should be of the same object [17] and should be temporally synchronized [18]. In addition, making use of temporal cues could reduce mental effort [50]. Contrarily, split attention, and redundancy need to be avoided since that retards learning [44].

When designing multimedia videos for learning environments, it should be taken into account to reduce extraneous load (what overwhelms users) and maximize germane load (that enhances learning) [1]. This could be done by using short videos that contain less information at a time which is in line with the limited capacity of working memory [47]. Also, information should be given at a pace that is not too fast and the start of the videos should be determined by the user so that the intrinsic load does not become too high causing the auditory and visual processing channels to be overloaded [35]. This load-reducing method is called segmenting, learner-controlled segments instead of continuous explanation videos [35]. Segmented educational videos reduce cognitive load and enhance user satisfaction [3]. Multimedia instructions using segmenting benefit novice learners most [35].

Moreno and Mayer [37] define the application of DCT within the context of learning as multimodal learning and state that this can enhance students' comprehension. If a multimodal learning environment is interactive, the content is adaptive and dynamic for each user. Within a non-interactive multimodal learning environment, the

information is presented fixedly, for instance with narrated animations or text with illustrations [37]. This is called the spatial contiguity effect [34].

For example, research by Zhong et al. [62] presented an onboarding tool called HelpViz, that automatically generates visual tutorials from text-based instructions on mobile phones. The study found that people favored visual tutorials over text-based instructions. Furthermore, an advantage of video tutorials is that interactions can better be shown, for instance with mouse visualizations. Therefore, a study by Chi et al. [11] proposed MixT, an automatically generated step-by-step tutorial with textual and video combined within the onboarding tutorial. Their findings included that users are less likely to re-attempt a tutorial step when it contains video content. In general, they recommend an approach that consists of multimedia (text, images, and video) and adheres to the following four design principles: scannable steps (step-by-step), small but legible videos, visualizing mouse movements, and giving control to the user. For future work, they suggest adding spoken explanations to the demonstration videos to show users the reason behind the steps [11].

Feedback

For guiding behavior and helping people go in the right direction, feedback is an important component [26]. Explanatory feedback could help learners understand potential misconceptions and therefore explanatory feedback could minimize the cognitive load by fostering a deeper understanding and focusing on learning the material more effectively [37]. Whereas direct feedback helps novice users and post-feedback helps experienced users better (in the context of games) [26]. Other research investigated the path to learning of students [12]. They state that within the context of learning, fully guided instruction consists of explicit guidance and practice. It contains comprehensive explanations of concepts and skills with provided examples that allow for practice and feedback. Minimal guidance does not entail this which encourages students to discover information themselves [12]. For novice learners, fully guided instruction works best, while for experts, partial guidance is less effective than full guidance [12].

2.2.3 Theoretical framework

Based on the above theories, the following diagram can be made which forms the framework for this study, see Figure 2.6.

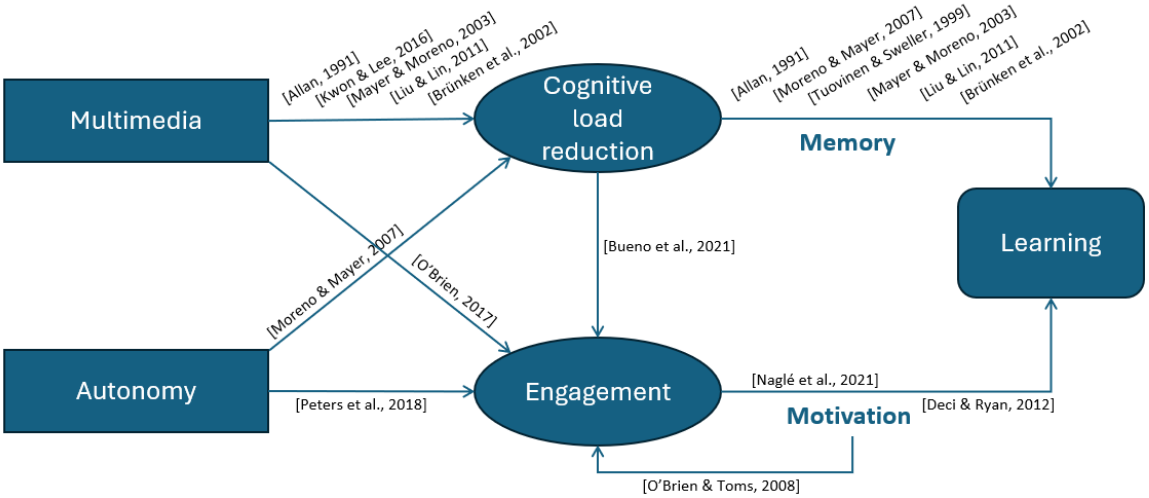

Figure 2.6: Relationship between theoretical constructs.

In summary, using multimedia could reduce cognitive load since the working memory separates visual and auditory information [2]. When reducing cognitive load through the combination of visual and verbal information, learning (new material) could be enhanced [34, 32, 6, 30, 57]. Also, when students can control the pace at which instructions are shown, this allows them to break down the information and therefore allows students to process the smaller parts of information in their working memory [37] which reduces cognitive load.

Furthermore, using interactive multimedia within computer-mediated learning environments could attain user engagement as well because of learning by doing [39].

In addition, Peter et al. [45] introduced the METUX model based on the Self-Determination Theory [13] describing that when increasing autonomy within technology design, motivation and engagement will improve. Besides, user engagement has a positive effect on motivation, which positively enhances learning [38]. In turn, motivation is an important attribute for engagement [41].

Lastly, a correlation has been found between cognitive load and user engagement within a learning environment that uses virtual reality [8]. The learners' frustration and effort level significantly impacts engagement level, and consequently, their learning results [8].

Chapter 3

Design of revised onboarding system

The current onboarding system starts with an introduction video in which the onboarding process is explained. As can be found in the Introduction section, after the video, the user will go to a demo version of TrainTool in which the UserGuiding tool is implemented. UserGuiding consists of a checklist with step-by-step high-guidance support throughout the system. Besides, there is a progress bar that indicates the progress.

As can be found in the previous section, the literature shows that for new users, a demo integrated within the system and full guidance work best [19], which is what the UserGuiding system uses. Literature also shows that worked examples (step-by-step guidance) work for novice users [57]. This is applied in the current onboarding.

What further appears from the literature, is that autonomy can lead to higher engagement [45]. Full guidance removes the autonomy to explore the system on one's own. Furthermore, according to dual coding theory, it works best to provide both auditory and visual guidance [2]. Because these are two different processing processes in the brain, it does not lead to excessive cognitive load [2]. In addition, it works well to reduce the cognitive load if the user can explore the system at their own pace [37]. Finally, the literature shows that video tutorials work well for onboarding [53, 11]. In the current onboarding process, the user is already shown a video, but this video is only used as an introduction to the system, and not as an explanation of the different tasks in the system.

Therefore, a revised onboarding system was designed that consisted of short demo videos with both visual and auditory explanations of the specific steps that can be completed in the system. There is no additional guidance after the videos, making it possible to have more autonomy in performing the steps and having more freedom to

explore the tool. The demo videos continued to act as a checklist, just as the current onboarding with UserGuiding does since instructions and checklists could help the user with the onboarding [33], and, to not overload new users, both of the checklists are limited to four tasks [56].

An overview of the components of each onboarding system is shown in Table 3.1.

Table 3.1: An overview of the components the onboarding versions exist of with literature support.

Component	Version A	Version B	Literature support
Demonstration within the interface	Yes	Yes	It is effective to do the demonstration within the tool itself [19]
Task focused design	Yes	Yes	Task-focused design could support cognitive processes [49]
Learning-by-doing	Yes	Yes	Learning-by-doing is found effective for learning [37]
Checklist	Yes	Yes	Checklists are found to be useful for onboarding systems [33]
Progress bar	Yes	Yes	Showing users' progress helps with goal-setting [56]
Use of multimedia (audio + visual)	No	Yes	Dual coding Theory [2], multimedia tutorial [53, 11, 19]
Guidance	Full	Minimal	Expertise reversal effect [16, 57, 12]
Freedom to explore	No	Yes	Control the pace [37], autonomy [45]

As can be seen, the onboarding versions only vary in terms of multimedia usage, the degree of guidance, and the ability of freedom to explore (autonomy). These three concepts are expected to cause a difference in user engagement and mental workload according to the relationships between the theoretical constructs in Figure 2.6, leading to increased learning and more effective onboarding.

3.1 Implementation

3.1.1 Version A

In version A, participants will follow the onboarding as currently integrated within TrainTool. The link below[1] shows the coach environment of TrainTool with the integrated onboarding checklist from UserGuiding.

3.1.2 Version B

To create the onboarding checklist, HTML, CSS, and JavaScript have been used. The checklist frame consists of a title 'Onboarding', a video container, the titles of the videos, a progress bar, and buttons to navigate between the videos. The font

[1]https://guide.traintool.com/guide/coach/b601c65e-9a34-489a-9757-120e37a7298a

and colors of the onboarding checklist are in line with the corporate identity/style of TrainTool and match onboarding version A.

To create the videos, the Snipping Tool available on Windows has been used to make screen recordings of the tool TrainTool within the coach environment. For verbal explanations, the text of the current user onboarding has been copied to keep the text similar. For the text of the videos, small adjustments were made to make it more of a running narrative. Besides, for the spoken text, ElevenLabs has been used to generate text-to-speech using AI voices. First, the researcher used their own voice to give the explanations while recording the videos. However, the sound was not of high quality and to make the video more professional, another voice than their own voice would contribute to this. Within ElevenLabs, Brian's voice has been used as that voice spoke Dutch most fluently.

The window with the onboarding checklist is located on the right of the screen, at the same place the onboarding checklist of version A is located (see Figure 3.1 for the comparison). The checklist is pinned using iframes within HTML. To see the part of the tool below the onboarding frame, the ability to open and close the checklist has been added. Besides, the choice was made to have the user study take place on a wide monitor so that most functionalities of the tool are visible and no functionalities are hidden by the onboarding frame. In Figures 3.2 - 3.6, the different steps within the checklist can be found.

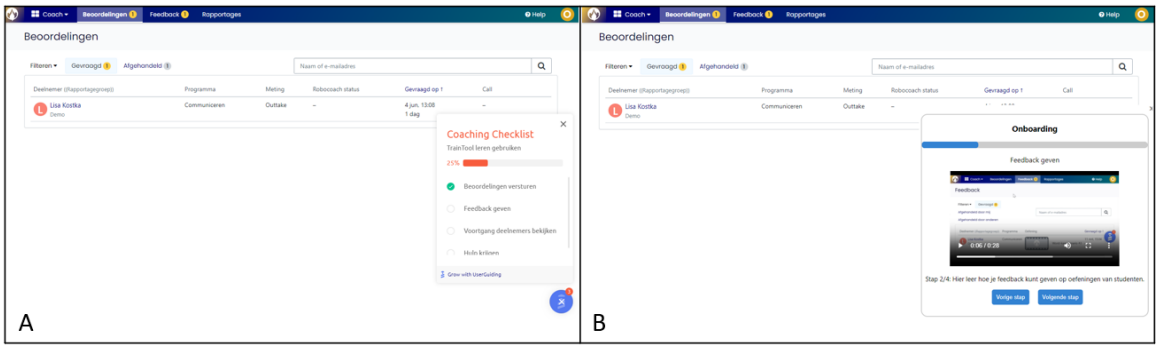

Figure 3.1: Comparison of the checklists of the onboarding versions with onboarding A on the left and onboarding B on the right.

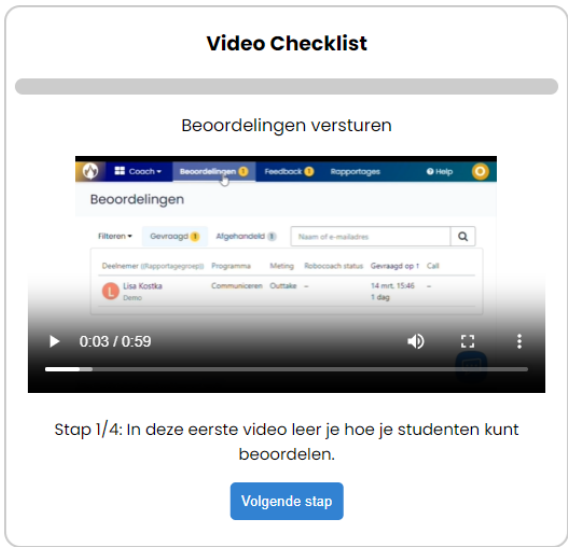

Figure 3.2: Screenshot of step 1 of the video checklist. This video shows how to assess students.

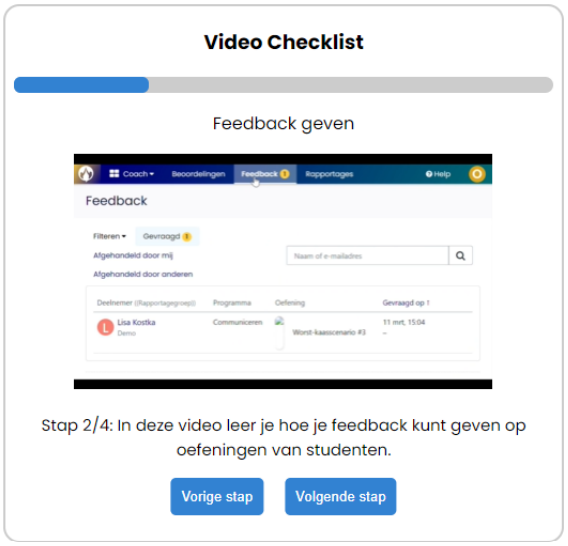

Figure 3.3: Screenshot of step 2 of the video checklist. This video shows how to give feedback on exercises from students.

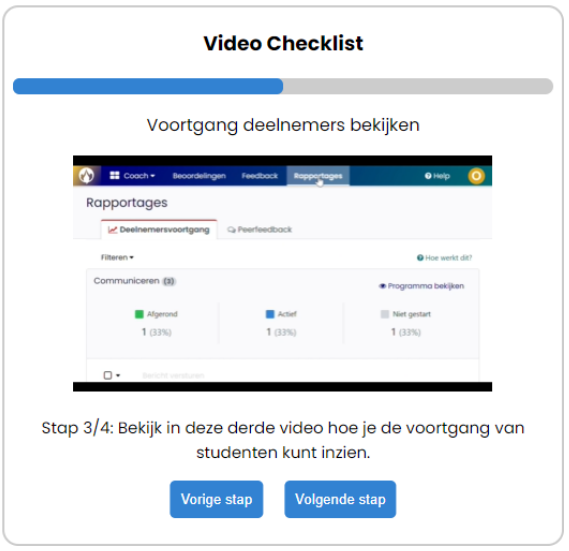

Figure 3.4: Screenshot of step 3 of the video checklist. This video shows how to gain an overview of the progress of students.

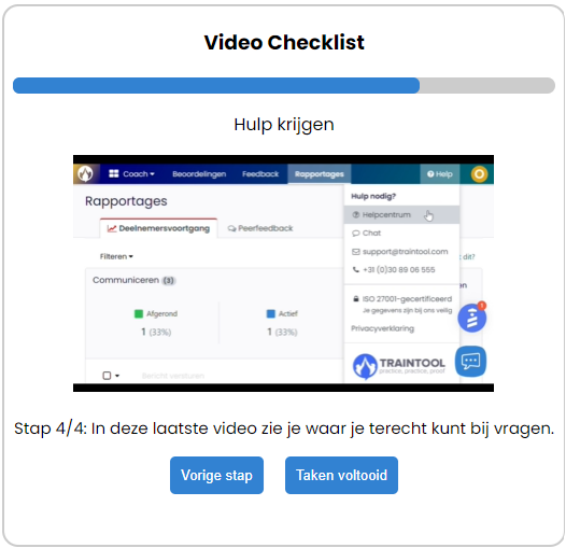

Figure 3.5: Screenshot of step 4 of the video checklist. This video shows where to find help within TrainTool.

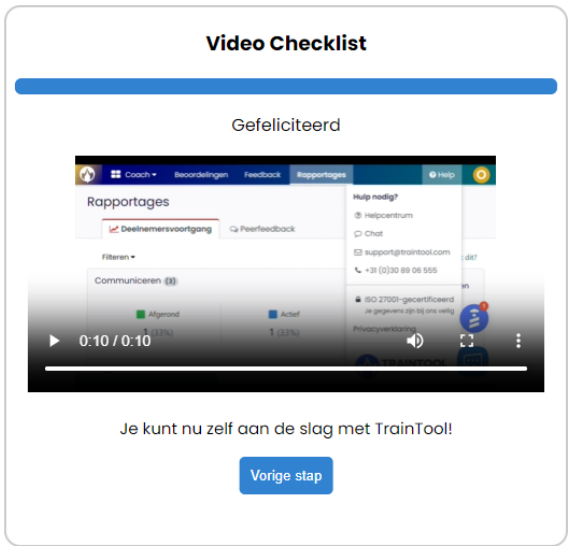

Figure 3.6: Screenshot of the completed video checklist. The user is notified that it can now start working with the tool itself.

3.1.3 Comparison

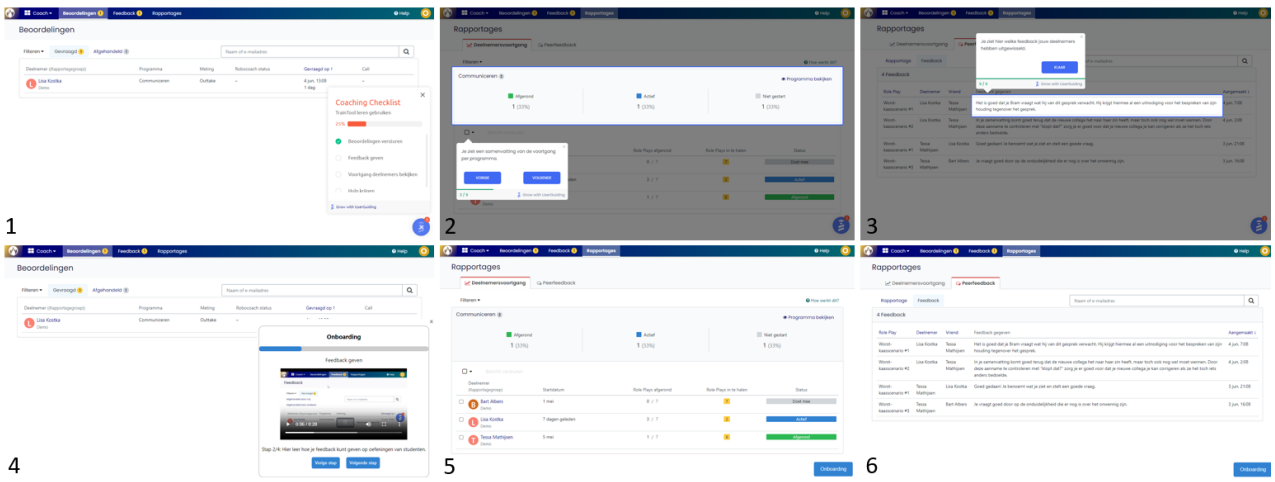

Figure 3.7: Comparison of the guidance within the onboarding versions with some screenshots of onboarding A on top (1-3) and some screenshots of onboarding B below (4-6).

Lastly, in Figure 3.7, a comparison of the guidance through the onboarding tasks can be found. Within onboarding A, there are four overarching onboarding tasks listed in a checklist, as can be seen in screenshot 1. When starting one of those tasks, a predefined path follows with guidance along all functionalities associated with that task (screenshots 2 and 3). The background is grayed out to highlight with white frames the functionalities at stake. Within the path, users can click on the 'next' button after performing a task or reading the instructions.

On the other hand, within onboarding B, the checklist consists of four instruction videos with visualizations that are in line with the content of the tool (screenshot 4). After each video, the user could close the onboarding frame and perform the task within the tool in their manner (screenshots 5-6). Each of the four videos covers the same steps as those in the predefined paths of onboarding A.

Chapter 4

Methods

This research is about redesigning an onboarding system that guides first-time users in an online educational tool, called TrainTool. To investigate this, the onboarding as-is (condition A) was compared with a revised onboarding system (condition B).

4.1 Participants

In total, 25 participants participated in this research. All participants were Dutch-speaking because the onboarding as-is was in Dutch. Most participants were recruited via convenience sampling and snowballing. These methods were chosen to get in touch with teachers who are not yet familiar with TrainTool because the effectiveness of onboarding could not have been measured when a teacher is already familiar with the system. Due to this requirement, clients of the company itself were no appropriate participants. As a result, the participants were people from the researcher's network, colleagues of their supervisors, and acquaintances of other participants. The goal was to have a diversity of faculties and education levels across the participants to best reflect the average user of TrainTool. In the end, the participants were higher vocational education (HBO) and university (WO) teachers in the fields of communication science, psychology, nursing, information science, health science, social work, biology, artificial intelligence, applied data science, and computer science.

An information email was sent to the participants with an invitation link in which the participants could pick a time slot for the experiment. The first participant was assigned to Group B and the participant after that to Group A. This order was maintained for all participants so that all participants were assigned to one of the

groups based on their participant number. This resulted in all participants in Group B having an odd participant number and all participants in Group A having an even participant number, which led to a random distribution within the groups. As a result, Group B consisted of 13 participants comprising six men and seven women. Group A consisted of 12 participants comprising four men and eight women.

4.2 Experiment design

It was chosen to do a between-subjects experiment design, mostly because this avoids the transfer of knowledge of the participant between the two conditions [7]. Especially in this case of an onboarding tutorial, it is essential that participants have not been exposed to the same task before since that could introduce a bias for the second condition. Furthermore, a between-subjects design decreases the amount of time needed per experiment, which is relevant because it is expected that teachers will only have a limited amount of time available for it. This weighs stronger than the advantage of requiring fewer participants for a within-subjects design, as recruiting participants for an experiment that takes significantly longer was considered more difficult.

For the comparison, mixed-methods research has been done, which means that both qualitative and quantitative data have been collected. This was chosen since quantified scales exist for user engagement and cognitive load and by collecting qualitative data, more insight into the reasons for the level of engagement as well as opinions about the onboarding manners could be collected.

The effect of using multimedia on cognitive load and the effect of more autonomy on user engagement were evaluated since mental workload reduction and higher user engagement have a proven positive effect on learning, which is the purpose of user onboarding.

Besides, during the experiment, participants' mouse behavior was recorded to determine whether the guiding steps were clear. This has been done via screen recording with the use of a screen-recording tool called ShareX. Notes on mouse movements were taken and the time in seconds on completing the onboarding has been tracked for each participant to get insight into user behavior and the efficiency of the onboarding manners. The participants were not asked to use the think-aloud method during the experiment since thinking aloud could interfere with the participants' thoughts [25] and this could have impacted their engagement within the onboarding experience.

After the experiment, qualitative data was collected through a semi-structured interview. The interview was conducted to confirm the perceived clarity of the instruction and get insights into the relative engagement of the participants. Besides, at the end of each experiment, participants were asked if they would like to see the other onboarding version and what their preference would be, in order to compare them within-subjects as well despite between-subjects design. Finally, the qualitative and quantitative results have been reported and coded, allowing for comparison between the results of both conditions.

The quantitative scales and interview questions can be found in Appendix A and Appendix B.

4.2.1 Measurements

The level of user engagement has been measured using the User Engagement Scale - Short Form (UES-SF) [43]. This scale consists of four sub-scales, all consisting of three questions on a Likert scale of 1-5 (strongly disagree - strongly agree). The sub-scales are Focused Attention, Perceived Usability, Aesthetic Appeal, and Reward factor. The UES scale is used within HCI research and the original scale consisted of six dimensions instead of four and 31 items instead of 12 [43]. Because of the length and poor documentation, a shorter version has been developed which this study will make use of.

The level of the cognitive load has been assessed through the perceived mental workload using the NASA-Task Load Index (NASA-TLX) scale [22]. This scale consists of six subcategories Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, and Frustration. The subcategories are separate clusters of variables that collectively constitute to the experienced workload of users performing a task [21]. The index goes from 0 to 100 on a 20-point scale (very low - very high). The NASA-TLX scale is widely used in the research field of Human-Computer Interaction to assess cognitive workload [29]. A drawback of this scale is that the components lack specificity, however, this scale has been chosen since it offers a quick assessment of perceived mental demands and because it is a widely used scale, it provides comparability across studies [29].

Next to those existing scales, the amount of time completing the onboarding was measured since time spent on a task within an application could indicate the level of engagement or the frustration and disorientation of a user [40]. Besides, comprehension based on clarity of the instructions and feeling of confidence after

doing the onboarding will be measured on a scale of 1-10.

The semi-structured questions addressed the perceived usefulness of the onboarding manner, as well as suggestions for improvements, whether participants now understand the tool, if they felt engaged and felt the freedom to explore (autonomy), and whether they are looking forward to using the tool.

4.2.2 Variables

Independent variables

The independent variable was the onboarding version, so condition A or condition B.

1. Onboarding A: Interactive walkthrough (textual instructions + full guidance)
2. Onboarding B: Video tutorial (visual & auditory instructions + less guidance)

Dependent variables

The quantitative dependent variables were user engagement and mental workload during the onboarding. Also, the time spent doing the onboarding was a dependent variable, as well as the comprehension of the instructions and the level of confidence the participants had in using the tool after completing the onboarding.

1. Level of user engagement (Focused Attention, Perceived Usability, Aesthetic Appeal, Reward factor)
2. Level of mental workload (Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, Frustration)
3. Time spent doing the onboarding.
4. Clarity of the instructions
5. Confidence level after completing the onboarding

The dependent variables for the qualitative part of the study were comprehension of the tool, perceived freedom to explore (to compare the level of autonomy), user engagement, and whether the participants were looking forward to using the tool after completing the onboarding. Those were the closed questions of the semi-structured interview.

4.2.3 Material

For the experiment, the following materials were used:

- The first 23 seconds of a short video explaining the students' environment in TrainTool[1].
- Version A: current onboarding system (see Figure 1.2)
- Version B: revised onboarding system (see Figure 3.1 - 3.6)
- An overview of the tasks the participants follow during the experiment
- Laptop with screen recorder (ShareX)
- Monitor: 24 inch
- Voice recorder
- Information sheet (Appendix C)
- Consent form (Appendix D)
- Questionnaire including the NASA-TLX scale and the UES-SF (Appendix A)
- Interview questions (Appendix B)

4.2.4 Procedure

The experiments took place during a period of roughly two weeks in a quiet office with an external monitor (mostly at the University). Each experiment was moderated by the author and took around 15-25 minutes. The research setup can be seen in Figure 4.1. First, the participants were welcomed and the information sheet, as well as consent form, were handed out. If they understood everything and gave consent, the experiment was conducted. During the experiment, the participants completed one version of onboarding, version A: the control group (existing onboarding system) or version B: treatment group, modified onboarding process with enhancements. The participants were observed while they completed tasks within the onboarding through screen recordings. The way a participant moved and clicked through the system while

[1]Link to the introduction video of TrainTool: https://youtu.be/mZyJRx9CVNM?si=qZ7lmuWvgUXIR6YV

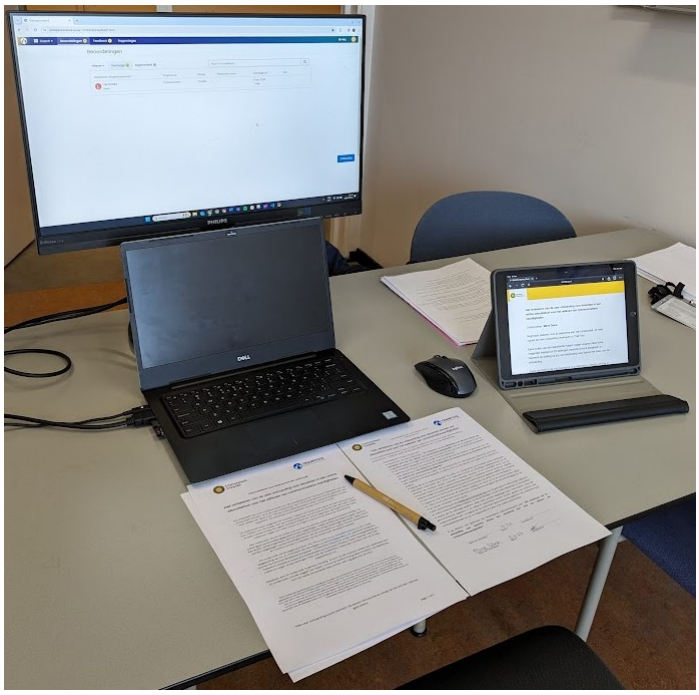

Figure 4.1: Research setup.

following the instructions was analyzed. Afterward, it was asked if the participants wanted to fill in a short questionnaire (containing the NASA-TLX scale and the UES-SF, see Appendix A), and subsequently, a semi-structured interview was held, which has been recorded. The interview started with thanking the participants. During the interview, the participants were asked about whether the system engaged them after the onboarding, as well as questions about whether they understood the core functionalities of the system, whether they had the feeling of autonomy, and if they had suggestions for improvements. Questions 1, 3, 4, and 6 were closed questions, and questions 2 and 5 were open questions (see Appendix B). After the interview, the participants were thanked again and asked whether they wanted to see the other onboarding version as well to compare them individually.

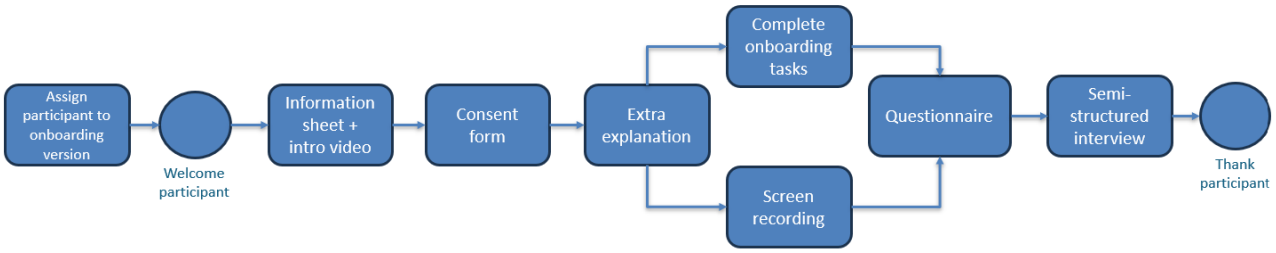

Figure 4.2: A short overview of the research protocol.

A short overview of the protocol can be seen in Figure 4.2. The step-by-step protocol of the study was as follows:

1. Welcome and thank the participants.
2. Explain the purpose of the study and give the information sheet.
3. Show the first 23 seconds of a short video on an iPad to give an idea of the students' environment in TrainTool. Also, explain that during the experiment, the coach environment was shown with assessment and feedback requests from students.
4. Give the consent form and give the participant time to ask questions.
5. If consent has been given, open the onboarding tool on a laptop.
6. Give some last explanations: "You will go through the onboarding by following the instructions. The onboarding is located in the bottom right-hand corner of the screen. You are testing the onboarding. It is about getting to know the tool, TrainTool. For version A: it was recommend going through all the steps and indicated that sometimes it is not possible to fill in feedback, then they can move on to the next. For version B: it was recommended to watch the video before performing the steps."
7. Start the study and the screen recording.
8. Let the user follow the onboarding.
9. After the experiment, thank the participant again.
10. Then, the participants were asked to fill in a short questionnaire (shown in Appendix A).

11. After the questionnaire has been filled in, the semi-structured interview will start.

12. The interview was conducted and recorded (if the participant gave consent).

13. After the interview: ask if the participant is curious about the other version and if so and they give an opinion, write down the version they prefer as well as their opinion.

14. Thank the participants again and give contact information if they are interested in further updates about the research.

4.3 Data analysis

4.3.1 Quantitative

For quantitative data obtained from the study, statistical analysis was done using R and JASP. First, the dataset has been prepared. For the NASA-TLX scale, the performance question of how successful the participants were in performing the task has been reversed to compute the total Mental Workload score. In addition, for the UES-SF the Perceived Usability scores have been reversed to estimate the total User Engagement score. After, statistical tests have been performed. If the assumptions of normally distributed data in each population, two independent groups, and homogeneity of variance were met, two-sample t-tests were executed to compare the means of both onboarding versions. It was tested whether the two means were equal. Two-tailed testing has been done because of limited scientific literature and two-tailed testing reduces the change of Type I errors compared to one-tailed testing. If the assumption of normally distributed data or homogeneity of variance were not met, the Mann-Whitney U test was executed to compare the medians. Additionally, the correlation between the NASA-TLX scores and the UES-SF scores has been examined to test the theoretical framework (Figure 2.6).

4.3.2 Qualitative

The participants' mouse movements as well as the interview have been recorded. The mouse movements were recorded via screen recordings, and from the interviews, voice recordings were obtained. To be able to analyze the data, the observations of

the screen recordings were written down and for the interview, the recordings were transcribed using the transcription tool within the OneDrive of Utrecht University and were anonymized for the results. After, the transcriptions were coded, using NVivo, a qualitative data analysis tool. Because the study is exploratory, the Straussian Grounded theory was used for coding. First, open coding was applied [5], and then, common themes were searched for. Quotes have been reported which have been translated into English as the interviews took place in Dutch. For the closed interview questions, the number of yes-es will be counted to be able to compare those for Condition A and B. This will be done in percentages since the group size differed.

4.4 Deliverable

The deliverable is a recommendation on which onboarding is best applied, considering user engagement, cognitive load, and comprehensibility. The expectation was that more autonomy and usage of visual and auditory guidance would result in higher user engagement and comprehensibility, than in the current situation where the user is simply ticking off a checklist without auditory guidance. Moreover, the use of multimedia is expected to reduce mental workload, and thus cognitive load.

Chapter 5

Results

This chapter presents the results of the research. First, the quantitative results are shown to illustrate the outcome of the questionnaire. After, the qualitative data will be discussed to gain deeper insight into the participants' opinions.

5.1 Quantitative Results

The mean of the main dependent variables for both conditions can be found in Table 5.1.

The variance of the data is not similar between conditions A and B for the Clarity of the instructions, and the total Mental Workload. Besides, for version A, the Clarity and Confidence scores were not normally distributed. For version B, the Time and Confidence scores were not normally distributed. So, for statistics including the variables Time, Clarity, Confidence, and total Mental Workload, non-parametric tests were used. For comparing the total User Engagement scores, parametric tests were used since the assumptions of normally distributed data, homogeneity of the variance, and independence between the groups were met. Note that all statistical tests were two-tailed.

Table 5.1: Means of the general items of the questionnaire per condition.

Condition	N	Time (sec.)	Clarity (1-10)	Confidence (1-10)	Mental Workload (0-100)	User Engagement (1-5)
A	12	449.50	6.33	6.08	33.13	3.19
B	13	504.85	7.77	7.77	18.65	3.48

Time spent doing the onboarding

There was no significant difference between condition A (M = 449.5) and condition B (M = 504.9) in the Time they spent doing the onboarding. The median Time spent during conditions A and B were 400 and 465 respectively. A Mann-Whitney U test indicated that the median Time spent on onboarding A was not significantly different from the median Time on onboarding B (U = 52.000, $p = 0.168$). This suggests there is no evidence to support the hypothesis that the Time spent on onboarding differs between the two conditions.

Clarity of the onboarding instructions

Besides, there was no significant difference between condition A (M = 6.3) and condition B (M = 7.8) in how clear they found the onboarding instructions. The median clarity levels of conditions A and B were 7 and 8 respectively. A Mann-Whitney U test indicated that the median of the Clarity of the instructions of onboarding A was not significantly different from the median of the Clarity of the instructions of onboarding B (U = 47.000, $p = 0.084$). This suggests there is no evidence to support the hypothesis that the Clarity of the instructions of the onboarding differs between the two conditions.

Confidence after completing the onboarding

Lastly, there was no significant difference between conditions A (M = 6.1) and B (M = 7.8) in how confident they felt after completing the onboarding. The median confidence level of conditions A and B were 7 and 8 respectively. A Mann-Whitney U test indicated that the median Confidence level after completing onboarding A was not significantly different from the median Confidence level after completing onboarding B (U = 46.000, $p = 0.077$). This suggests there is no evidence to support the hypothesis that the Confidence level after completing the onboarding differs between the two conditions.

5.1.1 NASA-Task Load Index

In Table 5.2 the descriptives of the Mental Workload data are shown. Besides, Figure 5.1 shows the bar charts of each component of the NASA-TLX scale that measures Mental Workload.

Table 5.2: Group Descriptives NASA-TLX scale. *note that performance is the only positive attribute.

	Condition	N	Mean	SD	SE	CV	Statistics	p-value
Mental Demand	A	12	47.50	28.88	8.34	0.61		
	B	13	32.69	27.05	7.50	0.83	U = 101.000	0.219
Physical Demand	A	12	5.83	5.97	1.72	1.02		
	B	13	5.77	6.41	1.78	1.11	U = 80.500	0.909
Temporal Demand	A	12	31.25	28.29	8.17	0.91		
	B	13	21.92	20.97	5.82	0.96	t = 0.942	0.356
Performance*	A	12	63.75	27.73	8.00	0.44		
	B	13	81.92	24.11	6.69	0.29	U = 36.000	0.023*
Effort	A	12	38.33	29.72	8.58	0.78		
	B	13	16.54	13.60	3.77	0.82	U = 111.000	0.074
Frustration	A	12	39.58	35.06	10.12	0.89		
	B	13	16.92	15.21	4.22	0.90	U = 103.500	0.170
CL total	A	12	33.13	20.02	5.78	0.60		
	B	13	18.65	10.87	3.01	0.58	U = 112.500	0.064

There was no significant difference between the total Mental Workload of conditions A (M = 33.1) and B (M = 18.7). The median of the total Mental Workload scores of conditions A and B were 32.1 and 19.2 respectively. A Mann-Whitney U test indicated that the median Mental Workload score of condition A was just not significantly different from the median Mental Workload score of condition B (U = 112.500, $p = 0.064$). This suggests there is no evidence to support the hypothesis

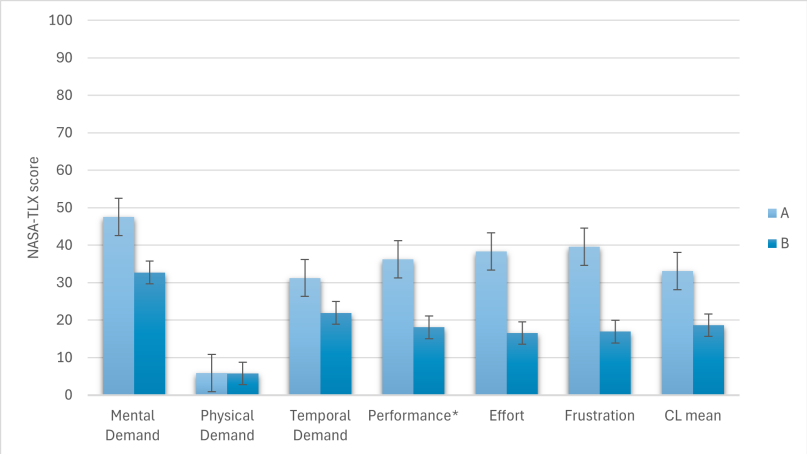

Figure 5.1: Barcharts Mental Workload scores. *note that for this visualization, the performance score has been re-pooled so that all attributes point in the same direction.

that the level of mental workload differs between the two conditions.

However, looking at each sub-scales of the NASA-TLX scale; there was a significant difference between conditions A (M = 63.8) and B (M = 81.9) in how successful they felt in completing the onboarding, namely the perceived Performance. The median of the Performance levels of conditions A and B were 70 and 85 respectively. A Mann-Whitney U test indicated that the median Performance rate of condition A was significantly different from the median performance rate of condition B (U = 120.000, $p = 0.023$). This suggests there is evidence to support the hypothesis that the level of performance differs between the two conditions. The rated Performance is significantly higher for onboarding B than for onboarding A.

On the other hand, the sub-scales Mental Demand, Physical Demand, Temporal Demand, Effort, and Frustration were not significantly different between conditions A and B ($p > 0.05$). This suggests there is no evidence to support the hypothesis that the level of Mental Demand, Physical Demand, Temporal Demand, Effort, and Frustration differs between the two conditions.

5.1.2 User Engagement Scale - Short Form

Table 5.3: Descriptives User Engagement Scale - Short Form.

	Condition	N	Mean	SD	SE	CV	Statistics	p-value
Focused Attention (FA)	A	12	3.08	0.74	0.21	0.24		
	B	13	2.89	0.74	0.21	0.26	t = 0.669	0.510
Perceived Usability (PU)	A	12	3.00	1.11	0.32	0.37		
	B	13	4.00	0.61	0.17	0.15	U = 33.500	0.015*
Aesthetic Appeal (AE)	A	12	2.81	1.07	0.31	0.38		
	B	13	3.41	0.78	0.22	0.23	U = 48.500	0.111
Reward factor (RW)	A	12	2.92	1.05	0.30	0.36		
	B	13	3.62	0.54	0.15	0.15	U = 49.000	0.115
UES total	A	12	2.95	0.80	0.23	0.27		
	B	13	3.48	0.51	0.14	0.15	t = - 1.969	0.061

In Table 5.3 the descriptives of the User Engagement Scale are shown. Besides, Figure 5.2 shows the boxplots of each component of the UES-SF.

There was no significant difference between the total User Engagement (UES) of conditions A and B (t = -1.974, df = 23, $p = 0.061$). The total User Engagement of condition A (M = 3.0) was just not significantly different from the total User Engagement of condition B (M = 3.5). This suggests there is no evidence to support the hypothesis that the level of User Engagement differs between the two conditions.

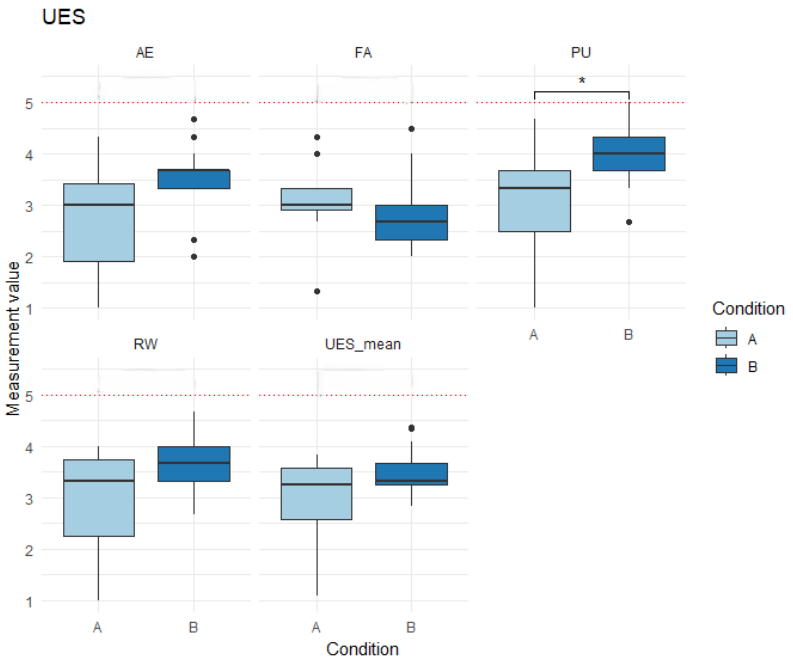

Figure 5.2: Boxplots User Engagement Scale - Short Form.

However, looking at each sub-scale of the UES-SF, as can be seen, there was a significant difference between conditions A (M = 3.0) and B (M = 4.0) in the Perceived Usability (PU). The median of the PU levels of conditions A and B were 3.3 and 4.0 respectively. A Mann-Whitney U test indicated that the median Perceived Usability of condition A was significantly different from the median Perceived Usability of condition B (U = 33.500, p = 0.015). This suggests there is evidence to support the hypothesis that the level of Perceived Usability differs between the two conditions. The Perceived Usability of condition B was significantly higher than the Perceived Usability of condition A.

On the other hand, there was no significant difference between the Focused Attention (FA) of conditions A (M = 3.1) and B (M = 2.9). The Focused Attention of condition A was not different from the Focused Attention of condition B (t = 0.669, df = 23, p = 0.510). This suggests there is no evidence to support the hypothesis that Focused Attention differs between the two conditions.

Also, there was no significant difference between the Aesthetic Appeal (AE) of conditions A and B (t = -1.624, df = 23, p = 0.118). The Aesthetic Appeal of condition A (M = 2.8) was not different from the Aesthetic Appeal of condition B

(M = 3.4). This suggests there is no evidence to support the hypothesis that the Aesthetic Appeal level differs between the two conditions.

Besides, there was no significant difference between conditions A and B in the Reward factor (RW) (U = 49.000, $M_A = 2.9$, $M_B = 3.6$, $p = 0.115$). This suggests there is no evidence to support the hypothesis that the Reward factor level differs between the two conditions. However, the level of one of the questions of the Reward factor sub-scale "*Using the onboarding was worthwhile*" was significantly different between condition A and condition B (U = 46.500, $M_B = 3.4$, $M_B = 4.2$, $p = 0.041$). This suggests there is evidence to support the hypothesis that the Worthwhile level of doing the onboarding differs between the two conditions. The Worthwhile level of condition B was significantly higher than the Worthwhile level of condition A.

5.1.3 Correlation User Engagement and Mental Workload

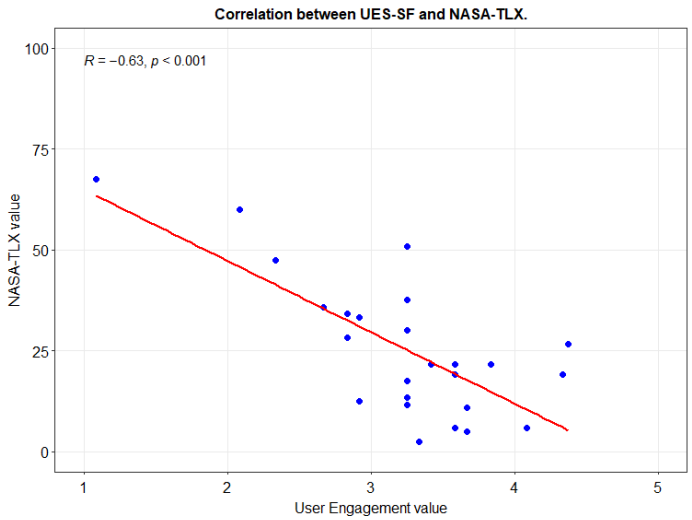

Figure 5.3: Correlation between User Engagement and Mental Workload.

There was a strong significant negative correlation between *User Engagement* and *Mental Workload* (rho = -0.632, $p < 0.001$). This means that as the Mental Workload increases, User Engagement decreases. The correlation coefficient indicates a strong negative correlation between the two variables (see Figure 5.3).

5.2 Qualitative Results

During the interview, five closed questions were asked. Those results are shown in Figure 5.4. The elaborated answers to the closed questions can be found in the following subsections.

Table 5.4: The percentage of the participants who answered "yes" to the closed interview questions.

Item	Question	Onboarding A	Onboarding B
Comprehensibility	Is it clear now how you could use TrainTool?	83.3%	100%
Freedom to explore	Did you feel you could explore the tool at your own pace?	25%	100%
Freedom to explore	Did you feel you could explore the tool in your own manner?	8.3%	76.9%
Engagement	Were you engaged with the tool while using the onboarding?	66.7%	53.8%
Looking forward	Are you looking forward to using TrainTool?	41.7%	69.2%

Comprehensibility

For version A, ten out of twelve participants (83.3%) indicated that it was clear how to use TrainTool after completing the onboarding, and for version B all participants (100%) indicated this.

For example, for both conditions, most participants mentioned that it is clear where to find the most important features. On the other hand, four participants who completed onboarding B indicated that the goal of the tool was clear and they got all the information they needed to understand the tool and start using it.

However, for version A, Participants 14 and 20 did not find it clear how to use the tool after completing onboarding A. They were confused. For instance, one of them stated:

> "No, I don't understand it at all. You are very much pushed by those buttons without really thinking about what you want and how you could do it. Your whole thought process is taken away from you it seems. I wouldn't be able to do this again on my own now. I would have preferred it if I could have just made mistakes and had a quick look at how it works. No, it's very compulsive." (P14, condition A).

Freedom to explore

Only one participant (8.3%) felt the freedom to explore during onboarding A and ten out of thirteen (76.9%) participants experienced this for onboarding B. Besides,

for version B, all participants felt they could do the onboarding at their own pace (100%). For version A, three out of twelve participants (25%) indicated this.

Participants who completed onboarding A indicated for instance having no initiative as user (P18), that it was very much imposed (P14), the user is pushed to click on certain buttons (P14), it was very rigid (P16), you were in a forced flow (P16). There was also no opportunity for exploration (P2) and the arrows were very compelling, this gave a certain pressure (P24). There was only one path you had to follow (P4).

One participant who completed onboarding A described it as follows:

> "Maybe it could have worked more if I could scroll through the pop-ups myself. So I could say well now I'm done so now give me the next one. Now it was too much that the system stole the initiative from me." (P18, condition A).

Four participants who completed onboarding B indicated they could click on buttons themselves after watching the instruction videos.

> "You have the instruction of course, but then just the whole online tool, so you can click through wherever you want and click on what you find interesting." (P1, condition B).

Lastly, two participants mentioned they felt they had less freedom to explore because the experiment took place in a research setting. The research setting caused them to obediently follow the instructions since the researcher was watching along.

Engagement

Eight out of twelve (66.7%) participants said they felt engaged during onboarding A and seven out of thirteen (53.8%) participants felt engaged during onboarding B.

Participants of both conditions indicated that they do not feel engaged with a tool. For instance, Participant 7 indicated:

> "Engaged? I feel engaged with persons not with a tool." (P7, condition B).

In addition, three participants of condition B mentioned not feeling engaged because of the content of the tool, it was about a conversation at a party instead of communication skills related to their teaching material.

Participants 9 and 24 also indicated the videos with answers from students they needed to give feedback on were too short which made it hard to give comprehensive feedback. Participant 24 indicated that irritated them and they would have been more involved if they could give more feedback.

Lastly, in both conditions, participants indicated they felt engaged, for instance, Participant 21 of condition B gave the following reason:

> "I think it is because of the videos that explain what you have to do, so, that you have an idea of where you have to be in the tool. And I think what does help with the tool is that the videos are in it, so it is of course a mix of different media. And if it was just text, it would indeed be less vivid to go through the tool and absorb it." (P21, Condition B).

Looking forward to using the tool

Lastly, five out of twelve (41.7%) participants who completed onboarding A indicated they look forward to using the tool after completing the onboarding. For version B, nine out of thirteen participants (69.2%) indicated this. Nine participants who were looking forward to using the tool indicated for instance that they saw the added value of it, and three indicated they liked the tool.

On the other hand, three participants of condition A indicated they were not looking forward to using the tool because of the onboarding. For instance, Participant 24 indicated not seeing the added value of the tool because of being too annoyed by the onboarding.

> "Well no more or less than what I was already doing. So then this [onboarding A] is not an added value for me. Because I also was a bit too much irritated." (P24, Condition A).

Three participants of condition B also indicated they were not looking forward to using the tool because of the platform, not because of the onboarding. One of them indicated not seeing the added value in teaching communication skills because of the preference for practicing communication skills face-to-face (P7).

On the other hand, five participants were neutral on this. For instance, they are not looking at a tool like that (P5, 16), or are still looking for the added value (P8).

5.2.1 Most useful

In addition to the closed interview questions, two open questions were asked. The first one was what participants found most useful about the onboarding manner.

What eight participants found most useful about onboarding A, was to see all the functionalities and go past them. Also, the process-based (P22), i.e. being guided through the tool in four steps (P2, 9, 12, 23, 25) and obligatory passing all the tabs of the tool (P4, 8) was indicated to be useful, and the core functionalities of the tool were highlighted using a checklist (P16) was appointed to be most useful. In addition, one participant indicated that she got the most out of textual explanations since she is the type that reads a lot (P10). Besides, Participant 18 mentioned:

"You sometimes just need experience with clicking." (P18, condition A).

On the other hand, one participant found nothing useful about the onboarding (P20).

What participants indicated to be most useful about onboarding B also include passing the important components of the tool, and seeing all functionalities step-by-step with explanations. Besides, four participants mentioned the video example as the most useful.

Also, using auditory explanations (P11) as well as visual explanations (P13) was found to be most useful. Because of the video explanations, the user does not have to find out for themselves where to find the functionalities (P21). In addition, someone indicated that the videos were short, easy to understand, and the pace of the explanations was calm (P15). Also, two participants indicated they found it most valuable to be able to try it themselves after the explanation (P17, 19), and someone else indicated that they found it useful that trying it out themselves could be done simultaneously with the video (P11).

5.2.2 Suggestions for improvement

The other open interview question stated whether participants had suggestions for improving the onboarding system. Suggestions for improvements varied between participants.

For instance, for version A, a participant would have preferred that the background does not grey out when a functionality lights up in the tool (P4). Related to this, someone indicated preferring to see no distinct marked white areas (P24). Also, a participant indicated that they would have liked to explore the tool themselves after the instructions (P6, 14) by having more autonomy (P18). This could be done

by allowing the user to scroll through the pop-ups themselves and only provide a new pop-up when the user is ready (P14, 18). Another suggestion for improvement for version A is that a participant would have liked it better if the examples were more in line with their teaching material, as in the demo version a student practices communication skills during a party. Another participant would have liked to have more explanations of the purpose of the tool and its functionalities (16). For instance, more context at the beginning could be given (P2). Last, a participant suggested using step-by-step videos instead of onboarding A (P20).

The participants who completed onboarding B also came up with suggestions for improvements. For instance, one participant would liked textual explanations as well, text to the videos, to see a quick summary of the possibilities (P1). Also, three participants suggested lighting up the parts within the tool simultaneously with the onboarding videos (P5, 7, 15). Another participant indicated that they would like a clearer indication of when is advised to start the next onboarding step, for instance, by highlighting the onboarding again when the user completed the previous step (P10). Besides, someone suggested giving more context within the videos about the purpose of the tool and its functionalities (P9). In addition, two participants would have liked the video to automatically become bigger (the size of the tool) while watching the video (P11, 25). Furthermore, a suggestion is to make it possible to drag the onboarding video around in case the onboarding is positioned on top of the tool's content (P11, 15). Then you do not have to click away the onboarding and can watch the video simultaneously with operating within the tool. Three participants mentioned they did not want to click on the close button of the onboarding because they were afraid of losing their progress. To make the button more intuitive they suggested using the minimise sign instead of the close sign. Last, three people suggest combining onboarding A and B by using a kind of tool-tip for each functionality where a notification icon lights up, and when you click on it the corresponding video starts playing so that the videos are even more integrated into the tool (P11, 14, 15).

Lastly, four participants did not have any suggestions for improvements, they were content with the onboarding manner.

5.2.3 Preferred onboarding version

As stated in the Experiment design, after the semi-structured interview, the participants were asked if they would like to see the other onboarding version and express their preference. 18 out of 25 participants gave their preference of which one person

(5.5%) preferred version A, fourteen participants (77.8%) preferred version B, and three participants (16.7%) would have liked a combination of the two versions.

Participant 4 indicated that they preferred version A provided that the background in version A does not get gray since they miss a transcript in version B. Other participants indicated preferring version B. For instance, they preferred instructions via video (P3, 17, 18) with auditive and visual explanations (P10, 25). The video was short and to the point (P18, 21), and gives the user more freedom to explore (P1, 11, 13, 23, 24).

> "Yes I am someone who does learn more easily from a video, I just find that easier. Because then I do it myself once and then I think to myself I don't get it again and then I watch the video again and then I think, why are there these scores? Then I would have been more involved than now. Because now [in onboarding A] I'm more clicking away than learning." (P24, Condition A).

> "I think video in general is useful because it's a combination of audio and visual. And I think they did look at learning styles and some people say, yes, I'm really into reading, but they found out that the combination of those two things helps best. And I find that myself, that videos I learn best from. It's an approachable way I think." (P13, Condition B).

Also, the videos first give an impression of the tool before the user operates within the tool (P2). And there is the possibility of simultaneous performance of tasks while watching the instructional video (P9).

Three people even indicated they probably would have become irritated if they had had to go through onboarding A. They indicate that they had probably lost their way in the program (P23) and written steps would have been harder to remember (P21). However, two people indicated they like written instructions too, next to video instructions (P1, 10).

The three participants who prefer a combination of the two onboarding versions indicated integrating help more into the tool when the user is ready to learn about a new functionality or tab (P14, 15). That would give the user even more freedom to explore and not give forced instructions (P11), for instance by using colored notifications as tooltips (P11, 15).

Chapter 6

Discussion

To contribute to the limited research field of user onboarding systems, this study investigated how an interactive walk-through user onboarding system for teachers could potentially be improved by increasing the feeling of autonomy and by making use of multimedia. This is done using literature about already existing onboarding systems as well as literature about user engagement, cognitive load, and the self-determination theory. Based on the insights from the literature research, a revised onboarding system has been designed to compare it with the current onboarding system of a tool called TrainTool. The experiment was a mixed-methods study to be able to combine quantitative results with qualitative insights. The time spent doing the onboarding, the clarity of the instructions, and the confidence after completing the onboarding were measured. Besides, already existing quantitative scales were used: the NASA-TLX scale to measure mental workload and the UES-SF scale to measure user engagement. Finally, more insights were gathered during a semi-structured interview. In the previous section, the results are shown. In this chapter, a summary of the main findings, the implications, limitations, and suggestions for future work will be discussed.

6.1 Summary of key findings

6.1.1 Quantitative results

As presented in the results section, there was no significant difference between conditions A and B in the time spent doing the onboarding, clarity of the onboarding instructions, and confidence after completing the onboarding ($p > 0.05$). An expla-

nation may be that despite onboarding A providing textual instructions within the tool and onboarding B explaining these instructions through a video, the same information about the core functionalities was given in both conditions as can be read in the Design section.

The total level of mental workload just was not significantly different between conditions A and B ($p = 0.064$). However, there appeared to be a significant difference between conditions A and B in how successful they felt in completing the onboarding, namely their rated Performance (U = 120.000, $p = 0.023$). In addition, the data of all attributes to measure the total mental workload are pointing in the direction that is in line with the expectation that they are (however not significantly) higher for condition A than condition B. This is in line with earlier research that showed that according to the Dual Coding Theory [2], making use of multimedia could reduce cognitive load [34, 32, 6].

The total level of user engagement also did just not reach a significant difference between conditions A and B ($p = 0.061$). Nevertheless, the Perceived Usability subscale appeared to be significantly different between conditions A and B ($p = 0.015$). While the other scales showed no significant difference between the conditions, the data of the Aesthetic Appeal and Reward factor sub-scales are pointing in a direction that is in line with the expectation. The means of those are, however not significantly, higher for onboarding version B. In addition, one of the questions of the Rewarded Factor sub-scale *"Using the onboarding was worthwhile"* appeared to be significantly different on its own between conditions A and B (U = 46.500, $p = 0.041$), meaning that participants of onboarding B found doing the onboarding more worthwhile. The only mean that is not higher for condition B than for condition A is the Focused Attention mean (although not significant). This may have been caused by possible misinterpretation of the first question of that sub-scale *"I lost myself in this experience"*. Two participants indicated that they thought it was negative to lose yourself. However, within the UES-SF as a whole, this is intended to be positive [43]. Another possible explanation of the total user engagement not being significantly different could be that the demo version of TrainTool (in which the onboarding systems were implemented) depicts a conversation at a party instead of practicing communication skills within an educational setting. This could have had an impact on user engagement as some participants indicated expecting it to be about other conversational skills that are more appropriate within their courses, for example, applied psychology or communication and information sciences. So there could be a side-effect of mismatching content on engagement, which may not have directly tested the effect of the

onboarding way on engagement. Another explanation for the total user engagement, as well as the total mental workload, just not being significantly different between the two onboarding versions could be the relatively small amount of participants for between-subjects testing. A larger sample size potentially would have yielded a significant difference. Besides, the difference between both conditions is tested two-tailed to see whether there is a difference. If more literature existed on the correlation between autonomy and user engagement for onboarding systems, one-tailed tests could have been chosen that would most likely have led to a significant difference. The same holds for the level of mental workload as a whole.

Despite no significance for user engagement and mental workload as a whole, there appeared to be a significant correlation between the user engagement scores and the mental workload scores (rho = -0.0632, $p < 0.001$). Meaning that if the mental workload increases, user engagement decreases. A possible explanation could be that the scale with which the user engagement level is measured (UES-SF) contains an item, Perceived Usability, about how taxing, frustrating, and confusing the onboarding was. This could be correlated to the Mental Demand and Frustration items within the NASA-TLX scale with which mental workload has been measured. Also, earlier research indicated a correlation between those two variables [8]. Besides, earlier research states that multimedia usage also affects engagement [39] and more autonomy could lead to cognitive load reduction as well [37] (see Figure 2.6). Thus, using multimedia and increasing the autonomy could affect both variables which may have created the correlation between those variables in this particular study.

6.1.2 Qualitative results

In addition to the quantitative results, the qualitative results show that the participants of onboarding B found it clearer how to use the tool than participants of onboarding A (100% vs 83.3%). Both onboarding manners helped to find the most important features, however, two participants who completed onboarding A were confused because of the onboarding, with the result of not understanding the tool. So the comprehensibility of participants who completed onboarding B appeared to be higher than participants who completed onboarding A.

The results show that within onboarding A, the user was forced into a certain path to click on every feature, and within onboarding B, the users were able to click on buttons themselves after watching the instructions. This result indicates that the video explanations used in onboarding B indeed gave more freedom to explore

(autonomy) than the interactive walk-through used in onboarding A, meaning that the autonomy component of the theoretical framework could be taken into account (Figure 2.6).

Besides, a lot more participants of onboarding B were looking forward to using the tool than participants who completed onboarding A (69.2% vs 41.7%). Three of the participants of onboarding A indicated not to look forward to using the tool due to the onboarding, which needs to be avoided when wanting people to use the tool. Another possible explanation for the higher amount of participants looking forward to using the tool after completing onboarding B could be the comprehensibility after onboarding B was higher and the participants had more freedom to explore during onboarding B. This may have given participants a better understanding of the tool and how it can be applied, leading to more enthusiasm to use the tool.

However, the amount of participants who indicated feeling engaged was slightly lower in onboarding B than in onboarding A (53.8% vs 66.7%). This is contrary to expectations since earlier work stated that more autonomy could lead to higher engagement [45]. The contrary result may be due to the fact that participants indicated that they did not feel engaged with a tool and the content of the tool did not seem to match the participants' expectations.

What participants found to be most useful was for both versions to go past all functionalities. This result ties in with the purpose of the onboarding systems. In addition, for onboarding version B, also the video example with auditory explanations was found to be most useful.

Also, suggestions for improvements have been given. Suggestions for onboarding version A were about changing the pop-ups and about having more initiative to explore the tool themselves. For onboarding B, participants suggested integrating the video explanations even more within the tool and came up with some minor aesthetic changes for the video checklist. Those could be taken into account when implementing an onboarding system at a company.

Lastly, almost all participants who expressed a preference indicated a preference for version B (77.8%). Most participants indicated to prefer instruction via video (combining visual and auditive explanations) and have more freedom to explore.

6.2 Implications

As stated in the introduction section, there is limited literature research on onboarding systems, while user onboarding is important for first-time users to get to know a system [54]. This research contributes to the limited amount of research on onboarding systems and contributes to the Human-Computer Interaction research field as well since it involves research about psychological theories, instructional design, and user experience design. One of the psychological theories is the cognitive load theory. This research found that using multimedia in onboarding systems could increase people's perception of performance which is an attribute of the mental workload scale (see Figure 5.1). This is in line with earlier research showing that in the context of learning, the use of multimedia could reduce cognitive load [57, 2, 34, 32, 6]. In addition, this study follows the future work suggestion by Chi et al. [11] to use multimedia for step-by-step tutorials with the addition of spoken explanations to demonstrate the reason behind the steps. The results of this study showed that for the condition with videos that included spoken instructions (onboarding B), the goal of the tool was indeed clear.

Also, this study found a negative correlation between the level of user engagement and mental workload for onboarding systems. According to earlier research [8], the learners' frustration and effort level significantly impact user engagement and consequently, the learning result. Their research only focused on three aspects of the NASA-TLX scale. Therefore, the finding of this study builds on this and implies that there is also a correlation between all aspects of the NASA-TLX scale and engagement. Future studies are encouraged to investigate this correlation within various contexts.

In addition, the results of this study contradict the expertise reversal effect. Earlier research [57, 16] concluded that offering more structure is more helpful for novice users. However, within this study, the onboarding condition with less guidance (onboarding version B) was preferred most and the comprehensibility was higher. Video instructions give the user more freedom to explore and when the user can control the pace, smaller parts can be processed in their working memory [37]. It would be interesting for future research to find the optimal balance between the amount of autonomy and the amount of guidance.

Besides, there is a practical relevance of this research. The onboarding manner TrainTool is using (UserGuiding) has been compared to a revised onboarding system (explanation videos). The results indicate that based on the following aspects, the

revised onboarding is advised: to let people feel more successful in completing the onboarding and to increase the perceived usability. Also, the revised onboarding version was most preferred by the participants and was found to be more worthwhile. Companies implementing onboarding systems may want to take this into account. Based on the results of this study, TrainTool is planning to adapt the user onboarding to video instructions instead of an interactive walk-through.

6.3 Limitations

There are limitations to this research, both limitations of the onboarding systems and the methodology.

6.3.1 Limitations of the onboarding systems

A limitation of this study is that only two specific variants of user onboarding were being compared. One of those onboarding systems utilizes UserGuiding as an interactive walkthrough that fades out the background of the tool and highlights with white frames the core functionalities at various locations. Arguably, this could have had an effect on the mental demand which is one of the attributes with which the total mental workload has been measured. However, there was no significant difference found in mental demand between the two versions ($p = 0.064$). Another drawback of onboarding A is that those highlighted frames sometimes overlay videos and feedback fields within the tool, which means the videos cannot always be played and at some places, written feedback cannot be given. This is a drawback of UserGuiding and could have had an impact on user engagement.

A limitation of the revised onboarding was that some teachers (e.g. participants 7 and 8) did not see the onboarding system (video checklist) separately from the tool itself. They saw it as a whole and mainly criticized the tool itself rather than the way of onboarding and getting to know the system. Because of this, it is unclear whether these participants completed the questionnaire in response to the (content in the) tool or the onboarding manner, despite the researcher having pointed out the difference several times.

6.3.2 Limitations of the methodology

A limitation of the User Engagement Scale appeared to be that some participants indicated they interpreted the first question *"I lost myself in this experience"* negatively. However, in the questionnaire, this question is intended to be a positive indication for Focused Attention [43]. This could potentially explain why the Focused Attention is the only subscale of which the mean is higher for version A, see Table 5.3 (although not significantly).

A limitation of the NASA-TLX scale is that the frustration question included more than one attribute. The explanation of that question stated, *"How insecure, discouraged, irritated, stressed, and annoyed were you?"*. Therefore, one participant indicated she felt insecure but not irritated. Furthermore, the NASA-TLX scale is a subjective measurement so it only offers insight into the perceived mental demands [29].

Another limitation of this research is that it was conducted in a research setup and actual behavior and perception could be different in a non-research setup. Accordingly, two participants indeed indicated they did not fully agree with having the freedom to explore the tool themselves because it was in a research setting where the researcher was watching along which caused them to obediently follow the instructions.

Furthermore, there could be a difference in engagement with to what extent the learning of communication skills fits in with teachers' lessons. There was a variation in the educational background but through convenience sampling, a large number came from information and computer science who have no teaching material on practicing conversation skills (which is the purpose of TrainTool). These participants are distributed across the groups but could bring down the actual engagement score which could lead to less difference between the groups (as no significant difference was found).

6.4 Future research

Taking into account the limitations of this research, for future work, interactive walkthroughs other than UserGuiding could be tested. For instance, interactive walkthroughs that do not fade out the background to measure if this gray background with white highlighted frames has an impact on the mental workload. Also, when doing future research about user onboarding, the content of the tool should be more

in line with teachers' teaching material, and to the question *I lost myself in this experience*, a comment should be placed so there is no ambiguity on how to interpret it, both to avoid the risk of letting this impact user engagement and testing a cleaner effect of the onboarding manner on user engagement.

Furthermore, for future work, engagement could be measured in the long term. Since engagement operates as a continuum [41], you want to make sure that users remain engaged for a while and do not get disengaged quickly causing them to abandon the tool [9]. Also, comprehension could be tested in the longer term; to measure which onboarding manner increases long-term memory on how to use the tool effectively.

Expanding on the research, the revised onboarding system could be optimized in accordance with the insights from this research. Besides, to investigate the scalability of this research, the revised onboarding manner with the freedom to explore and the use of multimedia could be investigated for other tools and target groups than teachers and the tool TrainTool.

Chapter 7

Conclusion

To summarize, this study investigated constructs for redesigning an onboarding system that guides first-time users in an online educational tool, called TrainTool. To investigate this, the onboarding as-is (condition A) has been compared with a proposed new onboarding system (condition B). This study focused on answering the research question:

> **How can user onboarding for first-time users be enhanced to be more effective?**

With the sub-questions:

1. What design features can enhance the user engagement of first-time users during onboarding?
2. What design features induce higher cognitive load during onboarding?
3. What design features can enhance the comprehension of an application for first-time users during onboarding?

To answer the research question and its sub-questions, both quantitative and qualitative data were collected through experiments in which teachers followed one of the onboarding versions, followed by a questionnaire and semi-structured interview. From the study, the following findings were found.

Based on the quantitative results, the results of the main constructs (total User Engagement and Mental Workload) were not significantly different between the onboarding versions. Therefore, sub-questions 1 and 2 could not fully be confirmed

based on this study. However, some variables within the measured scales appeared to be significant. The design of onboarding B did enhance the perceived Performance level compared to onboarding A ($p = 0.023$). Also, the Perceived Usability of onboarding B appeared to be higher than that of onboarding A ($p = 0.015$). In addition, there seemed to be a strong negative correlation between user engagement and mental workload ($p < 0.001$) of which the data of both scales, although not significant, was pointed in the preferable direction for onboarding B.

On the other hand, based on the qualitative results, the comprehension after completing onboarding B seemed to be higher, as well as the freedom to explore, the number of people who preferred onboarding version B, and whether the participants looked forward to using the tool after completing the onboarding. So, taking those results together, based on the opinions of the participants of this study, it could be assumed that onboarding B would be more effective.

Conclusively, the results suggest a higher preference for onboarding videos instead of an interactive walk-through with written instructions. In addition, the perceived performance and usability were higher for participants who used onboarding videos to become familiar with the tool. Taking into account the limitations of this study, it is recommended to see if there are more significant differences between the groups based on the theoretical constructs during future research.

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Appendix A

Questionnaire

Demographics:

- Participant number:
- Gender: (Male - Female - X - Prefer not to say)
- Level of education you teach at:
- Affiliated program you are affiliated with:

Comprehension:

1. On a scale of 1-10: how would you rate the clarity of the instructions provided during the onboarding? (totally not - extremely clear)
2. On a scale of 1-10: how confident do you feel using TrainTool now? (totally not - extremely confident)

NASA Task Load Index (20-point scale: very low - very high):

1. How mentally demanding was the onboarding? - Mental Demand
2. How physically demanding was the onboarding? - Physical Demand
3. How hurried or rushed was the pace of the onboarding? - Temporal Demand

4. How successful were you in following the onboarding? - Performance
5. How hard did you have to work to accomplish the onboarding? - Effort
6. How insecure, discouraged, irritated, stressed, and annoyed were you? - Frustration

User Engagement Scale (5-point scale: strongly disagree - disagree - neither agree nor disagree - agree - strongly agree):

- Focused Attention (FA):
    1. I lost myself in this experience.
    2. The time I spent doing the onboarding just slipped away.
    3. I was absorbed in this experience.
- Perceived Usability (PU):
    1. I felt frustrated while using the onboarding.
    2. I found this onboarding confusing to use.
    3. Using this onboarding was taxing.
- Aesthetic Appeal (AE):
    1. This onboarding was attractive.
    2. This onboarding was aesthetically appealing.
    3. This onboarding appealed to my senses.
- Rewarded Factor (RW):
    1. Using the onboarding was worthwhile.
    2. My experience was rewarding.
    3. I felt interested in this experience.

Appendix B

Interview questions

1. Is it clear now how you could use TrainTool? And what causes this?
2. What did you find most useful about the onboarding manner?
3. Did you feel you had the freedom to explore the tool (in your manner and pace)? Why?
4. Were you engaged with the tool while using the onboarding? Why?
5. Do you have any suggestions for improving the onboarding system?
6. Are you looking forward to using TrainTool? Why?

Appendix C

Information sheet

Research Participant Information Sheet

Enhancing the user onboarding for teachers within an educational tool for practicing communication skills

As part of my master's thesis for the Human-Computer Interaction program at Utrecht University, I want to evaluate the user onboarding system for TrainTool (see the Appendix in Dutch for a short description of this tool). With the results, design guidelines will be composed. The results will be shared with an external company, called TrainTool BV.

The user study will take around 20 minutes. During this user study, you will follow the onboarding. During the execution of the onboarding, your mouse behaviour will be recorded if you give consent for that. After, a short questionnaire will follow and at the end, I will ask some interview questions to gain deeper insight into your experience during the onboarding.

Any materials produced could be used for publication but will be fully anonymized. An audio recording of the interview will be taken (if you consent to it) and notes will be made. This recording will be stored on a secure university server. The recording will be transcribed so that opinions are captured into text. The recording will be securely deleted after transcription (within 2 months of the study). No personal data will be collected.

This study is carried out by me, Mirre Dona (m.a.l.dona@students.uu.nl), under the supervision of Dr. C. (Christof) van Nimwegen (c.vannimwegen@uu.nl), an assistant professor at the Interaction group of the Faculty of Science, Utrecht University, and under external supervision of Hadewich Hoekstra (hadewich.hoekstra@traintool.com), Product Team Lead at TrainTool. If you have any queries or concerns about this research, please ask me, send me an email, or contact my supervisor(s).

Taking part of this user study is voluntary. You may withdraw from the study at any time for any reason. You will even be able to withdraw your consent after you have participated. However, if you choose to do so, we will not be required to undo the processing of your data that has taken place up until that time.

This study has been allowed to proceed by the Research Institute of Information and Computing Sciences based on an Ethics and Privacy Quick Scan. If you have a complaint about the way this study is carried out, please send an email to: ics-ethics@uu.nl. If you have any complaints or questions about the processing of personal data, please send an email to the Faculty of Sciences Privacy Officer: privacy-beta@uu.nl. The Privacy Officer will also be able to assist you in exercising the rights you have under the GDPR. For details of our legal basis for using personal data and the rights you have over your data please see the University's privacy information at www.uu.nl/en/organisation/privacy.

*With *user onboarding* is meant: the initial introduction and explanation of the tool to new users.

Appendix

Korte introductie TrainTool

TrainTool is een online tool waarin studenten onbeperkt gespreksvaardigheden kunnen trainen door middel van rollenspellen. TrainTool wordt momenteel gebruikt binnen WO, HBO en MBO opleidingen. Zo wordt tijdens de opleiding gefocust op de theorie van gespreksvoering en kunnen studenten in hun eigen tijd de theorie toepassen binnen de online rollenspellen. Studenten kunnen feedback vragen op hun oefeningen en kunnen peer-feedback geven aan andere studenten. Ook hebben studenten inzicht in hun vaardigheden en resultaten.

→ De eerste 23 seconden van dit filmpje geeft een voorbeeld van hoe de studentenomgeving eruit ziet: https://www.youtube.com/watch?v=DgVxHEh4VGk&t=121s

Docenten hebben een los account waarmee ze de rollenspellen van studenten kunnen inzien, beoordelen en feedback er op kunnen geven. Ook ziet een docent in één oogopslag de voortgang van de studenten middels een voortgangsrapportage.

Consent form

Appendix D

Universiteit Utrecht

Consent form for participation in the research project

"Enhancing the user onboarding for teachers within an educational tool for practicing communication skills"

Please complete the form below by ticking the relevant boxes and signing on the line below. A copy of the completed form will be given to you for your own record.

- ☐ I confirm that I am 18 years of age or over.
- ☐ I confirm that the research project ***"Enhancing the user onboarding for teachers within an educational tool for practicing communication skills"*** has been explained to me. I have had the opportunity to ask questions about the project and have had these answered satisfactorily. I had enough time to consider whether to participate.
- ☐ I consent to the material I contribute being used to generate insights for the research project "***Enhancing the user onboarding for teachers within an educational tool for practicing communication skills".***
- ☐ I consent to *audio* recordings and screen recordings being used in this study as explained in the information sheet. I understand that I can request to stop recordings at any time.
- ☐ I understand that if I give permission, the audio and mouse recordings will be held confidentially so that only researcher Mirre Dona and supervisor Christof van Nimwegen have access to the recordings. The recordings will be held in a secure university server for up to 2 months after which period they will be transcribed/encoded in an anonymous form and the original securely destroyed. In accordance with the General Data Protection Regulation (GDPR) I can have access to my recordings and can request them to be deleted at any time during this period.
- ☐ I understand that my participation in this research is voluntary and that I may withdraw from the study at any time without providing a reason, and that if I withdraw any personal data already collected from me will be erased.
- ☐ I consent to allow the fully anonymized data to be used in future publications and other scholarly means of disseminating the findings from the research project.
- ☐ I understand that the data acquired will be securely stored by researchers, but that appropriately anonymized data may in future be made available to others for research purposes. I understand that the University may publish appropriately anonymized data in appropriate data repositories for verification purposes and to make it accessible to researchers and other research users.

- ☐ I agree to take part in the above research project on ***"Enhancing the user onboarding for teachers within an educational tool for practicing communication skills"***.

Name of participant	Date	Signature
Name of researcher	Date	Signature