NTNU

Norwegian University of
Science and Technology

User Engagement in Game-based Student Response Systems: A Case Study on Kahoot!

Julie Alice Skøien

Master of Science in Communication Technology
Submission date: June 2018
Supervisor: Poul Einar Heegaard, IIK

Norwegian University of Science and Technology
Department of Information Security and Communication Technology

NTNU – Trondheim
Norwegian University of
Science and Technology

User Engagement in Game-based Student Response Systems:

A Case Study on Kahoot!

Julie Alice Skøien

Submission date: June 2018
Responsible professor: Poul E. Heegaard, IIK
Supervisor: Katrien De Moor, IIK

Norwegian University of Science and Technology
Department of Information Security and Communication Technology

Title: User Engagement in Game-based Student Response Systems: A Case Study on Kahoot!

Student: Julie Alice Skøien

Problem description:

There are several types of methods and tools, which can be integrated into classroom environments to motivate students to participate more actively and to trigger engagement and enhanced learning. Student response systems (SRS) are one such category of tools. SRS are specific types of learning technology, which intend to trigger student engagement in educational environments. They allow for students to answer different types of questions (e.g., multiple choice) given by an instructor (e.g., teacher). The goal can be to assess the overall knowledge of the student group, related to a specific subject, or for the students to test their knowledge in a course. Most SRS services today can be used on personal computers (e.g., smartphones, PCs, etc.) acting as remote controls, typically called "clickers", and are heavily facilitated by the Bring Your Own Device (BYOD) wave. However, in order to foster engagement and enhanced learning through SRS, such systems have to be developed in such a way that facilitates user engagement. A challenge is, therefore, to understand what engagement actually means in a classroom setting. Which elements contribute to it and which elements are barriers to user engagement?

In this thesis, we focus on one such SRS, namely the quiz-based application Kahoot!. It differs from other SRS in that it makes the classroom transform into a game show, in which students turn into competitors and the teacher becomes a game show host. In addition, Kahoot! has an immense user base and is becoming ever more popular as it is able to evoke great engagement in classroom settings. For this reason, success-story Kahoot! is a very interesting case for closer investigation. Previous studies have focused on how game-based SRS (GSRS) make learning fun by adding elements familiar from games and by triggering increased social interaction between students. But what does user engagement mean in the context of Kahoot!?

Given this broader context, the objective of this thesis is to gain insight into the concept of user engagement in SRS by looking at the GSRS Kahoot! as a concrete case. More specifically, the aim is to investigate the elements that trigger and influence user engagement with Kahoot! and to gain better insights into the role that technical factors may play in this respect.

The main tasks include:

- Give an overview of the most relevant elements of student response systems, and why user engagement is important considering such systems.
- Qualitative data analysis of the interviews that were carried out during the fall semester with two SRS developers.
- Plan and conduct a study to identify factors of general and technical nature which influence user engagement in student response systems, and to which extent (and if possible considering different perspectives, e.g., teacher, developer, student).

Responsible professor: Poul E. Heegaard, IIK
Supervisor: Katrien De Moor, IIK

Abstract

Among all the new applications and services coming, are technological tools one can benefit from, in fields such as educational environments. The increased use of technology in schools has opened up for new ways of learning, particularly learning by digital interactions in classrooms which, in turn, make students take more active part in lectures. The enabling of digital interactions can be accomplished by using educational technology such as student response systems (SRS). Beyond their ability to both enhance learning and increase student attendance in class, these systems also have the ability to trigger *engagement* among students. One of such SRS is the popular quiz-based application Kahoot!. By having elements from traditional games integrated to its design, Kahoot! has been able to trigger great engagement in classrooms, and, for some, even made learning fun.

As a contribution to the existing literature on user engagement, the concept of user engagement in the context of SRS has been investigated in this thesis. This has been done by looking at the game-based SRS (GSRS) Kahoot!, as a concrete case. To identify which elements contribute to user engagement and which elements form barriers in a GSRS, elements that trigger and influence the user engagement in Kahoot!, specifically, has been focused on. Further, the role that technical factors potentially play in this respect has been examined. To this end, a mixed methods research design has been adopted. More concretely, a literature review, semi-structured interviews with two SRS developers, and a larger-scale study based on an electronic questionnaire (N=106) have been conducted. This thesis presents the background and related work for this research, the methodology used to carry out the research, results from conducting the three studies, and finally discussions and conclusive remarks.

The main findings indicate that both students and teachers highly engage when using Kahoot!. Especially the feeling of being drawn into/involved in the experience (Felt Involvement) with Kahoot! is very high. Thus, the role one has when playing/using Kahoot! - student or teacher - does not significantly affect the felt level of engagement. Moreover, a range of factors - categorized into either Human, System or Context Influencing Factors - that influence user engagement positively or negatively were identified. These factors can also be understood by viewing them in the light of six key engagement attributes suggested by previous work in

the field of user engagement (Perceived Usability, Focused Attention, Felt Involvement, Endurability, Novelty and Aesthetic Appealing). Among negatively influencing factors, are technical issues, such as bad Internet connection or experienced delay. However, even though many respondents had experienced technical problems with Kahoot!, this did not seem to significantly affect their level of engagement with Kahoot!. The findings thus indicate that Kahoot! is perceived as highly engaging and that negatively influencing factors, e.g., technical issues, might influence a certain engaging experience, but that in the long run, these do not seem to be affecting users' "top of mind" impression of Kahoot!.

Sammendrag

Blant alle de nye applikasjonene og tjenestene som stadig kommer, finnes det verktøy man kan dra nytte av innen utdanning. Den økende bruken av teknologi i skolen har åpnet for nye måter å lære på, særlig læring gjennom digitale interaksjoner, som kan få elever til å delta mer aktivt i undervisningen. Slik interaksjon kan oppnås ved for eksempel å ta i bruk responssystemer for studenter. I tillegg til disse systemenes evne til å bedre læring og øke elevenes oppmøte i undervisningen, kan disse systemene utløse *engasjement* blant studentene. Et eksempel på et slikt responssystem, er den populære quiz-baserte applikasjonen Kahoot!. Ved å integrere elementer fra tradisjonelle spill i designet sitt, har Kahoot! lykkes i å vekke et stort engasjement i klasserom, og bidratt til å gjøre læring gøy.

Som et bidrag til eksisterende litteratur om brukerengasjement, har brukerengasjement i en responssystemkontekst blitt undersøkt i denne oppgaven. Dette har blitt gjort ved å se på det spillbaserte responssystemet (GSRS) Kahoot! som et konkret eksempel. For å identifisere hvilke elementer som bidrar til brukerengasjement og hvilke elementer som hindrer det i et GSRS, har elementer som trigger og påvirker brukerengasjement spesifikt for Kahoot! blitt fokusert på. Videre har rollen som tekniske faktorer spiller i denne forbindelsen blitt undersøkt. For dette formålet ble kombinerte metoder tatt i bruk som forskningsdesign. Mer konkret har det blitt gjennomført et literaturstudie, semistrukturerte intervjuer med to responssystemutviklere og et større studie basert på en eleketronisk spørreundersøkelse (N=106). I denne oppgaven presenteres bakgrunnen og det relaterte arbeidet til studiet, metodologi brukt i forskningen, resultater fra de tre gjennomførte studiene, og til slutt diskusjon og avsluttende kommentarer.

Hovedfunnene indikerer at både studenter og lærere i stor grad engasjeres når de bruker Kahoot!. Særlig følelsen av å bli trukket inn/involvert i opplevelsen («Felt Involvement») i Kahoot! er veldig høy. Rollen man har når man spiller/bruker Kahoot! - enten det er student eler lærer - påvirker imidlertid ikke særlig det opplevde engasjementet. Videre blir en rekke faktorer - kategorisert som enten Menneskelig-, System- eller Kontekstpåvirkelige - identifisert, som påvirker brukerengasjement positivt eller negativt. Disse faktorene kan også tolkes i lys av seks viktige engasjementsattributter, presentert i tidligere studier innen brukerenga-

sjement («Perceived Usability», «Focused Attention», «Felt Involvement», «Endurability», «Novelty», and «Aesthetic Appealing»). Blant negativt påvirkende faktorer, er tekniske problemer, som dårlig internettforbindelse eller forsinkelse. Selv om mange respondenter har opplevd tekniske problemer i Kahoot!, ser det ikke ut til betydelig å påvirke brukerengasjementet deres i Kahoot!. Funnene indikerer dermed at Kahoot! oppleves svært engasjerende. Negativt påvirkende faktorer, som tekniske problemer, kan påvirke én spesifikk opplevelse, men i det lange løp, ser det ikke ut til at disse påvirker det første brukere tenker på (engelsk: «top of mind») ved Kahoot!.

Preface

This thesis has been submitted to fulfil the graduation requirements of the MSc in Communication Technology at the Norwegian University of Technology and Science (NTNU). The main research and writing were carried out between February and June 2018.

The main objective in this study is to investigate the concept of user engagement, by focusing on the game-based student response system Kahoot!.

The greatest appreciation is shown to my supervisor Katrien De Moor and professor Poul Heegaard for their support and invaluable contribution to the project. Also, special thanks go to Prof. Adrian George Stoica and Prof. Alf Inge Wang for their time and sharing of knowledge in the area. Finally, gratitude is expressed to all who participated in the questionnaire.

Julie Alice Skøien
Trondheim, 6th of June 2018

Contents

List of Figures

List of Tables

List of Acronyms

AA Aesthetic appealing.

BYOD Bring your own device.

EN Endurability.

FA Focused attention.

FI Felt involvement.

GSRS Game-based student response systems.

NO Novelty.

NTNU Norwegian University of Science and Technology.

PU Perceived usability.

QoE Quality of Experience.

QoS Quality of Service.

RQ Research question.

SPSS Statistical Package for the Social Science.

SRS Student response systems.

UES User engagement scale.

Chapter 1
Introduction

Today's Internet users can choose among a seemingly infinite number of web applications and services which apt their needs and delights. Consequently, it has become important for providers of such applications and services, e.g., developers, to understand what makes users invest their time and interest in specific web technologies. One way to gain insights into this investment is through considering the quality of their perceived experience. This approach is supported by well-established quality measures, such as QoS and QoE. However, a recent thought emphasizes that good technology should not only be designed for usage, but also for *engagement*. For this reason, user engagement has been proposed as an aspect of users' experiences that should gain prominence in the area of studying users' interaction with technology.

A specific field where human-technology interactions are crucial, is in educational environments where technology - when used in a proper way - can facilitate learning. However, the ever more use of technology in schools has really opened up for new ways of teaching in classrooms. For instance, one can make students take more part in lectures by having digital interaction in classrooms. This digital interaction is a fundamental fashion in educational technology services such as student response systems, or SRS. These systems might enhance learning and increase both participation and attendance in class by engaging the students [10, 11]. Besides, using SRS in lectures can be an excellent supplement to traditional teaching methods (e.g., blackboard teaching).

One of such systems is the game-based SRS Kahoot! [8]. It is a web platform mainly used for learning purposes. Also, it aims to increase student engagement by making classrooms turn into fictional game shows. The widespread application has elements inspired by both games and traditional SRS implemented, making it a game-based SRS (GSRS). These elements seem to make learning more enjoyable and engaging, based on Kahoot!'s high amount of users, more precisely, 70 million unique monthly users [8]. Thus, it is worthwhile to investigate more in-depth what the mentioned elements are, to get a better insight into the concept of user engagement

in the context of SRS. How and to which extent are they influencing user engagement in the context of Kahoot!?

1.1 Motivation

In previous studies, one can read about the use of Kahoot! in classrooms. That is, how using Kahoot! improves the learning outcomes, motivates, engages, and increases the concentration among students with the game-based approach [12, 13]. Kahoot! is an application designed for both the players (students) and the leader (teacher). But the elements to ensure that both players and the leader engage in the service, are not necessarily the same. What does user engagement mean for and require from a player perspective versus from the perspective of the instructor of a Kahoot! session? A motive to get a better insight into the concept of user engagement and how Kahoot! facilitates it, is thus to include the developer's, student's and teacher's view on this area. Previous studies seem to have focused predominantly only on the student perspective, thus how Kahoot! affects students as users. However, the existing literature lacks research taking the perspective of the leader of a Kahoot! session, i.e., the teacher, as user. So, by focusing on the under-investigated teacher perspective related to the use of Kahoot! in classrooms, a useful contribution to the existing literature can be made.

In addition, aspects related to the technical and perceived quality (e.g., Quality of Service, Quality of Experience) have gained importance as well, and can act as crucial enablers of or barriers to user engagement. Thus, to examine how Kahoot! enables user engagement and which factors bear an influence on engagement with Kahoot! can provide valuable insights into how users engage with a SRS in general.

1.2 Research questions and scope

Given this broader context, the main objective of this study is to investigate the concept of user engagement in the context of SRS. We do this by looking at the GSRS Kahoot! as a concrete case. More specific, the aim is to investigate elements in Kahoot! that trigger and influence user engagement. Additionally, we want to gain better insight into the role that technical factors may play in this respect. To narrow the scope of this research, we address the following research questions:

- **RQ1:** Why is user engagement important in SRS?
- **RQ2:** Which aspects of user engagement are being taken into account when developing GSRS in general, and Kahoot! in particular?

- **RQ3:** Which factors, in general and of technical nature, influence user engagement in GSRS, and specifically in Kahoot!?

To consider all the user perspectives of Kahoot! has been an explicit goal when developing the methodological approach and subsequent data collection. To get a more in-depth insight into the developer's and teacher's perspective, we, therefore, first of all conducted semi-structured interviews with developers of two different SRS. To support and extend the findings, we constructed a questionnaire to cover the student's perspective as well as the teacher's. The knowledge obtained from this study might be applied to other educational learning technologies and can help the developers of such technologies to design engaging services. This, in turn, may help to establish and maintain a steady user base of pleased and engaged users.

1.3 Outline

Given the introduction, the structure of the following chapters is:

- Chapter 2: Reports the background and related work in regard to the field of study.
- Chapter 3: Presents the chosen methods. The qualitative and quantitative research conducted will be introduced and explained.
- Chapter 4: Presents the analyses and results. This part includes analysed interviews and a processed/coded survey.
- Chapter 5: Discusses the research approach and results.
- Chapter 6: Discusses the main limitations of the study, future work, and conclusive remarks.

Chapter 2
Background and Related Work

In the previous chapter, we introduced the use of technology in educational environments, associated challenges, and the objective of this study. In this chapter, we address the concept of user engagement in more detail and cover relevant information found in the literature on user engagement in technology and services (educational in particular). That is, characteristics of user engagement and how user engagement previously has been measured are reported. Further, student response systems and general characteristics of such systems will be explained. This is followed by a thorough presentation of Kahoot!, the game-based SRS we focus on in this thesis.

2.1 The concept of user engagement

The global mobile data traffic is rapidly increasing [14], and the number of available mobile applications and services in the market is growing. With the seemingly endless emerging and evolving of web services, today's Internet users are offered an enormous amount of online choices. As a consequence, it has become ever more important for developers of mobile applications and services to find out what attracts users and what motivates them to stay or to keep using an application or service also over more extended time, as addressed by O'Brien et al. [1]. Developers should, therefore, try to consider what engages users the most with a particular service and what stimulates them to continue using it, as part of the design and development process. In other words, this user-centered approach stresses that technology should be designed to - not only use - but also to engage, i.e., make users invest their time, attention and emotions into a specific technology [15]. Moreover, to gain knowledge and insights into the concept of user engagement might result in improvements within the field of technology development. While "users expect a high Quality of Experience (QoE) (...) content providers aim at high User Engagement" [16]. In an educational setting, teachers can also be considered as "content providers", and engagement plays a vital role as well, as we will discuss in more detail in Section 2.2. For this reason, we will first look into the concept of user engagement as such more deeply in the following

sections.

2.1.1 Defining and characterising user engagement

The concept of user engagement is widely discussed in the recent literature, amongst others in human-computer interaction in research communities focusing on user experience, which may illustrate its importance when designing technology services. Several definitions of user engagement can be found, focusing on different views. For instance, Lehmann et al. [17] have defined user engagement as "the quality of the user experience that emphasizes the positive aspects of the interaction, and, in particular, the phenomena associated with being captivated by a web application, and so being motivated to use it." Moldovan and Metzger [16], on the other hand, have defined it more generally as a measurement of the activity or attention of users in a system.

While some researchers seem to have a clear definition of user engagement, others stress the complexity of it. That is, to acknowledge user engagement as a multifaceted concept, composed of several components, or attributes. Attfield et al. [15] have assessed three factors, more concretely the cognitive, emotional and behavioral dimensions that exist in user engagement, making it holistic. The cognitive factor relates to the individual's perception of the service, including their driven and social needs [4]. The emotional, or often called affective, factor is simply concerned with users' emotions and feelings toward a service [4]. Lastly, the behavioral factor is associated with the users' action and, intuitively, users' behavior when using a service [4]. These factors lead to the notion of user engagement as a measurable quality, and as a matter of duration from a single technology interaction session to a more long-term technology usage with multiple sessions [15, 18]. This is further supported by the work of O'Brien [19]. She provides an understanding of user engagement as an outcome and process, acknowledging this interaction relationship. Her work examines how users view the interaction as an experience (outcome) and how engagement develops during an interaction through phases (process). O'Brien's research has greatly contributed to the field of studying user engagement, illustrating not only the concept's relevance, yet also its complexity, e.g., with respect to measurement and modeling. Through extensive studies, she has defined user engagement as "a quality of user experience with technology, characterised by the perceived usability and aesthetic appeal of the system, focused attention, novelty, felt involvement, and endurability" [18]. Bringing O'Brien's engagement attributes together with the factors of Attfield et al. might give a more comprehensive picture of user engagement, illustrated in Table 2.1:

Attribute	Dimension	Description	Ref.
Perceived Usability	Cognitive and emotional	Related to users' perceived effort and ability to accomplish tasks in a web service, the navigation and organization of the service, and the emotions evoked by the experience.	[9]
Aesthetic Appeal	Emotional	The visual appearance of a service's interface that also conforms with design principles. Includes features giving aesthetic impressions to users through attractiveness and sensory appeal.	[1, 9, 15]
Focused Attention	Cognitive and behavioral	Users' perception of time when interacting with a service. The extent to which users lose track of time or becomes absorbed into the service to the exclusion of the surroundings.	[9, 20]
Novelty	Cognitive and emotional	How curiosity is stimulated or evoked by unfamiliar, surprising or unexpected elements.	[9, 15]
Felt Involvement	Cognitive	The extent to which users have the feeling of being drawn into and involved in the experience.	[9]
Endurability	Cognitive and behavioral	Perception of the experience as worthwhile, successful and rewarding. Related to the users' willingness to repeat and recommend an experience.	[9, 20]

Table 2.1: User engagement attributes explained in the light of the three user engagement dimensions.

It is worth noting that all three dimensions are more or less represented in the attributes, but some often have a stronger relation to the attribute than the others [15]. More attributes have been suggested in previous studies, such as motivation [4] and perceived user control [18], testifying user engagement's wide composition, depending on the context it is assessed in. We suggest a closer investigation of other attributes for a broader insight of the concept of user engagement.

2.1.2 The user engagement process and influencing factors

To recap, user engagement is hence a term of many dimensions and attributes that together describe its complexity. Nevertheless, the attributes' occurrence intensity during an engaging experience will vary, opening up for another field of interest within the concept of user engagement - its cycle. Naturally, to create good technological services, it is important for developers, or service providers, to understand which attributes initiate user engagement, which ones sustain engaging experiences, and what factors make users disengage. We aim to shed light on this by presenting O'Brien's "User Engagement Process Model" for user engagement [1] and highlight factors plausibly influencing user engagement, as found in the literature.

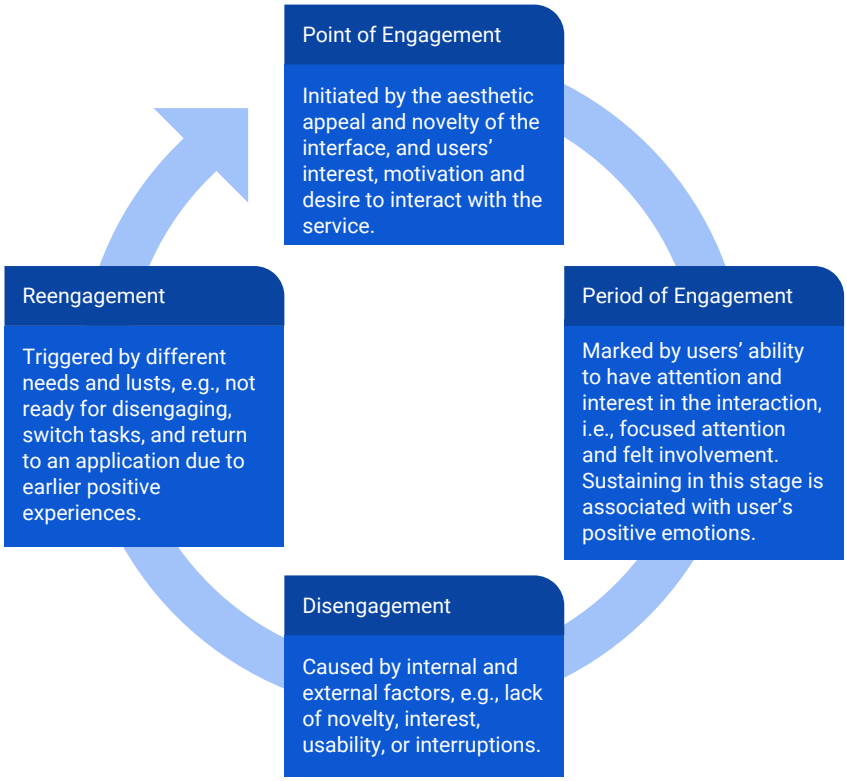


Figure 2.1: The "User Engagement Process Model" by O'Brien, illustrated with explanations [1].

The user engagement process cycle, illustrated in Figure 2.1, shows the four stages of engagement and associated attributes. However, the model lacks examples of

concrete triggering factors that may influence user engagement and, worst case, cause disengagement. As stated in RQ3, this thesis is concerned with determining factors that influence user engagement, specifically in Kahoot!. Unfortunately, work on such factors is poorly represented in the current literature. However, by reviewing existing literature it becomes clear that factors (both general and technical) affecting user engagement and perspectives on how these factors may play a role have been identified in other domains prior to this research. Before we embark on addressing these factors, we see a need to present a more technical perspective on user engagement, as it is strongly related to other known quality- and perception related concepts and measures.

As justified in Section 2.1, technology developers should design for engaging experiences in order to gain the users' attention, given all the choices that users have today. The focus on providing quality to users is nothing new and is emphasized through quality requirements measures, like Quality of Service (QoS) [21] and Quality of Experience (QoE) [22], standardized by ITU[1]. It goes beyond the scope of this work to discuss the conceptual understanding of Quality of Service and Quality of Experience in more detail, but a thorough discussion of the origins of both concepts, their definitions and how they relate to each other as well as other concepts such as user experience can be found in [23]. Previous work has to some extent addressed how user engagement is related to these measures. For instance, De Moor et al. have addressed how certain engagement constructs are related to QoE measures, and findings showed that the included user engagement constructs were related to both technical as well as perceived quality, underlining its relationship with QoE [24]. Further, Bouch et al. [25] saw that users' level of engagement affected the acceptability of QoS. With regards to QoE, there seems to be a common perception that user engagement is as a metric or a function of QoE [26, 27]. As user engagement seems to be closely related to QoE (even though both concepts developed in different fields/research communities), we argue here that the factors influencing QoE are likely to influence user engagement to some extent as well. Thus, we included work on QoE in the search for factors influencing user engagement as this is one of the main tasks in this research (see RQ3 in Section 1.2).

Reiter et al. [2] have discussed factors influencing QoE in different electronic communication services and applications. They define an Influence Factor (IF) as "Any characteristic of a user, system, service, application, or context whose actual state or setting may have influence on the Quality of Experience for the user." Because of the relationship between user engagement and QoE, we argue that the same definition can be used to describe influencing factors in user engagement. They have further categorized IFs into Human, System, and Context Influencing Factors (IFs). Human IFs was described as "any variant or invariant property or characteristic

[1]International Telecommunication Union https://itu.int

of a human user. The characteristic can describe the demographic and socio-economic background, the physical and mental constitution, or the user's emotional state", while System IFs "refer to properties and characteristics that determine the technically produced quality of an application or service [2]." Context IFs, on the other hand, was defined as "factors that embrace any situational property to describe the user's environment [2]." Reiter's et al. work stresses the lack of knowledge about IFs under specific circumstances and how they actually influence QoE in the research field. This supports the unsuccessful attempts to find any relevant work on factors influencing the subjective experience-related measure in focus - user engagement - in the existing literature. However, Reiter et al. listed a table giving an overview of important identified IFs to be used "when designing QoE experiments and reporting," which, in turn, can be adapted to similar user engagement studies:

IF	Type	Examples
HIF	Low-level: physical, emotional, mental constitution	Visual / auditory acuity and sensitivity; gender, age; lower-order emotions; mood; attention level
	High-level: understanding, interpretation, evaluation	Socio-cultural background; socio-economic position; values; goals; motivation; affective states; previous experiences; prior knowledge; skills
SIF	Content-related	Audio bandwidth, dynamic range; video motion and detail
	Media-related	Encoding, resolution, sampling rate, frame rate; synchronization
	Network-related	Bandwidth, delay, jitter, loss, error rate, throughput; transmission protocol
	Device-related	Display resolution, colors, brightness; audio channel count
CIF	Physical context	Location and space; environmental attributes; motion
	Temporal context	Time, duration and frequency of use
	Social context	Inter-personal relations
	Economic context	Costs, subscription type, brand
	Task context	Nature of experience; task type, interruptions, parallelism
	Technical / informational context	Compatibility, interoperability; additional informational artifacts

Figure 2.2: Examples of Influencing Factors (IFs), categorized as either Human (HIF), System (SIF) or Context (CIS) Influencing Factors [2].

Which factors are most important for a given type of application depends on the type of application, the context of use, the profile of the user, etc. In other words, all three influencing factors together (Human, System, and Context) are not necessarily equally important to consider in every setting. More specific application domains and the factors influencing either the QoE or user engagement in them have been identified in the literature, and are highlighted in Figure 2.3:

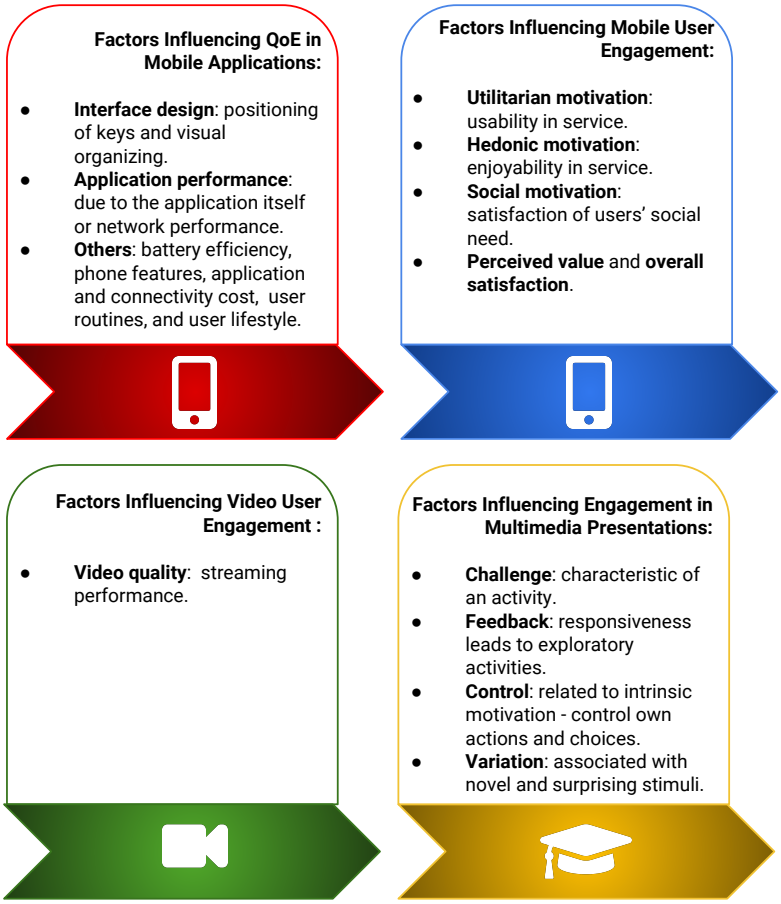


Figure 2.3: From left: Factors influencing QoE in mobile applications [3], factors influencing mobile user engagement [4], factors influencing video user engagement [5, 6], and factors influencing engagement in multimedia presentations [7].

Along with the attributes presented in Section 2.1.1, these factors can provide more meaning to the concept of user engagement. They include both technical factors (red and green list) and non-technical factors (blue and yellow list). By possessing this kind of knowledge, one can develop more valuable and profitable technology, as shown by Shafiq et al. [6] whose research resulted in a model useful for network operators to optimize their infrastructure in order for improved user engagement. There is thus a potential for developers and service providers to exploit and tap into the existing knowledge on (principles of) user engagement. However, this implies that

they need insights into measures and methods that can be used for user engagement measurement and that they need to be able to adapt these to their specific context

2.1.3 Measuring user engagement

Despite the multiple definitions out there, there seems to be a consensus in the literature that user engagement is complex. It is composed of different factors and attributes, depending on the context in which user engagement is assessed, as already explained. To measure how engaging user experiences in web services are can, therefore, be done in different ways. What is clear, is that we need methods allowing to capture the cognitive, emotional (or affective), and behavioral aspects of users' experiences. That, in addition to users' own perceptions, makes user engagement both "in the moment and a product of the users' reflections and evaluations of their interactions with technologies [19]." Measurements can either be subjective or objective. The subjective measurements are interested in capturing the users' experience and can cover a wide range of engagement aspects, generally through self-reports. The objective measurements, on the other hand, tends to aim at more specific aspects of engagement. They overcome the main limitation of self-reports - the need to rely on the users' subjectivity. Nevertheless, both approaches with several methods can be used to capture the three dimensions of user engagement in an interaction: the cognitive, emotional and behavioral engagement, as previously explained in Section 2.1.1.

Table 2.2 provides a summary of different types of metrics and methods used to measure user engagement found in the literature:

Type of UE measurement	**Description**	**Metrics and methods**	**Ref.**
Self-reported engagement measurement (subjective)	Can be used to gain insight into users' own perception of an interactive experience and often used to elicit engagement attributes. Can also be used to collect data about users' affective states, and behavior.	Typically, surveys, diaries or interviews are used to evaluate a post-experience interaction to capture engagement attributes or other aspects of user engagement.	[9, 11, 15]

Physiological engagement measurement (objective)	Measures users' unconscious, bodily reactions during an interaction with the use of sensors or other electronic devices used for physiological measures. Their physiological state can indicate some of their cognitive, affective and behavioral state.	Eye tracking can be used to capture the eye movement and pupil dilation, Electrocardiography (ECG) can track the heart rate and electrical activity of the heart, Electroencephalography (EEG) can provide indications of engagement, cognitive effort, emotional states by measuring electrical activity of the brain; and other electrodes attached to body (e.g., electromyography (EMG) can measure muscle activity (e.g., in the face). Physiological states as feeling stressed or relaxed, or explore users' attention can be detected and somehow reflect how engaged a user is.	[15, 17, 19]
Behavioral engagement measurement (objective)	Evaluates user engagement through objective observation of an interaction. Users' pattern of thinking can be detected by observing their behavior, which again can reveal their cognitive, affective, and behavioral state (depending on the method used).	Performance indicators and task-based methods are typically used to record the users' usage. For online engagement, indicators such as click-through rates, views per page, number of unique users, and time spent on site have previously used. In video streaming, one has used abandonment rate, video skip rate, total play time, and the number of videos viewed. For task-based methods, measures such as time on task, and how well a task is done if given immediately after another engaging task (follow-on task) have been used. Transaction logs have also been announced as a method to measure the behavior of users. Finally, tools for automated facial expression recognition can be used to investigate users' affective states.	[5, 6, 17, 19]

Table 2.2: User engagement measures explained in the light of three measurement types.

For this thesis, we focus on the self-reported engagement measurement. Self-report data have been gathered and analyzed in many domains to extract underlying structures in different settings, e.g., measurement of what leads to continuous usage of mobile applications [28] and motivations of online shoppers [29]. Some of these researches focus on measuring users' perception of specific features, e.g., functionality and design, whereas others use self-report scales to measure how important certain attributes of user engagement (e.g., Focused Attention and Perceived Usability) are in certain settings. One study in from the latter category is O'Brien and Toms' [9] work on developing a survey to measure user engagement, named the user engagement scale (UES), which we will address further.

2.1.4 The user engagement scale (UES)

Seeing the necessities of being able to ascertain that technological services incite engaging experiences, O'Brien and Toms [9] constructed a scale to measure user engagement in software applications, building on previous studies examining what attributes user engagement is composed of. Using online shopping environments as a domain to examine user engagement in, six user engagement attributes were identified (listed and explained in Section 2.1.1). Through two studies, the reliability and validity of the findings and the relationship between the attributes were tested. Later, the scale has been used to measure user engagement in other domains as well, thoroughly presented by O'Brien [30]:

- Online Search: UES used to help researchers gain an understanding of search behavior and system preferences among users when searching online.
- Online News: UES used to examine the relationship among the attributes, in addition to examining user experience with regards to "the presentation of news search results or how people might “think” about news content [30]."
- Online Video: UES used to examine the relationship between user engagement and interest. Results showed that the better perceived video quality, the higher the engagement was.
- Educational Applications: UES used to provide a better insight into user engagement in different educational domains.
- Haptic Applications: UES used to reveal differences in users' perception of interacting with gadgets when the interaction provides haptic (vibrations or motions) and non-haptic feedback.
- Consumer Engagement: UES used to assist researchers in testing consumers' perception of various things, for example, brand logos, ads, and quality of information perceived.

- Social Networking Applications: Amongst others, UES used to reveal a higher engagement when using Facebook on mobile devices instead of on computers.
- Video Games: UES used to look at perceived engagement among users of video games, yet failing as a good measuring.

In these studies, the UES have either been used in its entirety, or sub-scales (i.e., items related to a specific attribute) of it have been used alone or in combination with customized items related to the specific context user engagement was examined [30]. The wide range of domains the scale has been used in might illustrate both its importance and its generalizability. Moreover, this might support the assumption that the scale can also be used in this study to measure user engagement in Kahoot!. More on the use of UES in this research is further outlined in Section 3.5.1. The entire scale can be found in Appendix A.

User engagement has not only been viewed as an aspect of users' experience (and its quality) and a construct of interest in human-computer interaction but has also been a focus in educational settings. Several studies have looked at the importance of engagement in classrooms, and how students engage in both the teaching and in classroom technologies, such as Kahoot!. The subsequent sections elaborate on this area.

2.2 Increasing student engagement with classroom technology

With a constantly changing world, there is a reason to believe that the strong interest (both in research and at the policy level) into understanding what ideal learning environments should be like will last. That is, how learning technology tools are actually used and how they should be developed in order to trigger engagement and enhanced learning. Blessinger and Wankel [31] have introduced the concept "classroom-mediated discourse technologies" and defined it as "a set of technologies that facilitate student participation in learning activities in the classroom." Previous studies have investigated how the use of classroom technology (e.g., computers, digital whiteboards, projectors, digital cameras, etc.) can improve student engagement. That is, by "challenging traditional pedagogical practices and lectures by stressing the need for increased interactivity and mobility and a wider range of learning context to support the cognitive and social processes of learning and knowledge construction [32]."

Positive engagement among students is found to be related to their participation and motivation in classes, which again is linked to their learning outcome [10]. The value of how successful classroom technologies are, has, therefore, often been weighed

up against students' academical performance and grades. Similar to measuring user engagement through specific metrics, as described in Table 2.2, student engagement has been measured using metrics such as attendance rate [11], graduation rate and drop out rate [33]. What is more, is that student engagement can, like user engagement, be viewed in the light of cognitive, behavioral and emotional aspects of engagement. Lim et al. [11] have described cognitive engagement as "student psychological investment in learning," behavioral engagement as "student participation in classroom activities," and emotional engagement as "student affective reaction in classroom." Based on this, we conclude that student engagement is related to user engagement. Yet, student engagement differs from user engagement in assigning users a role in the learning environment, namely the role of a student. Similar *role assigning* can also be seen in studies concerned with users' consumption behavior or engagement with a brand, where the concepts of customer or consumer engagement have been used to define the users' role (see [4] and [28]). The focus is thus still on user engagement, but in more specific contexts, the users are assigned concrete roles (students in this case) with distinct characteristics. These different role qualities stress why user engagement is complex and depends on the context it is being viewed in.

New ways of interaction and teaching in classrooms are made possible with technology, and for integrating technology in classrooms, a relatively new trend has emerged, exploiting the prevalence of mobile devices [34]. Bring Your Own Device (BYOD) lets students use their personal smartphone, tablet or laptop in the learning environment, making fully interactive classrooms as every student will have computer access. Further, "students become active participants in learning both in and outside of the classroom setting by enabling employees and students to use their personal devices and connect with school/employers network [33]." Positively exploiting the fact that students bring own devices to school, might be the direction towards increased student engagement. A possible outcome of the BYOD trend is the growing use of several student/classroom response services and applications (to be used on student's own devices) over the last years.

2.2.1 Student response systems

Student response systems (SRS) and classroom response systems (CRS) are among other services examples of classroom technologies. SRS differs from CRS in the sense that they are also an online response system [35] (and we will further use SRS as a general term). SRS have been defined in various ways, but the key aspect of such systems is that they can be used as tools for instructors (i.e., teachers) to give interactive lectures by posting questions during classes, and collect and analyze the students' responses through an application (see Figure 2.4). Historically, the interaction in SRS have been enabled by "clickers" - a system composed of remote

electronic controls [31]. However, the BYOD wave has lowered the cost of adapting SRS in schools, as students can use their own mobile devices instead of clickers funded by the school itself [33]. In addition, most SRS today are web-based applications that the teacher and students access via interfaces, only requiring online access and no further set-ups [32]. This, in turn, makes it possible to engage larger audiences/classes and provide instant feedback to everyone [36]

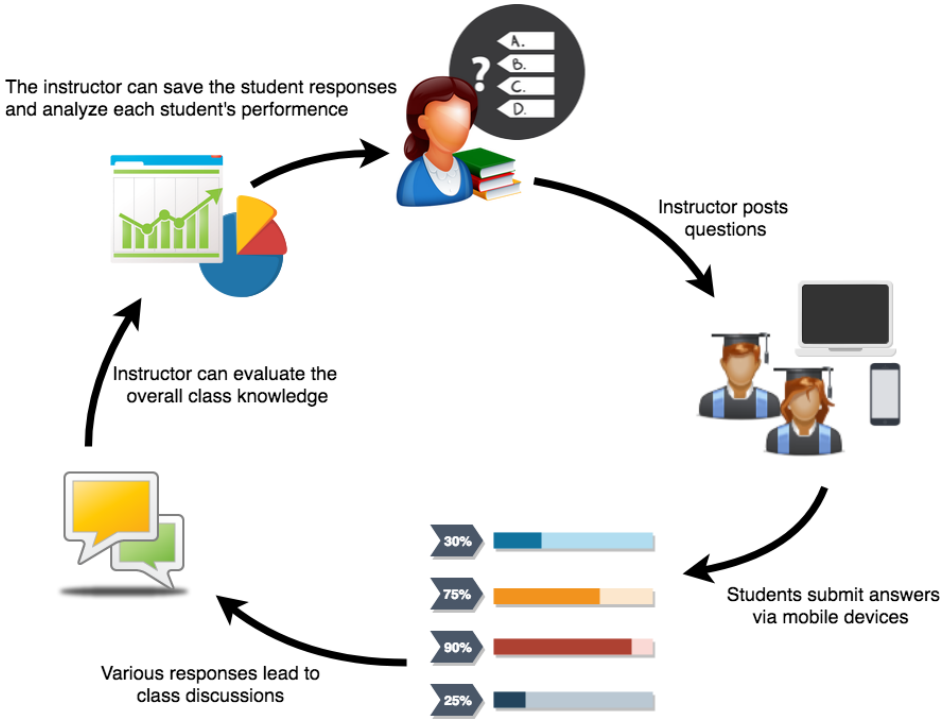


Figure 2.4: A general SRS.

Several advantages of using such systems can be found in the literature. Enhanced learning can be achieved by giving students a more active role in the classroom [35]. Additionally, students' attendance, attitude, and engagement in a course can be improved [36]. These advantages are supported by students' ability to get instant feedback, whereas students, to a greater extent, can learn from sessions, as the assessments are fresh in mind (contrary to traditional assessments where results are, sometimes, given the next week) [31]. This student-centered way of teaching can trigger discussions in class based on the various answers given. Further, SRS give students the opportunity to answers questions without raising hands, which facilitate student engagement and participation among modest students as well. To give some examples, SRS can be used by instructors to introduce new subjects and evaluate

what knowledge the students already have on the area (and hence adjust the what to be taught), or to test students' knowledge after a class to see what they understood from the lecture, among other things.

Research on the impact SRS have on engagement has been conducted in many settings. Dunn et al. [36] examined the use of the SRS "VotApedia" in a first-year class, where students responded questions using their mobile phones. The results indicated higher participation in the course, increased activity in class, and better attention and concentration during lectures. Similar findings are provided by Wu et al. [32], where the mobile-based SRS "ZUVIO" was used in an entrepreneur class. The research revealed students' experiences when using the SRS, with outcomes as enhanced engagement and a perception of the learning as "innovative, active and deep." However, their study introduced limitations in the use of SRS, which again could lead to lack of engagement: technology issues and pedagogical issues. The former was related to network connectivity, which could disrupt the learning flow if not stable, and incite frustrated and distracted students. The latter referred to the how learning can be maximized with the right approaches, but be less valuable if instructors did not have sufficient educational weight and knowledge about technology use, or did not engage properly in the technology. These findings emphasize an important point of using, not only SRS, but also classroom technology in general: there are certain disadvantages of using technology in learning environments as technical issues can occur, and those bringing technology to classrooms might not properly know how to utilize such systems for learning purposes. The findings of Wu et al. [32] show that when classroom technology systems do not work properly, they can have the completely opposite effect of what was intended, with frustration and not focused students, instead of engaged and motivated students. Similar findings have been reported by Sunde and Underdal [37], whose thesis showed that students experiencing delay in SRS (more specifically Kahoot!) were more annoyed than students not experiencing delay (who rather felt delight). Their study will be addressed in more detail later.

As engagement incited by classroom technology seems to have some similar characteristics as user engagement, we found it interesting to investigate different SRS to see how they facilitate user engagement. We thus picked out two SRS with roots in Trondheim to include in the research: ONE2ACT [38] and Kahoot! [8]. Further investigation disclosed that ONE2ACT's SRS was no longer in development, only in maintenance due to lack of necessary resources [39]. We, therefore, decided to bring more attention to Kahoot! in the research questions, which still is evolving and growing in the number of users. However, as both systems were investigated in the first phase of this research (see Methodology), we now briefly discuss the main characteristics of both ONE2ACT and Kahoot!

2.2.2 A brief outline of ONE2ACT

ONE2ACT is an online system for academical purposes, consisting of four services. More concretely, a student response system (SRS), a peer learning evaluation (PeLe), an evaluation system (Eval), and an assessment system for learning languages (iLike), all based on the response system concept. The ONE2ACT's SRS can be compared to traditional SRS, similar to Figure 2.4. Also, this SRS allows students to use their own devices to participate in voting. A typical scenario of using ONE2ACT's SRS is a teacher asking instant, spontaneous questions in class, and students vote on alternatives given by the teacher. A graph can be shown on the classroom screen, showing the distribution of answers. Such a system might help the teacher in adjusting the learning objectives in compliance with the students' attitudes or knowledge toward a subject [38]. Conveniently, ONE2ACT originates from former HiST in Trondheim, which, in turn, made it easy to get in contact with one of its developers, Prof. George Adrian Stoica, for questions regarding user engagement in ONE2ACT. Stoica and his colleagues work on guidelines that can be used to make successful user experience design of interactive classroom systems [40] has been used in this research to support the preliminary assumptions regarding user engagement's importance when developing new technology. In their opinion, the main fundamentals to make successful user experience designs, according to [40], are:

- *"deep understanding of the users' tasks and workflows that can be acquired through subjective and objective methods"*,
- *"integration and complementarity rather than radical change conserving time and control"*,
- *"minimalist and forgiving classroom interfaces that ideally allow users to forget about technology and just focus on the task"*.

ONE2ACT can definitely be used in classes to give more varied and interactive lectures. Yet, the SRS lacks a concrete element to trigger user engagement to another dimension by making users more focused, almost immersed, to the specific session or task. In this respect, a *game* element can awaken feelings among users and create a higher engagement level than in SRS not having this element integrated. Kahoot! is one of such SRS that - through its game element - has become a worldwide known application for creating engagement, especially in classrooms.

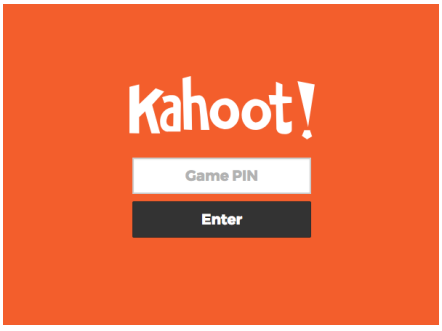
2.3 Kahoot!

From only being a research project starting back in 2006 [12], Kahoot! has managed to become a successful classroom technology played in over 180 countries [8]. Beyond

being an instance of SRS, Kahoot! is designed to provide game-based learning. This is enabled by *gamification*, "the idea of using game design elements in non-game contexts to motivate and increase user activity" [41] as game designers have mastered how to trigger engagement and motivation [42]. In short, Kahoot! is a peer-instructor online quizzing system, letting students respond to questions in lectures by using their own mobile devices (enabled by BYOD) to access Kahoot's own application or the online interface. The classroom will transform into a game show and generate more energy and engagement than traditional SRS [34]. According to Kahoot!'s inventor, Wang [34], "the idea is that when you learn through games, you are so engaged and motivated that you are learning even you are not aware of it." Therefore, Kahoot! is commonly referred to as a game-based student response system, or GSRS.

2.3.1 A Kahoot! session

On Kahoot!'s website (https://kahoot.com/), students and teachers/educators can access a large amount of pre-created public games and quizzes for academical purposes to be played in classrooms for free. What is more, is that they can also create private accounts to make customized game-based quizzes, surveys, and discussions, adjusted for specific learning purposes. Students can then join a Kahoot! session by using a unique pin to access it, either in their downloaded Kahoot! application, or on Kahoot!'s web interface (https://kahoot.it/) (see Figure 2.5a). Students can play in single mode or team mode, opening up for collaborative learning. When all joined students have answered or the pre-set time (chosen by the instructor) has expired, the correct alternative is highlighted on the instructor's screen, and the range of answers are displayed as result bars.



(a) Students enter a game pin to join a Kahoot! session.

(b) Questions appear on screen, the alternatives are chosen in the application/web interface on students' mobile devices.

Figure 2.5: The Kahoot! application [8].

The competition aspect stands tall in the application. It collects the individual students' answers, and ranks them in a scoreboard, showing the best five players (see Figure 2.6). Results can be used to elicit discussions based on the students' answers (when there is no right or wrong) related to their attitude or opinion towards something. Results can also be saved by the instructor or the students for later use, or shared with others.

Figure 2.6: Scoreboard in Kahoot! [8].

2.3.2 Game elements

We earlier described attributes of user engagement in technology (Table 2.1) which, to some extent, are present during an engaging experience. Research has shown that similar engagement attributes (complemented with additional ones) are found in specific contexts such as when being educated in classrooms, and when playing video games [1]. As reported by O'Brien and Toms [1], "education researchers have emphasized that engagement should be a pleasurable experience that involves intellectual challenge or stimulation." Additional characteristics of engaging educational systems found include enjoyable (fun) situations, ease of use, aesthetic appeal, choice, challenge, variety, interactivity, and feedback, "through the use of different multimedia components including text, graphics, and sound [1]." Similar attributes/aspects are found in studies concerning characteristics of engaging video games: feedback, intrinsic motivation, fun, user control, and interactivity [1].

By combining the knowledge of how users engage when using educational systems and video games, researchers have found that user engagement can be increased in learning environments by adding game mechanisms from traditional video games [42]. This is really the main essence in Kahoot!. The GSRS has been successful in combining engagement attributes, identified in both educational and game research,

and in adding game mechanisms to increase user engagement in the educational application so that learning is suddenly fun.

Several so-called "game mechanisms" in gameful designs have been identified, listed below:

- Feedback: learning is supported by giving frequent assessments/ratings after completion of levels or stages. This feedback can be visualized by, for example, graph bars (as in Kahoot!) [10].
- Problem solving or a challenge with uncertain outcomes. In Kahoot!, this can be to answer the questions correctly [12, 42].
- Leaderboards: students can "make a self-assessment as to the mastery of their own ability" [10], and compare themselves with other students. Can be used as a tool for providing competition among the students by triggering their intrinsic motivation (scoreboards are used in Kahoot!, see Figure 2.6).
- Points, rewards, levels and/or achievements/badges: tools to trigger extrinsic motivation, in addition to concrete feedback based on performance or behavior (students are awarded points based on their answering in Kahoot!) [10, 42].
- Music, graphics, and colors [12].
- Surprise and unexpected delight, or curiosity (the announcing of whether the user's answer was right or wrong in Kahoot!) [12, 10].

Most of these features are somehow integrated into Kahoot!, which possibly explains why Kahoot! gives its users the feeling of playing rather than learning.

2.3.3 Previous research on Kahoot! and engagement

As Kahoot! is a popular application for classroom use, there has been done a numerous number of studies that look into how Kahoot! and other similar systems enhance learning environments. We have gathered a handful of related work done, and we further recommend a thorough review of these if more comprehensive research about the concept of user engagement and previous work on it is to be carried out a later time.

Title	Description	Ref.
Investigating QoE in a Cloud-Based Classroom Response System	In this master's thesis, the user-perceived QoE in Kahoot! was investigated. The focus was on the affect the QoE parameter delay had on users. Results showed that this parameter was related to the users' experience, and triggered feelings of annoyance.	[37]
The effect of points and audio on concentration, engagement, enjoyment, learning, motivation, and classroom dynamics using Kahoot!	This paper presents the results from a conducted experiment, investigating "how the use of points and audio affect the learning environment," using Kahoot! as the platform for the experiment. The results were positive, showing that the learning environment was positively affected the students' concentration, engagement, enjoyment, and motivation.	[12]
The Effect of Digitising and Gamifying Quizzing in Classrooms	This article presents the results of an experiment, comparing a GSRS (Kahoot!) with a non-gamified SRS and a formative assessment on paper. The results did not show any significant improvement in learning by using a gamified SRS but showed improvements in students' motivation, engagement, enjoyment, and concentration.	[13]
Application of Gamification in a College STEM Introductory Course: A Case Study	This comprehensive work address students' experiences when doing course activities, with focus on gameful design. Kahoot! was used as the example of an application of gamification that increases engagement. Results disclosed five engagement themes: intellectual, emotional, behavioral, physical, and social engagement.	[10]
Measuring User Engagement in Mobile Classroom Response System: A Case Study	In this paper, temporal dynamics of user engagement were studied by examining Kahoot!, and interaction logs and diary logs as methods to gain insight into user engagement. The interaction logs tracked the students' usage of Kahoot!, while the diary log captured their feelings and attitudes, and linked it to the engagement attributes (see Table 2.1). The study was conducted as a contribution to researchers for understanding why students engage in lectures.	[11]

Table 2.3: Research including Kahoot!.

From this, it is clear that some research on Kahoot! has already been done. However, information about negatively influencing factors on user engagement, and technical factors ,in particular, lacks in existing work. As such factors can be a barrier for users to really engage in services and applications, we aim to investigate the importance of considering them in this thesis (see RQ3 in Section 1.2). The recent work of Sunde and Underlaug [37] (as addressed earlier), however, is one of few studies examining the impact of technical issues on the users' perceived experience. Though user engagement is not their field of interest, their findings on the impact the network issue *delay* has on QoE when using Kahoot!, might also indicate how exposed user engagement is to such network issues as well, due to its strong relationship with QoE (described in Section 2.1.2). Nevertheless, as general and technical factors influencing user engagement do not seem to be present or in focus in previous studies, there is reason to believe that they are not that important in engaging user experiences. To investigate whether this is really the case is one of this thesis' research tasks which we will discuss later in Chapter 5.

This chapter described user engagement as a concept, including associated attributes and ways to measure it. This was followed by an introduction to classroom technology, and student response systems specifically. Lastly, Kahoot! was presented in detail, also covering the game aspect of it and how it triggers user engagement. Given this background, more on how this research has been conducted will be explained. That is, the research questions are reviewed, the methods chosen are described, and the analysis process and tools used are pointed out.

Chapter 3
Methodology

In this chapter, we will give a presentation of the research methodology used. We do this by providing a thorough description of the prime objective and the supplementing research questions to be answered. Next, we argue for the chosen methods for tackling these research questions and discuss their abilities in this specific thesis.

The research approach is heavily inspired and partly based on disciplines and strategies suggested by Colin and Robson in Real World Research [43]. In general, the focus is on advancing the theory of existing areas in a systematic but flexible way [43]. The authors argue that the purpose of doing research is to either explore, describe and/or to explain [43]. This idea forms the objective and main tasks of this thesis and is evident in the following sections.

3.1 The goal, research questions, and main tasks

The goal of this thesis was to investigate the concept of user engagement in the domain of SRS, and particularly in GSRS. That is, to explore which elements trigger and influence user engagement in GSRS. The study started as a pre-project [39], lasting from September to November 2017, and it was initially issued as a study comparing two SRS which both trigger learning through engagement. Still, they had distinct functionalities and a different "look and feel," which would make them interesting to compare. However, due to later research information, the direction of the master's thesis was altered in favor of one of the SRS, specifically Kahoot!. We addressed this process change in more detail in Section 2.2.1.

To narrow the project scope and include Kahoot! in the thesis' focus, the following goal was defined:

The purpose of the thesis is to investigate the concept of user engagement in the context of SRS, specifically in Kahoot!.

As stated in the introduction, previous research concerning Kahoot! seem to focus on the students' view. It was, therefore, desirable to include the teacher's and developer's view as well when deciding on strategies to approach the set research goal. In that way, user engagement can be studied in a more diverse and complementary way in Kahoot!. This approach of adopting several perspectives when studying user engagement might also be beneficial and applicable in other fields and application domains.

Before deciding on which research paradigm and which specific methods were most suitable given the research goal, we needed to have a more defined project. This was accomplished by raising three research questions to explore and explain [43] some specific parts of our objective. In addition, setting research questions can be a helpful tool for defining success, (i.e., to know whether results answers the questions adequately) and to limit the project scope (i.e., ignore what is not relevant for the questions) [43]. By setting the research questions before choosing the research design, we avoided constraints on what questions we could ask. Also, the questions are formulated in a way so that answering them is feasible. The research questions are as follows:

RQ1: Why is user engagement important in SRS?

> According to the literature, SRS trigger engagement among its users and Kahoot! is no exception. But how important is it that the users get engaged in SRS, and specifically in GSRS? Or is the user engagement not that important at all? These subquestions were to be investigated.

RQ2: Which aspects of user engagement are being taken into account when developing GSRS in general, and Kahoot! in particular?

> It might be interesting to see if there are any common aspects of user engagement, found in the literature, that are integrated into SRS in general and in Kahoot!. To which extent are these aspects necessary for having an engaging service? And can new aspects be identified by a close investigation of Kahoot!?

RQ3: Which factors, in general and of technical nature, influence user engagement in GSRS, and specifically in Kahoot!?

> This question is considered the most important because of its possible concise and explicit answers. A clear list of factors that influence user engagement in Kahoot! might be adapted to other similar services to enhance user engagement, and is then a definite contribution to existing literature.

A mixed methods research design with three main studies was conducted to tackle the research questions:

- **First study:** Review of existing literature to gain knowledge about the concept of user engagement from previous studies and identify the main aspects to consider. Also, use the literature to obtain a state-of-the-art view of to what extent ICT services have included the user engagement aspect, e.g., gaming applications, social media, educational services (SRS in particular), etc.

- **Second study:** Interviews with two SRS developers: one from Kahoot! and one from ONE2ACT. These in-depth conversations were conducted to have the developer's view on user engagement in SRS. These interviews were then transcribed, analyzed and coded so that they could be used to support findings in the literature and supplement an additional study later.

- **Third study:** Construction of a self-report study including, amongst others, an already validated user engagement scale [9]. The main target group consisted of teachers and students in high school or higher education. With this questionnaire, we could gain better insights into user engagement in a specific SRS, specifically Kahoot!. Besides, we could investigate elements that trigger or influence user engagement in Kahoot! from both the student's and the teacher's perspective.

The central theme of the subsequent sections is to review the tasks above by describing in detail how and with which methods they were conducted.

3.2 Mixed methods research

How should the research process be entered? What are the best methods to use for answering the research questions? To embark on the research, we saw it as necessary to have some clear strategies in order to address the above-mentioned questions in a targeted and rigorous way, i.e., have a research design. Designing research involves to make plans on several decisions to be made in a research process, "from broad assumptions to detailed methods of data collection and analysis" [44], i.e., make strategies for how the topic field should be studied. This explanation rather assumes that research is carried out in systematic and careful order. There are several ways to conduct research, but the question whether researchers should use quantitative or qualitative research approaches has been widely debated in the past years and has been characterized by two opposite camps. Recently, a historically less acknowledged and disputed research paradigm has accompanied the other two: the mixed methods research paradigm [45, 46]. This kind of research design is based on a more pragmatic view, which can be described as a philosophical basis where researchers can choose among all possible approaches to meet their needs and purposes, without having to limit to only the quantitative or only the qualitative research paradigm [46]. This

pragmatic view is based on an acknowledgement that both quantitative and qualitative approaches have their advantages and shortcomings. This for best answering important research questions [45], independently of other philosophical systems for conducting research [44]. Johnsen et al. state that pragmatism, through values or standards and a combination of methods and ideas, "offers an epistemological justification and logic (...) for mixing approaches and methods" [46]. Mixed methods research has been defined in a number of ways. However, these definitions all seem to agree on that mixed methods research unites elements from other research approaches, e.g., qualitative and quantitative research [43, 44, 45, 46]. One definition is given by Johnsen et al. [46]:

> *"Mixed methods research is the type of research in which a research or a team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding a corroboration."*

What is clear is that choosing mixed research methods gives the researcher the freedom to combine several methods to answer his or her research questions in the best possible way. On one side the researcher can exploit the benefits of quantitative research, e.g., make generalizations and predictions in a deductive way based on extensive data collecting [47]. On the other side, the researcher can also make use of the benefits of qualitative research, e.g., inductive in-depth studies to get an understanding of people's view or experience of a field of interest [47].

Table 3.1 summarises some strengths and weaknesses of a mixed methods research design found in literature:

Strengths	**Weaknesses**
- Adapts the strengths in quantitative and qualitative research (e.g., obtain precise, quantitative, numerical data which can be generalized and is relatively independent of the researcher in quantitative research. Also, gather data in naturalistic settings, be responsive to changes in the research, study in-depth cases which takes account for the complexity in a phenomenon studied and its context in qualitative research.)[45]	- Time and resources must be spent on learning several research methods and how to use them together. As both time and resources are limited in a research process, carrying out a mixed methods research can become a challenge [45].

- As the researcher is not bound to use specific methods, one can obtain more complete knowledge and address a broader range of research questions [43, 45].	- It can be challenging for a single researcher to conduct both qualitative and quantitative concurrently, a research team may be required [45].
- The chance of missing insights and understanding is limited as the researcher is not confined to any approaches [45].	- To receive support from other researchers can be a problem as "methodological purists contend that one should always work within either a qualitative or a quantitative paradigm" [45].
- Validity can be enhanced with triangulation, i.e., correspondence between quantitative and qualitative data [43].	- Time can become an issue as conducting quantitative studies often have a quicker timing implication than qualitative studies have [43].

Table 3.1: Strength and weaknesses of mixed methods research.

Seeing the advantages of using the mixed methods research design, we decided on having an open and non-strict research process, i.e., to combine multiple research methods so that the research questions can be answered in the best possible way. As the research goal is to *investigate the concept* of user engagement, we argue that it makes sense to include all research approaches that can provide breadth and in-depth understanding of that concept, independent of any paradigm systems. Hence, doing a mixed methods research conforms to that goal. As already mentioned, this included doing interviews and developing and distributing a questionnaire. One could argue that these methods alone do not allow to adequately answer the research questions set to investigate the user engagement concept and that they should be complemented or replaced by other methods. To set up and conduct an experimental laboratory study was considered, similar to Sunde and Underlaugs' [37], described in Section 2.3.3. While their research consisted of experimental laboratory studies (among others), testing hypotheses under artificial circumstances, the study described in this thesis focuses on doing an exploratory research to investigate the concept of user engagement in a specific setting. In addition, experimental lab settings do not necessarily capture the wide range of engagement aspects we do know exist (see the previous chapter). An experiment implies manipulation of carefully selected, pre-determined variables/factors, based on explicit hypotheses which are tested in unnatural usage conditions. This strongly narrows the way user engagement can be investigated in. In addition, experimental studies are time- and resource-intensive, and require access to suitable lab facilities and equipment, which were also aspects that were considered. To summarize, we argue that doing a similar study to the

study reported in [37], though with a different approach, can contribute to existing literature on users' quality perceptions when interacting with technology, in this case on user engagement in Kahoot!.

Following Johnsen et al. process model for mixed methods research [45] throughout the research, we thus had systematic progress stages with clear tasks ahead. Figure 3.1 shows, in addition to the eight steps, when each step was processed. The steps included in the blue rectangle was conducted in the pre-project [39] phase, while the green rectangle surrounds steps conducted in the prime period for carrying out the master's thesis. The overlap of the steps "Select the mixed method research design" and "Collect data" indicates that the research process has been floating/overlapping, with focus on one specific method in the pre-project [39], and other methods in the master's thesis. In an early research stage, we started with the most feasible study at that time – a review of existing literature. The reviewing was followed by interviews with developers (and professors) of two different SRS, Kahoot! and ONE2ACT. Later, utilizing the flexibility of a mixed research method, we could supplement the two former studies with another method for investigating the research questions: distribution of a questionnaire. This approach can be described as a sequential exploratory design as we initially started with a qualitative study of data collecting and moved over to a quantitative phase [43]. We did this to expand the findings of the first phase with findings from the other method [44]. In the following sections, the above-mentioned studies are presented.

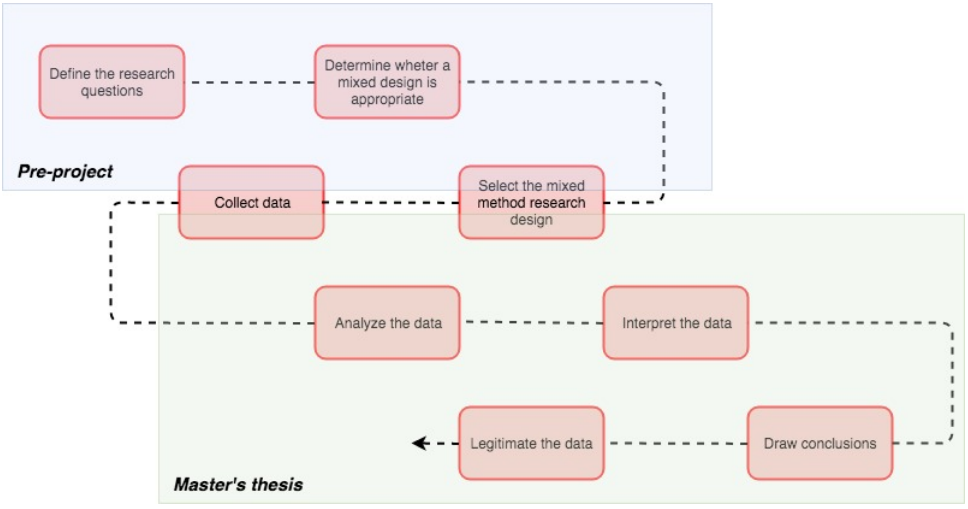


Figure 3.1: A framework illustrating the mixed methods research process model and its eight steps [45].

3.3 Literature review

A central part of both the early research phase and later study has been to locate and analyze information of interest in various documents, articles, dissertations and other literature. There are many reasons for doing literature reviews, one of them to provide a comprehensive summary of the literature and work in the relevant field of study [48]. Conducting this form of study can also provide general patterns, define terminology, and identify various definitions in a research area [43]. Overall, knowledge from literature review can be helpful for defining research goals and setting research questions [43].

3.3.1 The literature review process

Inspired by the steps presented by Cronin et al. [48], we could conduct a systematic literature review, later to be used as background material for this thesis:

Selecting a research topic was done at the start of the research process in collaboration with the responsible professor and supervisor of this thesis. It was considered important to select a topic in which there was sufficient associated literature and previous work that could be found.

Searching the literature began with retrieving recommended articles as a starting point. This was followed by further information searching in Google's academical electronic database, Google Scholar[1], and NTNU's online library, Oria[2]. Boolean operators and carefully chosen keywords used to confine the number of search results. Moreover, using the reference list of already gathered academic work turned out to be quite useful. The reference list gave an overview of related work to the topic searched for and the referenced work was often more detailed about a specific part of the topic discussed.

Gathering, reading and analyzing the literature was time-consuming. Thus, the focus, in the beginning, was on reading the preface and conclusion of the literature found to remain an efficient way of conducting the literature review. For this reason, we could exclude irrelevant information and sort literature into categories of central themes. Later, we could use the categories to pick out information of interest, e.g., definitions, quotations, descriptions, etc. While reading, personal notes and text marking was undertaken to keep the fresh understanding written down so that the text didn't have to be read as thoroughly at a later time.

[1] https://scholar.google.no/
[2] https://www.oria.no/

Writing about the most relevant findings from reading the literature can be found in Chapter 2. Background and Related Work provides a summary of the literature review and highlights gained knowledge. The categories mentioned above form the conceptual framework/structure of the review.

References were gathered while searching for relevant literature. Most electronic databases and online libraries offer ready-made citations that can be copied into the thesis' reference list.

3.3.2 Reliability and validity of a literature review

Cronin et al. suggest that the reliability and validity of a literature review can be seen in the light of how the reviewer presents criteria and framework for several aspects [48]. That is, how the reviewer has criteria that were used to "formulate the research questions, select and access the literature, (...), assess the literature quality, analyze, synthesize and disseminate the findings" [48]. Another view focus on three fundamental purposes of literature review in which their fulfillment corresponds to the validity: 1) show readers that one is familiar with existing literature in the research area, 2) identify key issues and gaps, and 3) provide an understanding of principles and theories given in various literature [49]. Both perspectives were taken into account when doing the literature review for the thesis.

While conducting the literature review, the planning of the second study was commenced. Further description of this phase is given in the subsequent section.

3.4 Interviewing two SRS developers

When deciding on the research design (the strategy that will be used to answer the formulated research questions), it is crucial to identify proper techniques and (a) suitable method(s) for collecting the information/data that can result in useful findings. The time was limited in the pre-study [39], so to find a feasible method for gathering a sufficient amount of data was challenging. Tjora [50] has listed some guiding questions regarding practical conditions/issues which are important to consider when choosing a method:

- *"What practical options do you have for conducting interviews, observations, or surveys?"*
- *"What access to informants/participants in the relevant environment do you have?"*
- *"What resources (e.g., persons, money, time and aids) are available for conducting the research?"*

- *"What knowledge, experiences, interests, and motivations do the informants/-participants have?"*

Taking these questions into account, we considered it more feasible to carry out a potential larger-scale study in the later master's thesis phase. However, in order to gain initial insights into user engagement considerations in response systems, it was decided to run a small exploratory and qualitative study already in the pre-project [39]. More concretely, two semi-structured interviews with two developers of SRS, both located in Trondheim, were conducted. Thus, a study could be carried out in spite of the lack of available time, and we could take advantage of having two prime resources (the developers) in the same city and free of time to be interviewed.

In the following section, a brief intro to qualitative research and a short description of semi-structured interviews as a qualitative/mixed methods research method are given.

3.4.1 A qualitative approach: interviews

Interview as a method is situated under the umbrella of qualitative research. It is a context-sensitive [50], flexible [43], and time consuming [43] way of gathering data. Qualitative research can be characterized as gathering of data from samples of individuals or groups of people [51], where data is in a non-numerical form (words for instance) [43]. In addition to interviews, observations and focus groups are also common practices in qualitative research.

In the case of user engagement, previous studies have adopted both qualitative and quantitative research approaches, analyzing different types of data from users of a given system [1, 5, 17, 28, 52]. The dominant focus has in this respect, and as mentioned earlier, been on the "use/audience/consumption"-perspective. However, the SRS developers' point of view may also be very valuable to consider and may provide insights that are relevant in the light of the formulated research questions. Naturally, the developers have a lot of knowledge about the topic and have made certain choices along the development process. For the exploratory pre-study [39], it was, therefore, decided to interview the developers of two different response systems: Kahoot!, which we focus more specifically on in this research, and ONE2ACT (see Section 2.2.2).

3.4.2 Semi-structured interviews

Semi-structured interviews are one type of interviews fitting within the qualitative research tradition and especially useful also in mixed methods research. Tjora [50] explains that the goal of this method is to gain knowledge and understanding of a

topic by creating a situation to promote a free conversation and sometimes raise a discussion, circulating some predetermined subjects. He further argues that by creating a relaxed atmosphere, the informant will likely reflect on own experiences and opinions on the relevant topic related to the research. The use of semi-structured interviews is especially useful when the availability of numerous interview objects are limited, and the knowledge in the topic field is poor. An additional advantage of using the semi-structured interview as a method is that it provides the opportunity to use the information provided by the interview object to delineate the research scope [50].

Typical for qualitative research, is the quest for enriched and in-depth answers to "how", "what", and "why" questions [47], as is especially relevant in the light of the research questions set in this thesis. Along with the open-ended questions semi-structured interviews provides, this method was thus regarded best suitable for the case of having only two developers as informants. With such a limited number of sources, it was necessary to have an interview model that facilitated the need to go beyond the pre-determined questions to explore certain responses further. The semi-structured approach was consequently useful for getting sufficient and desired data from the developers' experiences and thoughts.

3.4.3 Structure of the interviews

Even though one can think of semi-structured interviews as an informal event, some structure is needed to gain the desired information. Typically, questions of three phases are prepared, as explained and illustrated (see Figure 3.2) by Tjora [50].

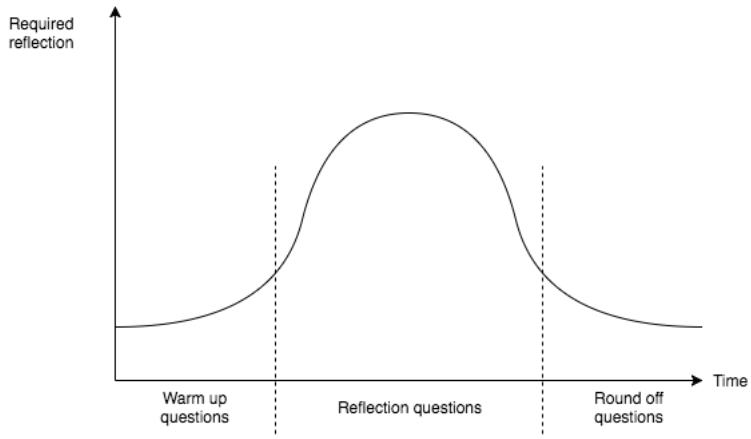


Figure 3.2: The structure of semi-structured interview [50] (translated from Norwegian).

Warm up questions: Often simple, concrete questions not requiring any reflections from the informant.

Reflection questions: Questions letting the informant reveal in-depth information, and answer possible follow-up questions.

Round off questions: The purpose of these questions is to "normalize the situation" by leading away from the reflection questions. Presenting the further research process and showing gratitude for the informant's time are among other points of interest in this phase.

In addition to using the model given above, guidelines from Tjora [50], and Robson and McCartanof [43] for conducting a semi-interview as a method were included. The personal interview guide used when conducting the interviews, can be found in Appendix C.

3.4.4 Conducting the interviews

Some careful planning was required in advance of the interviews. Best results are given when the informants are feeling comfortable in the situation [50], e.g., free from stress and noise. Hence, meeting time was set on the informants' premise. Brief summaries of the interviews are as follows:

10/26/2017 Prof. George Adrian Stoica, developer of ONE2ACT: As Prof. Stoica was only able to make an interview over Skype[3], a meeting room was booked in order to talk in private. He was then informed about the necessary recording, which was done with the media application QuickTime[4]. Further, using the interview guide (Appendix C), the interview turned more or less into a less formal conversation, talking about the pre-determined topics. As scheduled, the interview lasted for one hour and all questions were covered during this amount of time. Critical for this interview was using the same electronic device for both the communication and the recording. If any technical issues had occurred, the interview would probably have some adverse outcomes.

10/27/2017 Prof. Alf Inge Wang, developer of Kahoot!: As scheduled, the interview was held at Prof. Wang's office, located on campus. Recording of the interview was informed of and done on an iPhone. The interview was likely affected by Prof. Wang's sudden hurry due to another important appointment which came up. The scheduled hour was reduced to 30 minutes, which, perhaps, might have made an impact on the responses. Nevertheless, all prepared questions were answered, and no follow-up interview was considered necessary.

[3] https://www.skype.com/en/
[4] https://en.wikipedia.org/wiki/QuickTime

3.4.5 Credibility and dependability in semi-structured interviews

Due to the fundamental differences in qualitative and quantitative research, terms as "credibility" and "dependability" have previously been used to discuss the quality of a qualitative research method [47] instead of the more commonly used terms: reliability and validity. These terms are also used in this research. Credibility (validity) relates to which extent "participants involved in the study find the results of the study true or credible" [47]. On the other hand, dependability (reliability) is associated with which extent the "process of selecting, justifying and applying research strategies, procedures and methods is clearly explained and its effectiveness evaluated by the research and confirmed by an auditor (...)" and "(...) the process of the study is consistent over time (...)" [47].

There are several ways to evaluate the quality (i.e., the credibility and dependability) of findings provided a by qualitative methods, e.g., by semi-structured interviews as used in this research. Yilmaz [47] provides a list of questions one can use to judge the quality by checking whether the question is fulfilled or not with regards to the research. Dellinger and Leech [53], on the other hand, have contributed to the field with a framework that can be followed to decide on the validity in, not only the qualitative but all, methods used in mixed methods research. Onwuegbuzie et al. [54] suggest a legitimation framework in mixed research, including qualitative methods. The semi-structured interviews conducted in this research could be assessed by the questions or the frameworks from the previous works, but due to their complexity we have chosen to address the credibility and dependability in the semi-structured interviews in the light of related issues found in the literature:

Skill level of the interviewer [50] Naturally, the interview will be affected by the interviewer. If an interviewer's skill level in interviewing is poor, it is likely that the quality of the interview will be so as well. In this thesis, the interviewer had no prior experience in conducting an interview for research purposes, which may thus have affected the quality of the interview. However, several precautions were made to limit this aspect, for instance, raise awareness about this point and identify potential pitfalls (as given below) to be avoided. In addition, an experienced interviewer observed the first in-depth interview and provided feedback both before and after the interview.

Length of interview [43]: How long an interview lasts will affect the overall value from doing the interview. Colin and Robson [43] state that an interview should at least last for half an hour to give something valuable in return. Consequently, finding informants willing to participate in such a time-consuming arrangement can, therefore, be challenging. Due to our informants' hectic workday, we neglected the recommended time allocation and customized the interviews

so that they would not last longer than an hour. In this way, we knew that a sufficient amount of questions could be answered while not stressing the informants by stealing too much of their time.

Recording [50]: To ensure that everything said in the interviews was accumulated, recording the interviews was crucial. It is worth noting that use of recording might have, however, led to the informants being uncomfortable and nervous in the interview context. Consequently, the quality can have been reduced. In addition, a great aspect to consider is how one must rely on the recorder to work in any occasion. Technical issues can occur when using electronic devices, and this was handled by taking notes during both interviews as backups.

Dependability in findings [50]: Results from interviews can vary. Not only because of the information provided by the respondents but also in how the interview was carried out. Asking different questions to the informants can raise questions to the dependability of the results. Bringing the interview guide (Appendix C) was a clear action done to prevent this issue. Another view of this point involves the number of interview objects, which also might play a crucial role in deciding on the quality, as one might not get a diverse and adequate picture of what is studied with a small number of interviews.

Credibility in findings [55]: An advantageous effect of doing in-depth interviewing, is the possibly revealing of information which would not be brought to light in other contexts. However, there will be no guarantee for knowing if the informant's information is correct, i.e., the informant can have a bad memory or hold back information.

Ethics [50]: When interviewing, it is important to keep in mind that the informant should not be harmed in any means. The questionnaire was, thus, made anonymous in respect to whatever information the participants would find as too sensitive to reveal.

One can argue that using a proposed framework, such as the ones presented in this section, could give a more comprehensive and accurate evaluation of the quality in the semi-structured interviews. We suggest a further examination of this in future research.

By coding and analyzing the interviews, parts considered important and/or supportive for answering the research questions were extracted. More concrete, the parts could be aspects or answers to subquestions which, together, could provide insights of interest. The results from the conducted analyses are presented in Chapter 4 along with how these findings are combined with results from the consecutive study, which is described in the following section.

3.5 Questionnaire

In contrast to qualitative research methods, quantitative research methods typically use sampling techniques to gather data before applying statistical methods to analyze it [51]. Polls, questionnaires, and surveys are examples of such research methods [51]. The data obtained is typically in statistical and numerical form [43]. Also, it is said that "qualitative methods seek understanding, while quantitative methods seek explanation" [43], i.e., use generalization to explain a phenomenon [51]. Even though the two types of methods have different research approaches, quantitative research methods may, however, be used in conjunction with qualitative research methods. That is, to substantiate findings in qualitative research [43]. Using this idea, we decided to construct a self-report measure, a questionnaire, to support the obtained data from the semi-structured interviews.

3.5.1 Constructing the questionnaire

As the research relied on making a questionnaire that could complement the earlier studies, it was crucial to make the questionnaire worthwhile. Thus, general tips suggested by Harrison [56] were taken into consideration when creating the questionnaire to make it as good as possible. For instance, after introducing the purpose of the questionnaire, participants were asked general and simple questions to give them a soft start to perhaps motivate them to continue. Additionally emphasized by Harrison [56], respondents are more likely to skip lengthy questionnaires. Hence the questionnaire was made as short as possible. Both open-ended and closed-ended questions were included, further following tips by Harrison [56]. The former to have the respondents own thoughts and experiences in words, the latter to make sure participants interpret the questions by the same means [56]. Also, the closed-ended questions result in statistics that can be viewed graphically, which can be useful as one might get a more straightforward picture of the results in that way. Moreover, the items were randomized to improve the data (as some participants tend to pick the first item).

The structure of the questionnaire was as follows:

The first part included questions regarding their general usage of Kahoot! and in which settings they use it.

The second part included statements related to user engagement the participants were asked to rate. As the goal of this thesis was to investigate the concept of user engagement in the context of Kahoot!, we adapted and integrated the already evaluated scale for measuring user engagement into the questionnaire, presented in Section 2.1.4. Thus, we adjusted the original user engagement scale

(UES) by O'Brien [9] to fit into the context of measuring user engagement in Kahoot!. Originally, the scale consisted of 31 items, but for this questionnaire, it was reduced to 18. The reduction was done to shorten the questionnaire, hopefully, to increase the participants' willingness to complete it. A five-point Likert Scale was used to rate the items, ranging from "Strongly Disagree" to "Strongly Agree".

The scale items represent the six user engagement attributes Focused Attention, Felt Involvement, Novelty, Perceived Usability, Aesthetic Appeal and Endurability, described earlier in the thesis. For this questionnaire, we kept three items per attribute, as shown in Table 3.2.

User engagement attribute	**Items**
Focused Attention (FA)	1. I tend to lose myself when I play/use Kahoot!. 2. I tend to get so involved in Kahoot! when I play/use it, so I lose track of time. 3. I have experienced that the time just slips away when I play/use Kahoot!.
Felt Involvement (FI)	1. I tend to get really drawn into Kahoot! when I play/use it. 2. I tend to feel involved when playing/using Kahoot!. 3. Playing/using Kahoot! is fun.
Novelty (NO)	1. I play/use Kahoot! out of curiosity. 2. My curiosity gets incited by Kahoot!'s content. 3. I am feeling interested when I play/use Kahoot!.
Perceived Usability (PU)	1. I have felt frustrated while playing/using Kahoot!. 2. I have felt discouraged while playing/using Kahoot! 3. I feel in control of my Kahoot! sessions.
Aesthetic Appeal (AA)	1. Kahoot! is attractive. 2. Kahoot! is aesthetically appealing. 3. I like the graphics and images used on Kahoot!.

Endurability (EN)	1. I have experienced that Kahoot! sessions do not always work out the way I planned. 2. Using Kahoot! is rewarding. 3. I would recommend Kahoot! to my friends and family.

Table 3.2: The user engagement attributes and their corresponding items in the questionnaire.

The third part involved another point of interest, which has been to survey which factors, both general and technical, influence user engagement. Based on this, the participants were asked to recall any technical issues they might have been exposed to followed by questions regarding their positive and negative experiences with the application. These questions were included in the questionnaire to disclose what considerable factors and technical challenges occur in Kahoot!, and further naturally influence the experience of using the application, and maybe - influence the user engagement.

Lastly, the participants was kindly asked to leave any comments of interest, and their e-mail if they were willing to be contacted for a follow-up study if necessary.

Before the questionnaire was sent out, a handful of test respondents were recruited to evaluate it. In this phase, misspellings, lacking information and ambiguous questions were detected. The reduction from 31 to 18 items in the UES was based on feedback gathered in the pre-testing phase, and as a means to shorten the questionnaire somewhat. As illustrated in Table 3.2, three items per user engagement construct (the most relevant items for the use case were retained) were kept, in all 18 out of 31, which still allows for running the necessary reliability analysis afterwards.

The questionnaire was made with SelectSurvey[5], a tool for creating, distributing, and analyzing surveys with several design options. The results of the questionnaire and how they support findings from earlier studies are given in Chapter 4. The entire questionnaire can be found in Appendix F.

3.5.2 Recruiting respondents

As stated in Chapter 1, a focus of this research has been to cover all user perspectives of Kahoot!. We covered the developer's view in the semi-structured interviews,

[5]The SelectSurvey system can be used by employees and students at NTNU for academic and administrative use https://innsida.ntnu.no/wiki/-/wiki/Norsk/Spørreundersøkelser

thus, the target group for the questionnaire consisted of students and, in particular, teachers/professors using Kahoot!. Later, the questionnaire was distributed through various channels. First, it was sent to employees (specifically teachers and professors) at the institutes belonging to the Faculty of Information Technology and Electronic Engineering. They were also encouraged to share it with students taking their courses. Concurrently, it was forwarded to employees at NTNU Business School and posted to the public on NTNU's intranet, Innsida. Due to a lack of responses, the questionnaire was emailed to teachers in local high school and posted in Facebook groups for educators. Choosing high schools in Trondheim was reasoned with the potential for conducting follow-up interviews at a later time and being able to meet the volunteers in person if necessary. A Facebook group of relatively few members and with requirements that needed to be fulfilled for joining was chosen to minimize the risk of getting a lot of untrustworthy respondents via Facebook.

3.5.3 Validity and reliability in questionnaires

When measuring the quality of data collected by a quantitative method, one is typically concerned about how accurate, and consistent the measurements provided by the instruments are, more commonly referred to as validity and reliability. Validity relates to "the degree to which a measurement measures what it purports to measure" [57], i.e., how accurate the results are. Reliability, on the other hand, deals with "the degree to which the results obtained by a measurement and procedure can be replicated" [57], i.e., how results are consistent over time under the same conditions [47]. Even though previous work stresses several types of validity, we only focus on the broad aspects of internal and external validity in this research. The former underlines to which extent there is a relationship between the actual outcome and what the measurement was designed to measure [47]. The latter describes to which extent results obtained can be generalized given the conditions (e.g., population, time, settings, etc.) [47]. Likewise, we do not emphasize on other aspects of reliability to not complicate the research scope.

Similar to what is described in Section 3.4.5, the quality of our questionnaire is hereunder briefly discussed in terms of related threats to the validity and reliability, addressed by Ihantola and Kihn [58]:

Threats to the internal validity: In this research, we considered threats like instrumentation issues and errors during the statistical testing highly relevant. Issues in the questionnaire are identified as inadequate content which, in turn, might not generate valid scores, perhaps due to lack of knowledge. To minimize the possible effect of such threats, face validity testing [57] was carried out during the questionnaire phase, where the supervisor and the professor of this thesis contributed to the questionnaire with their expertise in the field. The

purpose was to have them to evaluate the questionnaire items and agree on it's validity in respect to answering the research questions set. In addition, using the Likert scaling for item rating, provided content validity to some degree as all attitudes towards the user engagement items were represented [57].

Threats to the external validity: Here, the main threat was identified as the population, or respondents. As the main goal of this validation step is to make as general solutions as possible [58], attempts were made to bring diversity (and subsequently randomisation) by distributing the questionnaire to students, teachers and professors on both high school and university level. With over 100 responds, no further attempts were done to improve the sample size as the goal of this study is not to be representative for all Kahoot! users but rather to contribute to a better understanding of user engagement in this respect. Thus, the goal was only to get as many respondents as possible during the period the questionnaire was open.

Threats to the reliability: Errors, which may affect the reliability in the questionnaire, likely occur during the data collecting due to several insufficiency [58]. Amongst others, ambiguous items, typos, lack of instructions or alternatives and improper order can affect the reliability. Precautions made to reduce this threat are already mentioned. Briefly, the pre-testing and the reviewing by the supervisor and professor were crucial initiatives to this point.

After conducting the three studies presented, the next focus was on further data handling and analyses. This is explained in the following section.

3.6 Data analysis and mixing the data collected

Still following the mixed methods research process model, given in Figure 3.1, step five leads the research into analyzing the collected data. An important aspect to consider - not only in this step - is how and when the data to be (or already) collected through different methods should be combined [44]. This is especially an issue addressed in mixed methods research where data is obtained from both quantitative and qualitative research methods. Creswell [44] explains *mixing* of data in three ways: either as data being merged, kept separate or combined (in the midst of the other two alternatives). The latter mixing approach is based on data from a second phase (in this case the questionnaire) that gets *embedded* with primary data from another phase (the interviews) to support it [44]. Creswell further states that data analysis in mixed methods research "involves data transformation, exploring outliers, examining multiple levels, or creating matrices that combine the quantitative results and the qualitative findings" [44]. A perhaps more concrete description of how data analyses are done in mixed methods research is suggested by Onwuegbuzie and Teddlie [59]. According to them, the data analysis process can follow a seven-stage conceptualization, which additionally has been applied in this research:

1. Data reduction

Includes reducing the qualitative data (e.g., exploratory thematic analysis, memoing) and quantitative data (e.g., descriptive statistics , exploratory factor analysis).

2. Data display

In this stage, further data reduction is done by describing data with illustrations. Qualitative data can be described via matrices, charts, and graphs among other instruments, while quantitative data can be visualized by tables and graphs.

3. Data transformation

Further on, transforming the data involves qualitizing and/or quantizing it, i.e., convert quantitative numerical data into narrative data, and qualitative data into numerical codes for further analysis [46].

4. Data correlation

Involves correlating the qualitative and quantitative data with each other.

5. Data consolidation

The data from both types are combined to create new or consolidated variables or data sets.

6. Data comparison

In this stage, data from the qualitative and quantitative sources are compared.

7. Data integration

Lastly, all data is integrated into a coherent whole or two separate sets (i.e., qualitative and quantitative) of coherent wholes.

In this research, data reduction involved simple coding mechanisms and partitioning of the interviews, and to extract relevant frequencies and measure central tendencies in the statistics provided by the questionnaire. Data of interest were displayed in tables and as graphs, and can be found in Chapter 4. The transitions between the transformation, correlation, and consolidation parts were overlapping and slightly undefined. The involving tasks were done in an interchanging manner, working with small parts from both the qualitative and the quantitative study with similar codes. The transformation and the correlation involved trying to link the obtained data with known engagement aspects found in the literature (the user engagement attributes). These relationships could then be used to combine the qualitative and the quantitative data better (consolidation) by having joint reference points (the engagement aspects). The obtained and combined data could then be compared and discussed (comparison), and later used as a whole to answer the research questions (integration).

Using these stages as inspiration for a framework for analyzing mixed methods data provided an orderly analysis process. Yet, the framework itself was not sufficient. Two software tools were used to support the analysis process: Nvivo and SPSS.

NVivo

The software program NVivo[6], provided by NTNU, was used to analyze the qualitative data from the interviews. The program offers various features for coding, categorizing, sorting and graphically displaying unstructured data, amongst others. Figure 3.3 is a screenshot taken from the coding of the Kahoot! interview in NVivo. This picture illustrates how text gets coded (the highlighted text to the left) with associated labels (to the right). The coding arrangement is thus providing a clear and orderly analysis of the data, and data can efficiently be organized and extracted by using and searching for data linked to a specific label.

[6]https://innsida.ntnu.no/wiki/-/wiki/English/NVivo

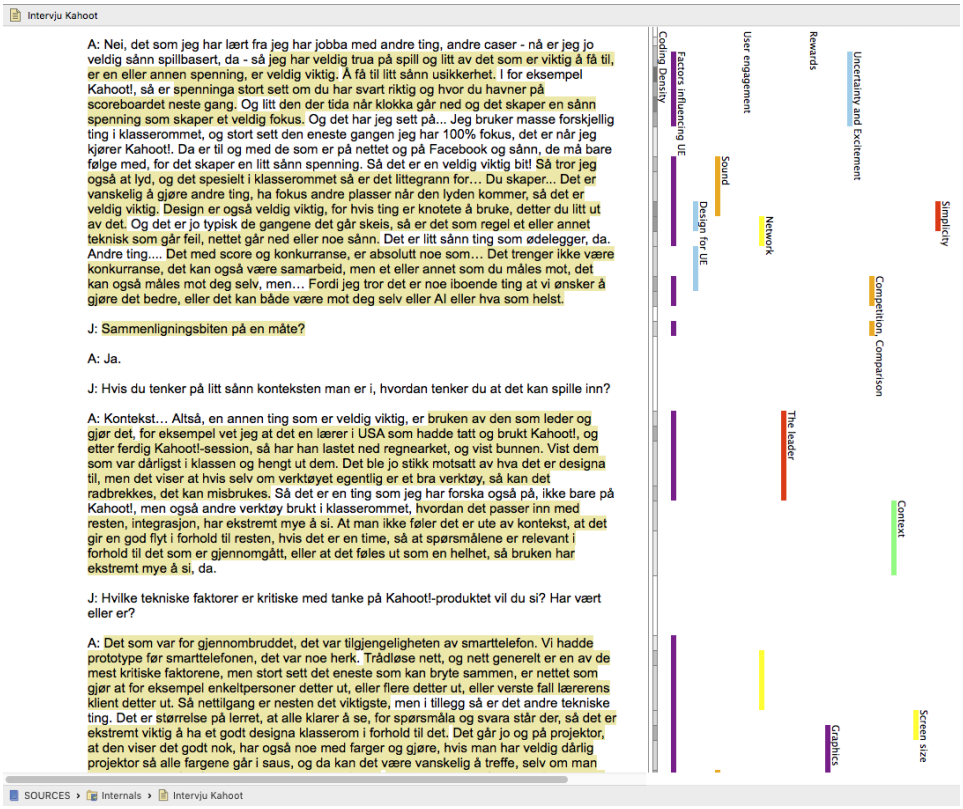
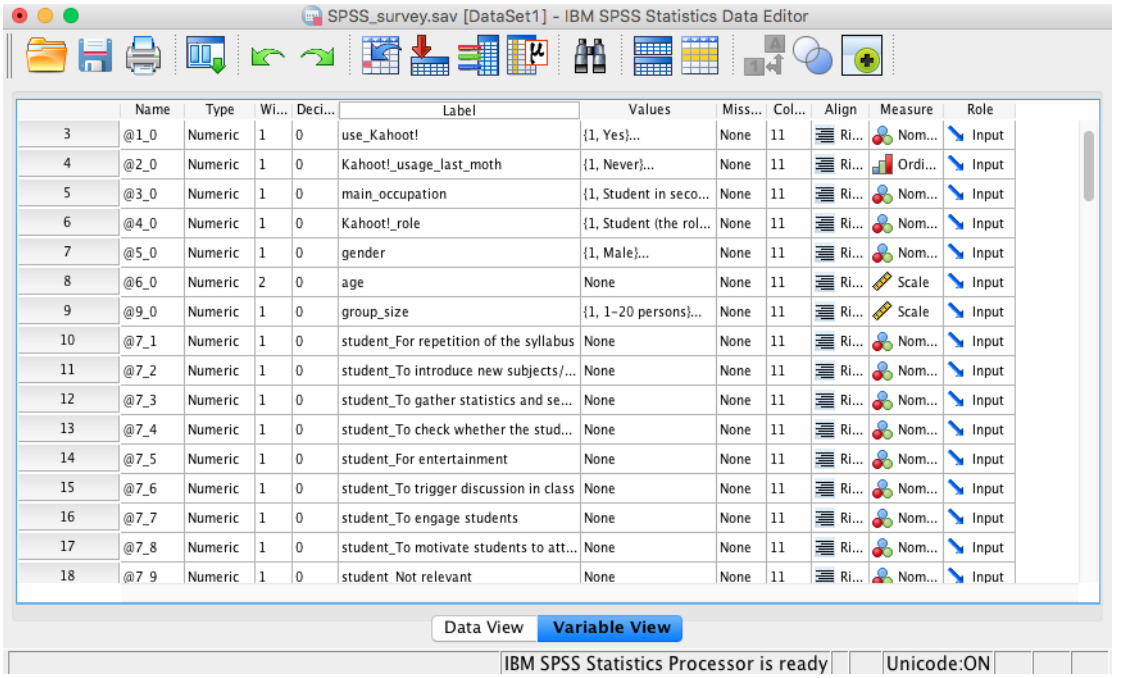


Figure 3.3: Text from the transcribed interview with Alf Inge Wang is coded with labels.

SPSS

The software package IBM SPSS Statistics[7], also provided by NTNU, was used to analyze and manage the statistical data collected from the questionnaire. With this tool, tests and measures could be done to examine the reliability and internal consistency in the questionnaire items, and relationships and correlations between data. In addition, SPSS could be used to view the results graphically. Figure 3.4 is a screenshot taken from the software program, where "Name" refers to each questionnaire question, and "Label" is used to give proper names to each question for more understandable and efficient analyzing.

[7]https://innsida.ntnu.no/wiki/-/wiki/English/SPSS



	Name	Type	Wi...	Deci...	Label	Values	Miss...	Col...	Align	Measure	Role
3	@1_0	Numeric	1	0	use_Kahoot!	{1, Yes}...	None	11	Ri...	Nom...	Input
4	@2_0	Numeric	1	0	Kahoot!_usage_last_moth	{1, Never}...	None	11	Ri...	Ordi...	Input
5	@3_0	Numeric	1	0	main_occupation	{1, Student in seco...	None	11	Ri...	Nom...	Input
6	@4_0	Numeric	1	0	Kahoot!_role	{1, Student (the rol...	None	11	Ri...	Nom...	Input
7	@5_0	Numeric	1	0	gender	{1, Male}...	None	11	Ri...	Nom...	Input
8	@6_0	Numeric	2	0	age	None	None	11	Ri...	Scale	Input
9	@9_0	Numeric	1	0	group_size	{1, 1-20 persons}...	None	11	Ri...	Scale	Input
10	@7_1	Numeric	1	0	student_For repetition of the syllabus	None	None	11	Ri...	Nom...	Input
11	@7_2	Numeric	1	0	student_To introduce new subjects/...	None	None	11	Ri...	Nom...	Input
12	@7_3	Numeric	1	0	student_To gather statistics and se...	None	None	11	Ri...	Nom...	Input
13	@7_4	Numeric	1	0	student_To check whether the stud...	None	None	11	Ri...	Nom...	Input
14	@7_5	Numeric	1	0	student_For entertainment	None	None	11	Ri...	Nom...	Input
15	@7_6	Numeric	1	0	student_To trigger discussion in class	None	None	11	Ri...	Nom...	Input
16	@7_7	Numeric	1	0	student_To engage students	None	None	11	Ri...	Nom...	Input
17	@7_8	Numeric	1	0	student_To motivate students to att...	None	None	11	Ri...	Nom...	Input
18	@7_9	Numeric	1	0	student_Not relevant	None	None	11	Ri...	Nom...	Input

Figure 3.4: All not open-ended questions are labelled to easily perform analysis.

By reading literature related to methodology, it becomes clear that there are several ways to carry out research, and that the identification of recommended design proposals depends on which of the various disciplines in the field of research studies one adheres to. However, we found the mixed methods research design strategy most suitable for our research, which has been both elaborated on and justified in this chapter. In the subsequent chapter, outcomes from the chosen design approach are presented, including both results from the interviews and the questionnaire.

Chapter 4
Results

In the foregoing chapter, the three studies used to investigate the research questions set in this thesis and their corresponding methods were described in detail. Next, this chapter presents the results found from conducting the interviews and analyzing the answers from the questionnaire. Figures and tables to illustrate the findings and to clarify significant relationships between certain variables are included. The results are further discussed in Chapter 5.

First, relevant information gathered from the two transcribed interviews conducted in the preliminary project are brought to light. These aimed to shed light on a developer's perspective on user engagement, and to which extent a developer consider this quality measure important when developing services, SRS respectively.

Thereupon, the results from the questionnaire in its entirety are thoroughly presented, and important findings are highlighted. The distribution of the questionnaire intended to capture users' perception of the experience when using Kahoot!, either as the role of a student or as the role of an instructor. The creation of the questionnaire was based on findings from the literature study, which provided knowledge in the background of user engagement and how it is measured and evaluated. By integrating the user engagement scale (see Section 2.1.4) and questions related to factors influencing their perceived experience, we aimed to get a better understanding of how user engagement is facilitated in Kahoot!. For a more detailed description of how the questionnaire was created and sent out, see Section 3.5.

4.1 Results from the pre-project study: interviews

Information about how the interviews were conducted, can be found in Section 3.4. As stated in the introduction (Section 1.2), a clear goal of this thesis has been to cover all the user perspectives of the SRS in focus (Kahoot! and partially ONE2ACT), including not only the students' and the teachers'/instructors' views, but also the developers' view on user engagement. This section covers some of Wang's (Kahoot!

developer) and Stoica's (ONE2ACT developer) explanations and statements, relevant for getting a deeper insight into the concept of user engagement. As Wang's interview was held in Norwegian, the included citations have been translated to English. The interviews were conducted with the support of an interview guide which can be found in Appendix C.

4.1.1 A general overview

We first wanted to get a general overview of the two SRS to be able to both characterize and compare them, and get the feeling of today's status. We did this by asking the developers questions regarding their work position, what services their systems offer, and about the users using their systems. From this part, the most important finding was the lack of interest in the continuation of developing ONE2ACT. Stoica stated: *"During times we had peak times where we had people working on it, now we have actively developing maybe three people in the departments of... It's more like maintaining now. It's maintaining, trying to fix things, and it's not so much developing going on. (...) But the activity diminished... It's not necessary... It's lack of interest I guess."* For this reason, ONE2ACT was not further included in our research, as already mentioned in Section 2.2.1. Other noteworthy samples from the start of the interviews were:

- Confirmation of what is said about Kahoot! in the literature. On the question about what service Kahoot! offers to its users, Wang said: *"mainly it is the classroom game show, or quiz in the classroom. That is the main focus that has really been there all the time. Additionally, it's a very important part to be able to create quizzes in which the teacher easily should be able to gather data. And another thing is also that you can take and use other quizzes and customise them to your own."*
- Wang also said that engagement has been one of his main focuses when developing Kahoot!, reassuring that his contribution to this research has been both valuable and reliable as he has a lot of knowledge on the field.
- According to Stoica, ONE2ACT has 4000-5000 registered users, located at different universities, and even in other countries. Though ONE2ACT has a remarkably lower number of users than Kahoot!, they still have a large user base, making the system worth to include in the first study of the research.

4.1.2 User engagement aspects

By analyzing the interviews, it became clear that triggering user engagement seems to have been a central goal to achieve when developing the two SRS. However, a fundamental difference between Kahoot! and ONE2ACT was disclosed when

conversing about the developers' opinion on user engagement's importance (first bullet point):

- While ONE2ACT is designed, first of all, to enhance learning and considers user engagement as a secondary outcome of using the SRS, Kahoot!'s design is built for user engagement and to give good user experiences. The latter approach makes it also more interesting to examine Kahoot! rather than ONE2ACT in this research.
- On the question about what the developers put into the concept of user engagement, both interviewees, first of all, confirmed the importance attached to user engagement: *"what drives the users to use it, to get into the system and use it"* (Stoica), and *"It means everything. It is the main reason for why Kahoot! exist"* (Wang).

Further, we have chosen to bring the engagement attributes described in Section 2.1.1 together with the information provided by the developers to put the potential findings in a broader and more clear perspective. After all, the SRS are designed to engage students in the classroom which may be easier to understand in the view of the six attributes. This also illustrates how the developers have considered the different engagement aspects when developing their SRS.

First, a recap of the six engagement attributes in a technology context, suggested by O'Brien [9] and previously described in Section 2.1.1. Here, the six attributes are specifically explained in the light of classroom technology:

Perceived Usability: Students' perceived effort and ability to accomplish tasks given, and their associated feelings.

Aesthetic Appealing: How attractive and visually appealing the students find the service.

Focused Attention: Related to students' concentration and how absorbed they get in the learning activity.

Novelty: How students' curiosity is increased by unfamiliar, surprising or unexpected elements, triggering excitement and joy.

Felt Involvement: The extent to which students have the feeling of being drawn into and involved in the experience, evoking the feeling of having fun.

Endurability: Related to the students' perception of the experience as rewarding, and the students' willingness to repeat and recommend the experience. Remembering the feeling of joy and fun can trigger this element.

Table 4.1 highlights some of Stoica's and Wang's statements related to user engagement in general. In the right column, the associated engagement attributes are listed, exemplifying how aspects of user engagement have been taken into account by the developers.

#	Developer	Statement excerpt about user engagement	Engagement attribute
1	Stoica (ONE2ACT)	*"The students have feeling of ownership towards their learning (...)"* - about what user engagement is.	Perceived Usability
2	Stoica (ONE2ACT)	*"Triggering user engagement is some kind of perceived... The usefulness perceived... If you think that the thing you are offered is useful to you and you can get something out of it which otherwise you couldn't, then you are likely to use it."* - about general elements of user engagement.	Perceived Usability and Endurability
3	Stoica (ONE2ACT)	*"More like design for learning. (...) That was the main driving force. (...) Design for getting people to learn more and be able to get the feedback and then understand what's happening. And the user engagement is like a consequence of that. You need people to be able to learn, they need to be engaged, and that's why we talked with the user target group and involved them in the process of designing."* - about the design process, including both the teachers' and students' view on the experience.	Perceived Usability
4	Wang (Kahoot!)	*"It means everything. That is the main reason for why Kahoot! exists based on own experiences from classroom teaching, where it is difficult to keep the engagement high (...) One shall have interaction which increases the engagement and the motivation to keep attention and focus (...)"* - about to which extent user engagement plays an important role regarding Kahoot!.	Focused Attention

5	Wang (Kahoot!)	*"Everything is designed with roots in engagement and user experience. Everything should be simple and provide a good user experience. (...) It has a lot of principles, using the fantasy among others (...) to accentuate that fantasy, we use graphics, and sound and music, all to create the excitement or the atmosphere."* - about to which extent it has been a goal to design for engagement.	Novelty, Perceived Usability and Aesthetic Appealing

Table 4.1: Statements about user engagement and related engagement attributes.

By viewing Table 4.1, one can clearly see that several of the engagement attributes documented in the literature are also identified in the two SRS we are examining in this research.

4.1.3 Influencing factors

By influencing factors, we mean factors that can alter user engagement positively or negatively in a given setting. We asked the developers questions related to such factors to get a better insight into how user engagement takes place based on factors influencing it, i.e., the user engagement process (described in Section 2.1). A broader driving force was also to use the obtained knowledge on how factors influence user engagement to understand the user engagement concept better in the context of classroom technology in general and not only in SRS specifically. In Background and Related Work, we motivated for including factors influencing QoE in the work of investigating factors influencing user engagement. Further, we reported that Influence Factors (IFs) can be categorized into the three broader terms, specifically Human, System and Context Influence Factors, illustrating the complexity of viewing user engagement and which factors influence it. To see whether these categories are underlying aspects of our findings on influencing factors in ONE2ACT and Kahoot!, can, therefore, demonstrate this complexity.

Several factors, both non-technical and technical, were found in the two interviews. We have listed factors mentioned by the developers, which they consider as either engagement triggers or showstoppers, in Table 4.2:

#	Developer	Statement excerpt about influencing factors	Engagement attributes affected
1	Stoica (ONE2ACT)	*"And about the number of students, of course, there is maybe a limitation, maybe a technological limitation."* - about what technical factors influence user engagement.	Probably every attribute except Aesthetic Appealing, as technical limitations can affect the entire experience in a negative way.
2	Wang (Kahoot!)	*"I believe in games, and what is important to achieve, is some excitement (...) To bring some uncertainty. (...) and about the time when the clock countdowns, it creates such excitement that creates intense focus."* - about factors influencing user engagement.	Focused Attention and Novelty
3	Wang (Kahoot!)	*"Scoring and competition is absolutely... It does not need to be competition, it can be teamwork, but with something you can compete against, it can also be yourself, but... Because I believe there is something inherent in us that we desire to do it better (...)"* - about using a competition element to trigger engagement.	Novelty, Felt Involvement, Focused Attention
4	Wang (Kahoot!)	*"Wireless networks and network, in general, is one of the most critical factors (...)"* - on technical factors influencing user engagement.	All attributes. No network access - no Kahoot!.

5	Wang (Kahoot!)	*"The screen size, that everyone can see. All questions and answers are given there, so it is extremely important to have well-designed classroom considering that. Also, the projector, that it shows it good enough, has something to do with colors. If you have a very bad projector, the colors can interfere, and then it can be difficult to hit, even though one has symbols, one has to know that it is the right color. (...) The stereo system is also a great advantage, not that critical, but the sound is important to get a good experience."* - about technical devices that can influence how the Kahoot! experience is perceived. Graphics and sound are an important part of Kahoot!, more on this can be found in Chapter 2.	Perceived Usability, Aesthetic Appealing, Endurability

Table 4.2: Statements concerning influencing factors and related engagement attributes.

This part of the interview somehow revealed more differences between the game-based SRS and the non-game-based SRS to a greater extent than what the former questions did. That is, Wangs' comments on influencing factors touched more user engagement aspects (the engagement attributes) than what Stoica stated. This, in turn, might indicate that using Kahoot! leads to a more composed and complex user engagement. Wang exemplified this difference by referring to an elder study that he conducted, where he saw that traditional written assessments are as engaging as a non-game-based SRS (contradicting the literature), but that the game element (in Kahoot!) is what makes it more engaging: *"What I thought in my head, was that paper quiz was the least engaging, traditional SRS more engaging than paper quiz, and then I thought that maybe the game element was the most engaging. But that was not what I found. It turned out that paper quiz and SRS were equally engaging, and that the game element made it more engaging. (...) I thought that maybe SRS in general, and to use mobile devices were more engaging, but it did not turn out that way. There was mostly no difference on those two at all."*

Other influences interesting to extract from this part, were two elements which seem to influence user engagement, independently of whether the SRS is game-based or not:

- **The premise that everything has to work properly:** According to both developers, it is crucial that the systems need to work properly and are easy to use for both students and teachers to make them engage in the systems. Wang emphasized this with *"Design is also very important because if things are complicated to use, you fall off."* He stresses this further by *"I know that for some if they, for example, have been leading and then they suddenly are... Then they are not in the top five because the Internet falls out, then they lose their motivation."* Stoica was concerned about how annoyance can be triggered in students and teachers due to occurring issues or design solutions they do not understand. The ease of use was, therefore, important to avoid the aggravation, and *"(...) it should be as simple as possible, and that's one reason we tried to have just the bare minimum out in this first level."* To be concrete, a central factor is thus the experience of how students and teachers are presented the technology, as Stoica stated: *"(...)one factor which can deter users from using it, is starting on the wrong foot. So, let's say the first day you want to use it in class, and there is some IT issue (...) The students have some issues with their devices (...) If you have this kind of happening in the beginning, it's kind of "oh, the system it doesn't work, it's that" (...) might be some incidence, but it's very damaging if it is in the very beginning when you started."* Lastly, to add one more statement to this specific point, Stoica said: *"Well, technology is... Is good when it is almost invisible. Should be blended into the thing. When you have to think about it, and you have to deal with issues, then it becomes the very big problem for the users. Especially for users which are not tech-savvy which they just take the smartphone as you take any tool."*
- **The leader's role:** Clear to both developers, is the influence the leader/instructor of SRS sessions has on the user engagement. Stoica mentioned the teachers' attitude towards the system, saying that if they are not showing enthusiasm, it can negatively influence user engagement, and *"If you are like these people which have the lecture set in stone, then it's not like that, because this brings you like unknown. Brings you open-ended stuff, you don't know what you get."* Additionally, it is important that the teachers integrate the use of SRS in a manner so that it fits in with the rest of the context and makes sense. Stoica explained: *"(...) if you just ask this kind of factual questions all the time, there is no meaning. You need to have a bit more advanced questions. Which are more conceptual, generate discussion and so on. Especially, for example, if we talk about SRS and these things you want to generate reflection, discussion..."* This was complemented by Wang: *"(...) if it is a lecture, the questions must be relevant to what has been gone through, or that it feels complete (...)."*

Based on the findings from the interviews, we have tried to place them into the three categories below (note that we only list explicitly mentioned aspects, the

overview is therefore not exhaustive, but grounded in the collected data). Each category was defined in Section 2.1.2:

- Human IFs:
  - How pedagogically correct the leader of SRS integrates it in lectures to maximize the learning outcomes.
  - How well the first impressions and experiences in SRS are for users.
  - The affective state of the participants (excitement, fun, feeling challenged because of the competition element).
- System IFs:
  - Wireless networks and networks in general.
  - Usability of the SRS.
  - The competition element to enhance your inner motivation to perform well.
  - Timer that counts down to create an uncertainty/excitement.
- Context IFs:
  - Number of students using SRS at the same time (this is also important for the "competition" element).
  - The screen size, important for everyone to see.
  - The projector's quality, specifically how well it can provide good quality of colors and images to give the best possible experience.
  - The stereo, providing sound for a better experience.

The overview of the IFs categories and identified examples from the interviews might provide a more clear picture of how factors influencing user engagement can be viewed in the light of different aspects known from the literature. As one probably can see from the IF list, and as we will see later from the IFs provided by the questionnaire respondents, these categories tend to overlap to some extent. That is, various factors can often be placed in more than just one category, based on how they are viewed. For instance, competition is something contextual, or environmental, and hence placed in the Context IFs category. Yet, competition is also something triggered by humans as well, and could thus be placed in the Human IFs category. Therefore, this IFs insertion into the categories must be considered with a grain of salt, keeping the overlapping in mind. By this fact, the complexity of user engagement's composition with the influencing factors it is subject to, is again here emphasized by putting concrete factors in a broader context.

The findings from doing the interviews are discussed in more detail in the following chapter. In the following sections, the second study including the questionnaire is presented.

4.2 Results from the questionnaire

Following the questionnaire partitioning given in Appendix F, we first look at the results on general usage. This is followed by a more comprehensive part including the statements related to user engagement, inspired by the UES (see Appendix A), and relevant comparisons between the outcomes of the scale and findings from other questions. At last, we investigate the answers related to factors influencing user engagement. The questionnaire was active for one and a half month, and a total number of 106 respondents completed it.

4.2.1 General usage

First, we take a brief look at the general characteristics of the respondents. Among the 106 respondents:

- The average age was 37,5,
- 24% were students (in school or higher education), 72% teachers or professors (in school or higher education), and 4,7 % specified *other*,
- 37% respondents were male, and 63% respondents were female.

To examine how actively the respondents used Kahoot!, they were asked about their usage at the beginning of the questionnaire. During the last month, the usage among the respondents varied to a great extent. Slightly over a third of the respondents used Kahoot! 2 to 3 times in the preceding month and only 6,6% had used it more frequently than that (several times a week). What we became aware of, was that some respondents chose the open-ended alternative "other", though their answer fitted one of the alternatives above (see Appendix F for all alternatives). Thus, these answers were changed to the correct alternatives. For example, some explained that they only use Kahoot! in the fall semester due to specific courses only taught once a year. These answers were then altered from "other" to "never". This issue occurred in other questions including open-ended alternatives as well, but were, similarly, solved by manually changing the answers to more suitable alternatives. The usage distribution is given in Table 4.3.

How often have you used Kahoot! during the last month?	**Percentage**
Never	30%
Once	27%
2-3 times	36%
Once a week	0%
Several times a week	6,6%
Daily	0%

Table 4.3: Kahoot! usage during the last month

In Chapter 2, the concept of allocating *roles* when discussing user engagement was brought up. In the context of the questionnaire, we were interested in distinguishing the two roles Kahoot! opens up for, namely the role of a player (student), and the role of an instructor/leader (often teacher or professor). The distribution is illustrated in Figure 4.1, stressing the predominance of respondents associating themselves with the role of instructors. 11% of the respondents associated themselves with the role of students when using Kahoot!, 73% as instructors and 16% as both. The high prevalence of teachers can be explained by the approach used to distribute the questionnaire, described in Section 3.5.2. Additionally, considering the focus that has mainly been on the students in previous research on engagement in classrooms, we have motivated for giving the teachers' view a particular focus in this thesis. The high percentage of 73% is thus considered valuable given the limited focus on the teacher role in the existing work.

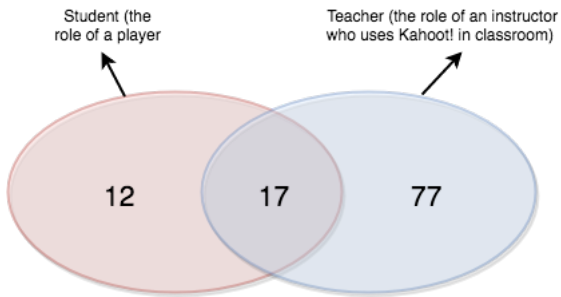


Figure 4.1: The distribution between respondents using Kahoot! as players, instructors or both.

The 106 respondents were further asked to pick alternatives that fitted their

perception of how they had been using Kahoot!, or what the intentions were when they either used it as students or instructors. The results show that - both from the student and teacher perspective - Kahoot! was mainly used to repeat the syllabus and to understand whether students have understood what was just taught in the classroom. These statements are closely related, which may also explain why the outcomes are nearly equal (especially from the teacher perspective). They were followed by "For entertainment" and "To engage students", which, similarly, are statements with strong relationship (see Section 2.3.2 on how games can increase engagement). The results are shown in Figure 4.2.

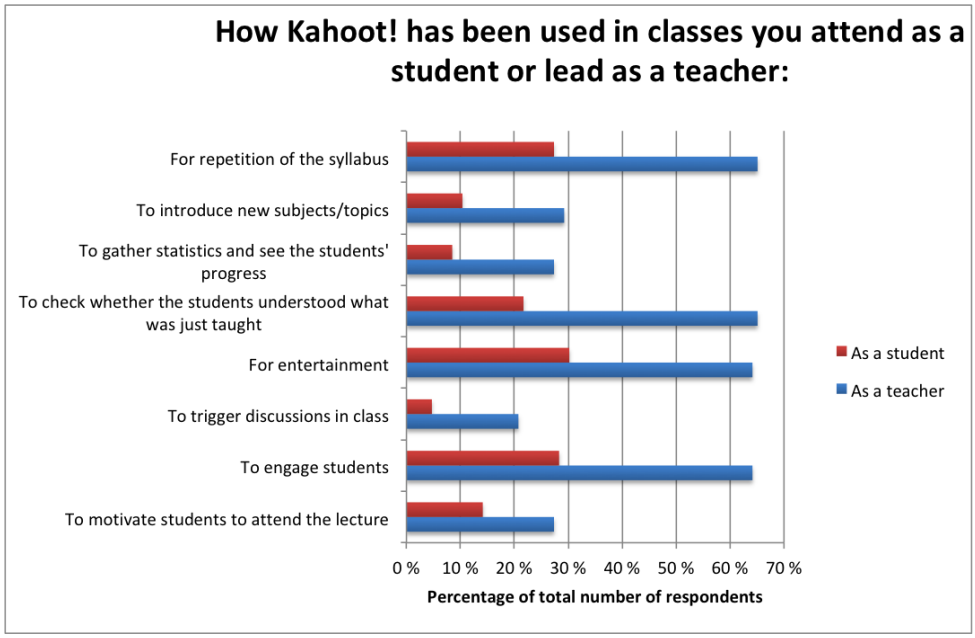


Figure 4.2: How Kahoot! has been used in classrooms, and what the intentions of using it were, varied based on which role the respondents associated themselves with.

Furthermore, feedback on the group size which the respondents usually play/use Kahoot! in was collected, as the number of players in the classroom could potentially be a relevant influence factor. As shown in Table 4.4, around a third of the respondents usually plays/uses Kahoot! with groups of up to 20 people. 42% of the respondents typically play Kahoot! with groups of more than 20 and for one out of four, it varies.

I play/use Kahoot! with groups of around:	**Percentage**
1-20 persons	33%
21+ persons	42%
It varies	25%

Table 4.4: People play/use Kahoot! with groups of different sizes.

4.2.2 Statements related to the user engagement attributes

This part of the questionnaire included the adjusted version of O'Brien's user engagement scale (UES) [9], better described in Section 3.5.1. In short, the scale represents the engagement constructs Focused Attention, Felt Involvement, Novelty, Perceived Usability, Aesthetic Appealing and Endurability. Before using the replies to the UES items in further analyses, the first necessary step was to check the internal consistency of the included items per construct.

Consistency of the scale

A reliability analysis was conducted in SPSS to measure the scale's consistency. This could be done by using the measure Cronbach's α (Cronbach's Alpha), with its value indicating how consistent a set of items are, or how closely they are related and whether the value can be increased by removing one or more items from the scale. The scale used in the questionnaire consisted of six subsets, or subscales, with each having three corresponding statements. We, therefore, wanted to check to which extent the three items in each subscale measured the same underlying constructs as initially intended - the engagement attributes. If the consistency was high enough, we could simplify both the scale itself and further analyses by taking the average score of each subscales' three items and use it as one construct, rather than using the three items separately. Field [60] has reported that an acceptable value for Cronbach's α is usually 0.7 to 0.8 and that lower values are considered inadequate, and indicate unreliable scales. However, he also reported that these thresholds are heavily relying on which context the α is measured in and that an α value of above 0.65 can be suitable for settings similar to this research. This value is also supported by the fact that "the α depends on the number of items on the scale" [60], or in the subscales in this case, with a higher α the more items the subscales holds. With only three items in each subscale, a relatively low value of the α was to expect. We thus considered 0.65 to be an acceptable value for internal consistency and used this as a threshold.

To reduce the response bias, or the tendency respondents have to answer misleadingly by, for instance, only pick the first alternative throughout a questionnaire,

reverse-phrased items were included. That is, statements asked the opposite way compared to the other items. In this scale, this concerned EN1, PU1, and PU2, which we had to re-phrase to "I have experienced that Kahoot! sessions work out the way I planned", "I have never felt frustrated while playing/using Kahoot!" and "I feel encouraged while playing/using Kahoot!" respectively, and reverse the respective scores (1 to 5, 2 to 4, 4 to 2 and 5 to 1), in order to make sure the α was not affected by reversed phrases.

The outcomes are found in Table 4.5:

Engagement construct	**Initial α**	**Final α**
Focused Attention (FA)	0,808	0,808
Felt Involvement (FI)	0,729	0,729
Novelty (NO)	0,655	0,655
Perceived Usability (PU)	0,586	0,586 (Not reliable)
Aesthetic Appealing (AA)	0,657	0,710 (Removed AA1)
Endurability (EN)	0,520	0,700 (Removed EN1)

Table 4.5: The six engagement constructs and the corresponding Cronbach's α.

The second column shows the α value of all three items' consistency. The third column shows the α if any of the three items are removed from the subscale, resulting in a higher α. This case was present when measuring the consistency in Endurability, and is illustrated in Figure 4.3. Here, the column "Cronbach's Alpha if Item Deleted" shows the value of the subscale's reliability if one of the related items is deleted. Initially, the value was 0,520, but by removing "EN1_I have experienced that Kahoot! sessions work out the way I planned" the value is increased to 0,700. Thus, this subscale was reduced to hold two items instead of three, and the subscale's new α value was 0,700.

Reliability Statistics

Cronbach's Alpha	N of Items
,520	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
EN1_I have experienced that Kahoot! sessions work out the way I planned	7,8396	1,869	,197	,700
EN2_Using Kahoot! is rewarding.	6,9151	2,117	,399	,346
EN3_I would recommend Kahoot! to my friends and family.	6,7170	1,786	,461	,214

Figure 4.3: Reliability analysis of the items related to the attribute Endurability.

According to the reliability analysis, the scale could now be represented by 5 constructs: Focused Attention (3 items), Felt Involvement (3 items), Novelty (3 items), Aesthetic Appealing (2 items) and Endurability (2 items). The construct Perceived Usability did not have an acceptable Cronbach's α value. For this construct, we thus retained the original and individual statements and did not compute an average value.

Overall, the included engagement constructs were to a large extent recognized in Kahoot!, as is reflected in the ratings shown in Figure 4.4. The figure illustrates how the outcomes related to the different engagement constructs and items were distributed. According to the distribution, the respondents' overall perceptions related to the engagements aspects of Kahoot! were positive. Felt Involvement and Endurability are clearly most prominent followed by Novelty, Aesthetic Appealing, and "I feel in control of my Kahoot! sessions" (PU3). Focused Attention on the other hand, is clearly lower in Kahoot!. This is reflected by the fact that almost 30% of all respondents disagree that when one plays Kahoot!, one completely forgets the world around. Similarly, nearly one out of four disagrees with the statement "I have never felt frustrated while playing/using Kahoot!" (PU1).

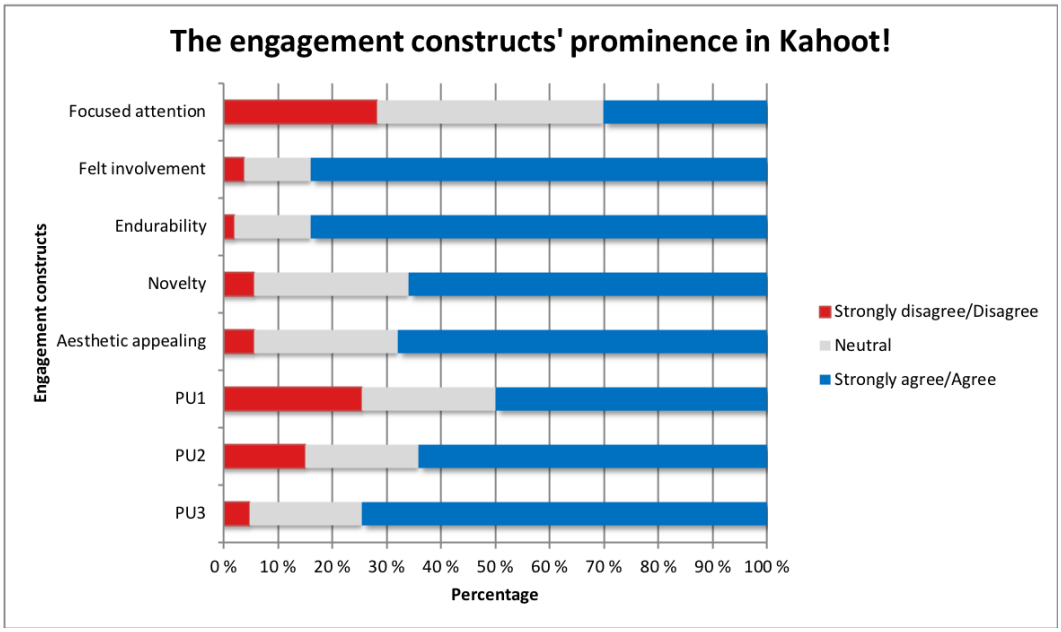


Figure 4.4: The engagement constructs' prominence in Kahoot!

Roles and engagement aspects

Earlier, we stressed the interest of covering all user perspectives of Kahoot!. This is supported by a similar school of thought, elaborated on in Section 2.2, where the role assigning was highlighted. In short, we addressed how investigating user engagement depends on which context it is being viewed in, as users typically are assigned specific roles due to that context. For this research, the roles we wanted to gain insights in, were the role of using Kahoot! as a teacher, and the role of playing Kahoot! as a student. Thus, to investigate whether the different engagement aspects have different prominence when Kahoot! is viewed either by teachers or by students was considered valuable for the research. Figure 4.5 shows the scores of the different engagement constructs and items (as in Figure 4.4), comparing the scores of the different roles the respondents associated themselves with, specifically the student role, instructor role, or both roles.

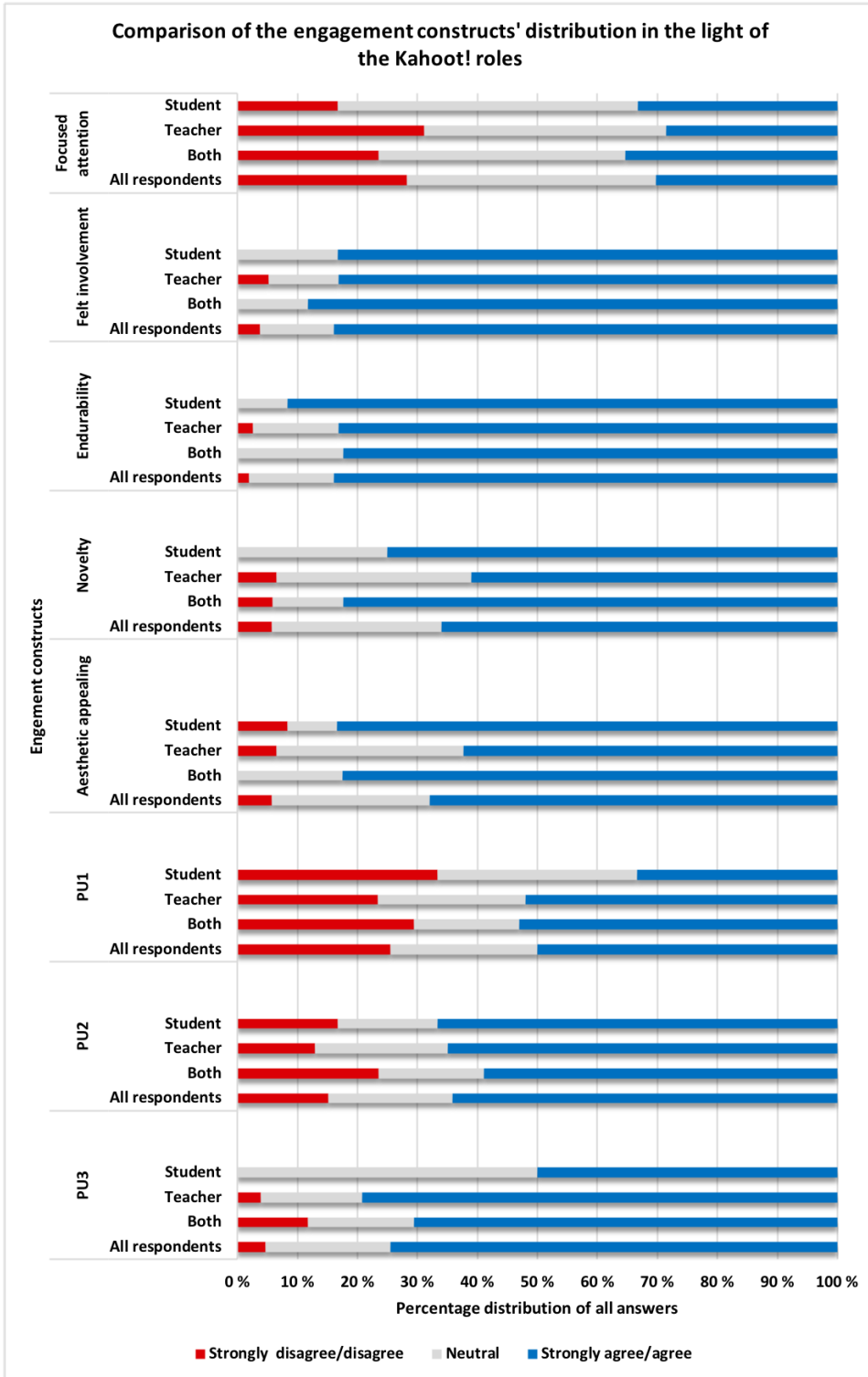


Figure 4.5: The difference in the prominence of each engagement construct and the roles.

By viewing Figure 4.5, it becomes clear that differences between the engagement scores with respect to the Kahoot! roles are more or less absent. These observations are to some extent surprising, as one, for instance, could have expected a slightly higher score of disagreement in the construct Felt Involvement for the teacher role due to their less equal footing during a session. Thus, the role does not seem to play an important role in the construct related to involvement: Kahoot! is associated with high Felt Involvement both by both groups. A slight variation can be seen in Focused Attention, were teachers disagree to a greater extent that one is immersed while using Kahoot!. The only clear difference between the student role and the teacher role is in "I feel in control of my Kahoot! session" (PU3). Naturally, this item was rated higher for teachers who indeed are in charge of the sessions, with a nearly 30% higher score than for students.

We also conducted an analysis in SPSS to check whether there were any significant differences between both groups in terms of how prominent they consider the key engagement constructs to be in relation to Kahoot! For this analysis, the Pearson's Chi-square test was used. This statistic compares the frequencies observed from different categories with the expected frequencies from the same categories to see if there are any significant differences between them [60]. The difference is considered significant (in other words, there are indications in the data that the difference between certain groups is not due to chance) if the value is less than .05. In this case, we wanted to see whether there were any significant differences regarding the prominence of the engagement constructs (measured on a 5-point scale from strongly disagree to strongly agree) when using Kahoot! in the role of teacher, or playing Kahoot! in the role of a student. However, according to the Chi-square test, none of the engagement constructs appeared to yield any significant differences between the roles when using Kahoot!. The extent to which one feels engaged with Kahoot! is thus not related to the role one has when using it.

Regarding the sizes of the groups Kahoot! is being used in, worth noting is a small tendency towards higher engagement when Kahoot! is used in smaller groups (1-20 persons) as shown in Figure 4.6. This applies to most of the included engagement constructs, except for the two statements related to Perceived Usability (PU1 and PU2). This finding was expected due to the nature of Kahoot! - the competition element may be more pronounced when there are fewer players (that maybe also know each other better), which might explain a higher engagement among the involved ones. A similar explanation can be used to interpret the higher score for Novelty, related to users' curiosity and interest. With a smaller number of persons involved, the chance of winning or land on the leaderboard is bigger. Thus, the feeling of excitement associated with the Novelty construct may be triggered to a greater extent. Nevertheless, these differences are quite small, and thus the sizes of the groups do not seem to affect the level of engagement to a great extent. The Pearson's Chi-square

test was also used in this case to check for significant differences, but the analysis did not yield any significant differences. Therefore, no strong claims can be made here.

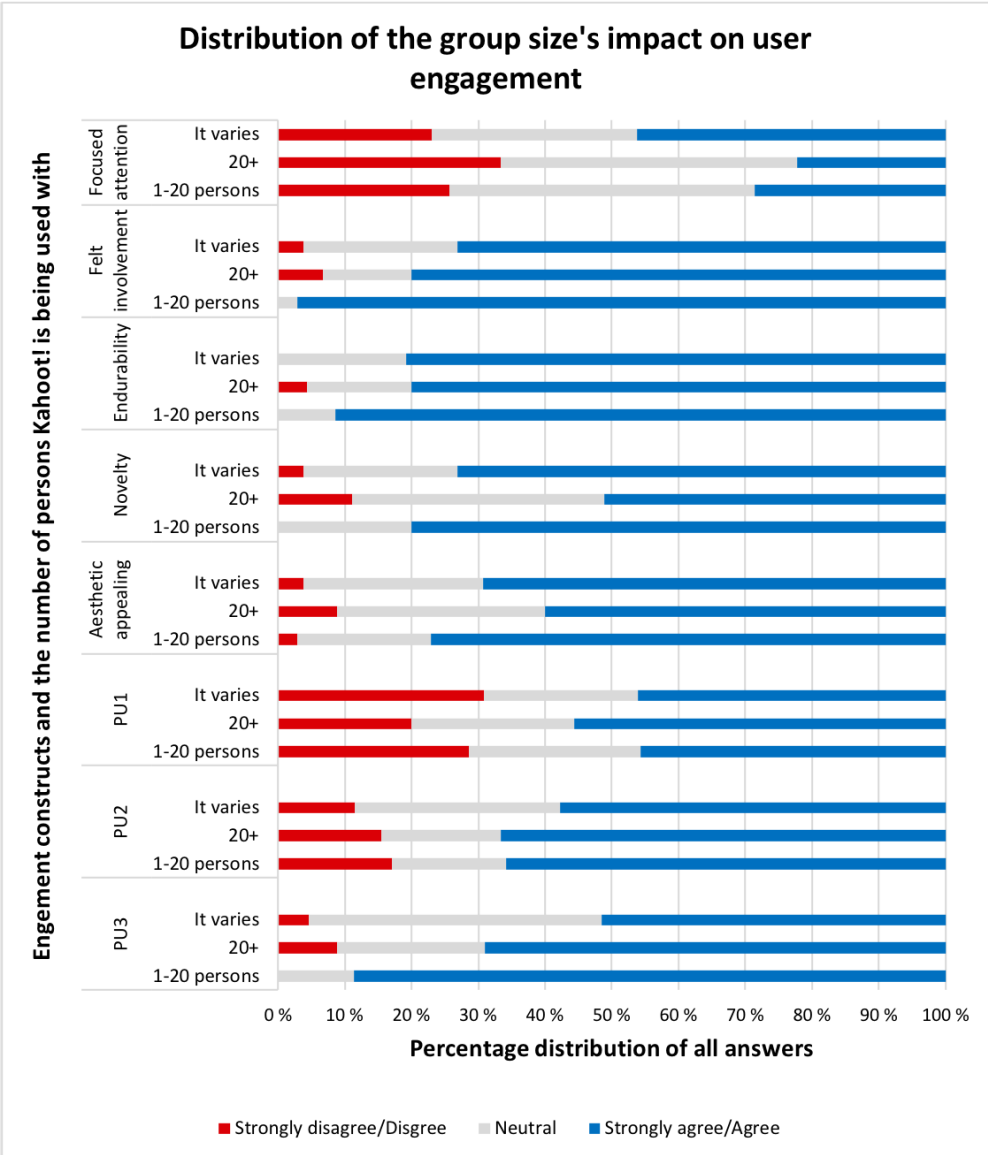


Figure 4.6: The difference in the prominence of each engagement construct and the group sizes Kahoot! is being used in.

To summarize, the findings indicate that Kahoot! seems to facilitate elements that stimulate both the students' and the instructor's engagement, and this is the case both when used in small as well as larger groups.

4.2.3 Influencing factors

Similar to how we investigated the developers' view on influencing factors in their respective SRS, we wanted to collect information on the users' perception. More specifically, the students' and the instructors' opinion on influencing factors in Kahoot!. They were, therefore, asked open-ended questions related to which aspects/factors contribute most to positive or negative experiences with Kahoot!. This was followed by a question directly linked to technical factors in specific, and if they had ever experienced such technical issues (i.e., bad Internet connection, interruptions/disturbances, noticeable delay) affect a Kahoot! session.

Factors contributing to positive experiences

74 out of the 106 respondents replied with full texts, providing a large base of answers to go through. Thus, similar techniques as used when analyzing the interviews were used to analyze the answers. That is, using codes to organise the responses. By sorting each reply, six categories were created, namely "fun/entertainment", "ease of use/usability", "learning outcomes" (related to the academical aspect), "aesthetics/design" of the application, "the competition/challenge element", and "other". The latter was used for the responses which did not fit into any of the above categories. Within these categories, the engagement attributes discussed earlier were, in one way or another, brought up by the respondents. Even though the majority did not point out specific aspects/factors contributing to the perception of having a positive experience with Kahoot!, most answers were somehow related to the attributes. This was illustrated through contents such as how pleased and happy students get, how easy it is to use Kahoot!, the increased engagement, and for what academical purposes Kahoot! had been used for. The most significant findings in each category are highlighted in Table 4.6. Also, the relation to the engagement attributes presented in this thesis is commented on to the right (see the attribute descriptions in Section 4.1.2).

Category	**Responses**	**Comments**
Fun/entertainment	*"The competition element (playing against each other, time pressure) makes it very fun and engaging. The fact that one can follow results live on the screen also makes it fun. The music and graphics also contribute in a positive way."* - teacher in higher education *"It is a fun way to see how well students remember the facts I have taught them. Students tend to like it a lot, they see it as a game, not as tests."* - student in higher education	The perception of something being fun is related to the engagement constructs Felt Involvement and Endurability.
Ease of use/usability	*"Easy to use, engaging, makes students more interested in learning the subject, releases energy, rewarding."* - teacher in higher education *"Most positive aspects are the simple user interface, and the fact that students can play on any smart phone without having anything special installed. Also the competition aspects and the ghost mode."* - teacher in higher education *"Intuitiveness and easy access from different devices is a great advantage."* - teacher in higher education	How easy the users find Kahoot! to use is linked to their ability in doing tasks and navigation in the application. This again is associated with the Perceived Usability.

Learning outcomes	*"I appreciate when students start discussions over questions that can have more than one answer. This can assist the students in arguing their view."* - teacher in secondary or high school *"Students tend to focus and be more attentive and active learners when they are aware that they will be given a Kahoot! at the end of the lesson. This creates a positive learning environment just by simply mentioning the possibility of a Kahoot!."* - teacher in secondary or high school *"That you get a distraction from the typical passive lectures. It makes you wake up a bit because it is more of an active learning form. Also, it might make students pay more attention if they know that there will be a "test"/Kahoot!."* - student in higher education *"It is a nice tool for the teacher to get feedback on the students' gained knowledge. It also contributes to make the teacher reflect upon the main elements of the content to be taught when preparing, and what knowledge the students should be left with [translated from Norwegian]."* - student in higher education	Here, the respondents are clearly pointing out several enhancing effects of using Kahoot!, including the rewarding sides of it as focused and active students, and feedback for teachers. This can be associated with Focused Attention and Endurability.
Aesthetics/design	*"A lot of choices and aesthetically appealing [translated from Norwegian]."* - teacher in secondary or high school *"Pictures and unexpected questions."* - teacher in secondary or high school	The category set is equal to the attribute Aesthetic Appealing, and also Novelty (unexpected elements) is brought up by the latter respondent.

Competition or challenge	*"The students are able to test understanding of concepts in an informal way. The competition aspect encourages understanding and motivation."* - teacher in higher education *"The students enjoy the competition, and I also think that the possibility to stay anonymous helps the students that usually are afraid to speak up or answer questions."* - teacher in secondary or high school	Enjoyment, positive feelings, and how valuable the respondents find the usage of Kahoot! are related to Endurability.

Table 4.6: Responses to what factors contribute to positive experiences with Kahoot!.

As with the findings from the interviews, positively influencing factors brought up by the respondents can be placed in the three categories of IFs to bring them into a broader perspective:

- Human IFs:
  - Unexpected questions.
  - Questions that trigger discussion among the students.
  - Using Kahoot! as a distraction from regular passive lectures.
  - The feedback aspect of Kahoot! that provides teachers feedback on the students' gained knowledge.
  - Pictures integrated.
- System IFs:
  - Ease of use, simple user interface, intuitiveness.
  - Graphics and music in the application.
  - Can be used on several platforms/devices.
  - Variety of choices.
  - Aesthetically appealing.
  - The timer.
  - The competition aspect that encourages understanding and motivation.

- Context IFs:
  - The time pressure.
  - Using screens to follow the results live makes it fun.

Also here, the overlapping of the categories can be sensed by the time pressure for instance. The timer can be seen as a factor influencing the context, but also as a stress factor influenced by humans (and thus a Human IF).

Factors contributing to negative experiences

72 participants responded to this question. In the same manner, as with the positive contributing factors, the responses related to the negative experiences were categorized. Surprisingly perhaps, new categories unfolded. Here, "technical issues", "features/functionalities" in Kahoot!, "time aspects", "the competition element" and "other" were identified as main categories. The broad majority commented on the amount of time it takes to prepare a high-quality quiz and lead a Kahoot! in lecture. Their dissatisfaction was also based on their lack of confidence in Kahoot! as a tool to enhance the students' learning. Some stressed the lack of technically adequate electronic equipment in classes and others were more worried about how weak students might struggle to keep up with others, and that cheating can take place. Table 4.7 points out relevant findings in each category.

Category	**Responses**	**Comments**
Technical issues	*"Bad network connection can be a killer (frustrating when you cannot participate or send in an answer in time)."* - teacher in higher education *"Network problems in the classroom as it can not handle 20+ users online at the same time."* - teacher in higher education *"When Internet and other aspects that you have no control over causes you to answer wrong or late."* - student in higher education *"The most frustrating is when the students lose their network access. Frustrations and noise are then easily triggered [translated from Norwegian]."* - teacher in secondary or high school	Not being able to do or accomplish desired tasks, is related to the attribute Perceived Usability. Also, frustration as an opposite of being enjoyed can be associated with a lack of Felt Involvement and Endurability.
Features or functionalities	*"Preparing the Kahoot! can be frustrating due to the very limited number of characters allowed on each question and each alternative."* - teacher in higher education *"Kahoot! lacks functionality to import questions from other formats. For instance, if you already have a set of multiple choice questions in another tool (...), it would be a great time saver to be able to import these questions to Kahoot! rather than entering them manually."* - teacher in higher education *"Lack of suitable place for storing metadata - e.g., when was this Kahoot! used last time, what was the aim of this Kahoot!, where is the original version, etc."* - teacher in higher education	See comment above.

Time aspects	*"The countdown timer is not always a good thing, forces students to guess instead of think."* - teacher in higher education *"Time consuming. I lack the creativity/knowledge to use Kahoot! for much more than just an informal test."* - teacher in secondary or high school *"Time consuming to make good alternatives."* - teacher in secondary or high school	These statements can be associated with how worthwhile the teachers consider Kahoot! to be. This is emphasized by Endurability.
Competition	*"Can be stressful, can affect students in a negative way if they don't succeed."* - teacher in higher education *"The competition aspect, not necessarily a representative outcome of what the students have learned through the Kahoot!, as many students just rush through to get points. The students stress and do not spend time reflecting on the questions and answers they provide. May be negative for students who do not come up on a scoreboard and thus do not get a sense of achievement [translated from Norwegian]."* - student in higher education	The perception of an experience as successful, as the respondents stress, is related to Endurability.
Other	*"Should not be used too often, then it will be repetitive and monotonous."* - *student in higher education* *"(...) making good and relevant questions."* - teacher in higher education	Similar to the comment above, with the respondents' perception of using Kahoot! as worthwhile.

Table 4.7: Responses to what factors contribute to negative experiences with Kahoot!.

Also here, the three categories of IFs are used to concretize the negatively influencing factors mentioned by the respondents:

- Human IFs:
  - Stress, due to the countdown timer and competition aspect.
  - Preparation of a Kahoot!.
  - Lack of creativity/knowledge to use Kahoot! for more than just informal tests.
  - Use too much time to make good alternatives to the questions.
  - How often Kahoot! is used in lectures, can be repetitive and monotonous when used too often.
  - Make good and relevant questions.
- System IFs:
  - Bad network connection/access (cannot handle 20+ users online).
  - Internet problems.
  - Limited number of characters allowed in Kahoot!.
  - Lack of functionality to import questions in other formats.
  - Lack of possibility to store metadata.
  - The countdown timer which forces students to guess on answers.
  - The competition aspect can stress students, make them rush through to get points, and negatively influence those who do not make it to the top as they will not get the sense of achievement.
- Context IFs:
  - Number of users online at the same time.
  - Time consuming in lectures.

As seen with the IFs provided by the developers, the negatively influenced factors can be categorized into Human, System or Context IFs.

Technical issues

In Section 2.3, the interest in investigating to which extent negatively influencing factors, among them technical factors, should be considered when developing engaging services, was emphasized. Thus, we considered it important to identify which technical factors users of Kahoot! have encountered, and whether or not such factors influenced

their engaging experience with Kahoot!. This focus is related to the System IFs, specifically, exemplified by factors given by the developers and respondents in the preceding sections. Based on the assumption that potential questionnaire participants would not have any technical background, we found it necessary to only include technical issues the majority of all users were likely to relate to without needing any technical references. Thus, the participants were asked whether or not they had experienced bad Internet connection, interruptions/disturbances, and noticeable delay during a Kahoot! session. The results showed that 51% of all respondents had experienced that their sessions were affected by bad Internet connection, 16% experienced interruptions/disturbances and 36% experienced noticeable delay, as shown in Figure 4.7.

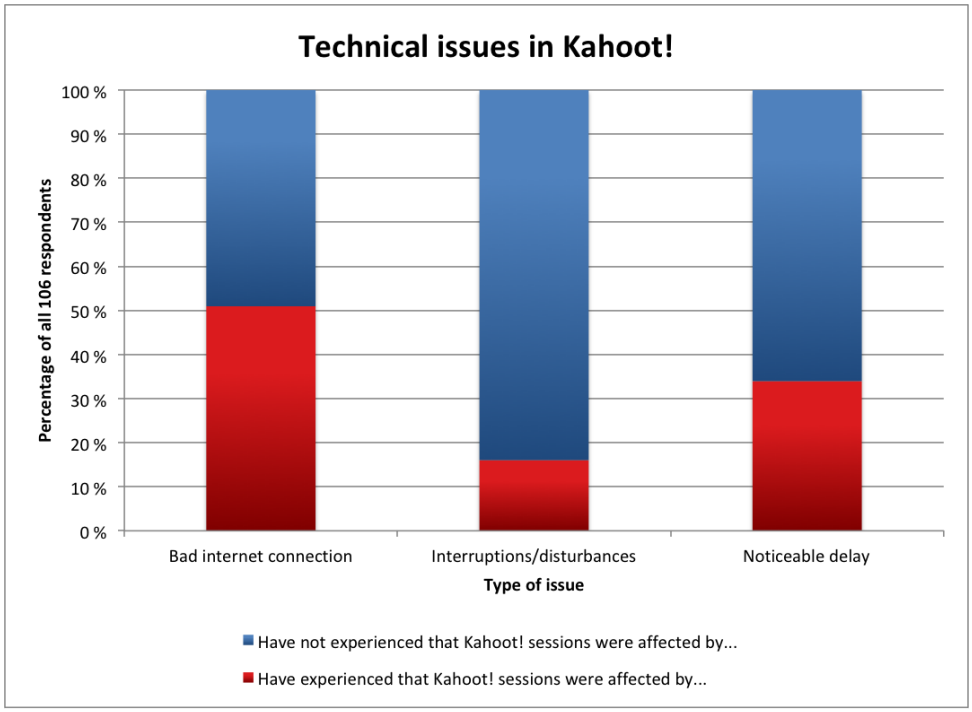


Figure 4.7: Percentage of all respondents who have experienced any technical issues during a Kahoot! session.

We were further interested in examining how these technical issues might have influenced users' perceptions of engagement in Kahoot!, and whether there was any difference between those who had experienced issues and those who had not. Figure 4.8 compares the ratings for Aesthetic Appealing, Novelty, Endurability, Felt Involvement and Focused Attention for the respondents that have experienced bad

Internet connection during a Kahoot! session, and those that have not. Overall, we can see that having experienced bad Internet connection does not have implications for the extent to which the different engagement constructs are prominent (and in some cases, the ones that have experienced bad Internet connection are even more positive, which could be interpreted as an indication of the relatively low importance of technical issues, when considering engagement with Kahoot!).

In the same way, as with checking potential differences between engagement constructs and roles, the chi-square test was nevertheless used here to check for potential differences from a statistical point of view. As none of the comparisons revealed any significant differences, we can conclude that - based on this study - the perception of Kahoot! in terms of different engagement constructs is overall rather positive and whether one has experienced technical problems or not, does not affect that perception.

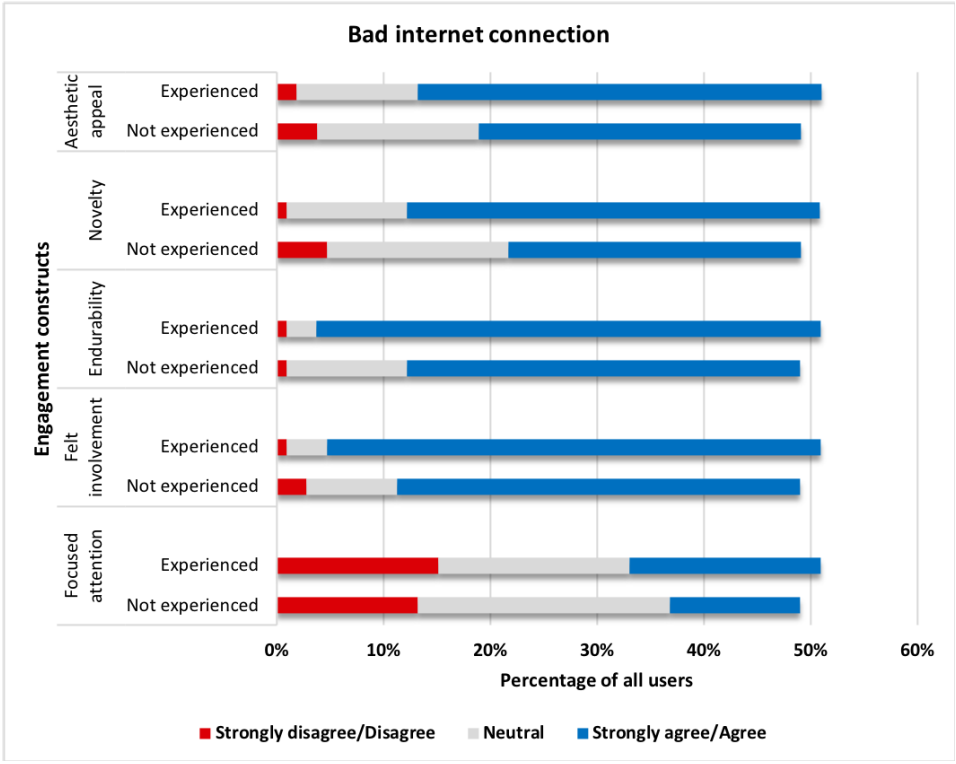


Figure 4.8: The relationship between the distribution of ratings related to the engagement constructs, and whether users have experienced bad Internet connection.

As technical issues might be taken into account when considering the Perceived Usability, i.e., the users' perceived effort and ability to accomplish tasks, and their associated feelings with Kahoot!, we also ran an analysis to verify whether having experienced technical issues is reflected in lower scores for Perceived Usability (note that we here used the individual items, as explained earlier). As the results showed that a slightly low number of respondents had experienced interruptions/disturbances and noticeable delay, these issues were not taken into account in further analyses, due to the low number of respondents. We thus only focused on bad Internet connection. Figure 4.9 shows the outcome of the analysis:

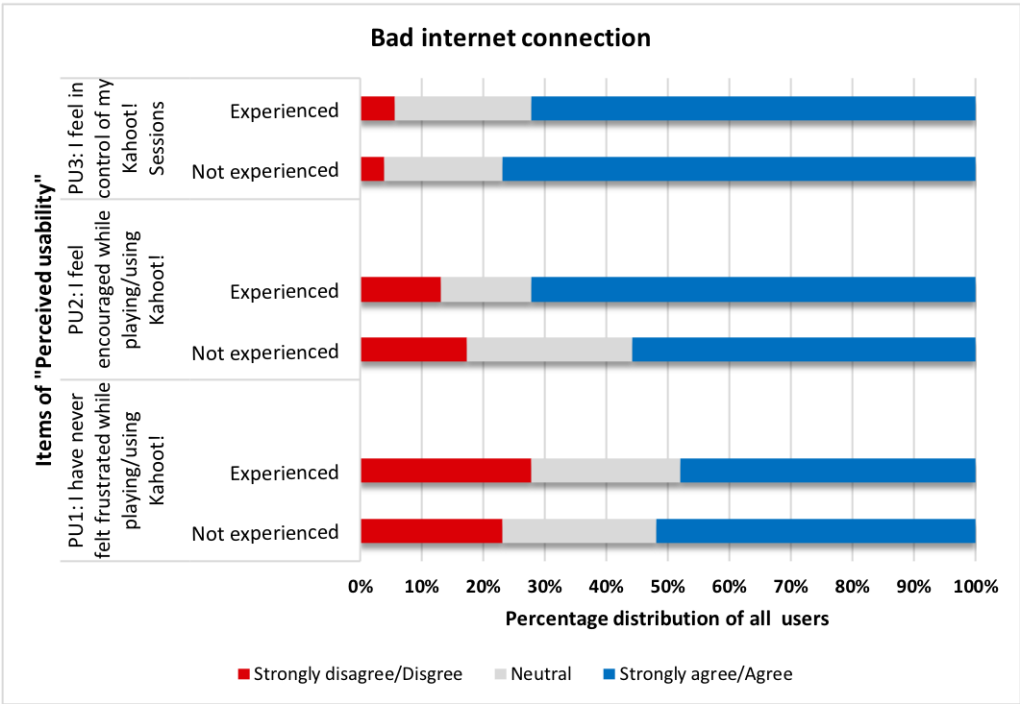


Figure 4.9: The relationship between the distribution of ratings related to the Perceived Usability in Kahoot! and whether users have experienced bad Internet connection.

Likewise Figure 4.8, Figure 4.9 illustrates that bad Internet connection does not affect any of the aspects related to the five engagement constructs or the three items of Perceived Usability to a great extent. The only relatively significant correlation is that PU1 is seemingly the most affected aspect in respect of technical issues.

To summarize, the results show that Kahoot! is used in lectures for several reasons, for instance, repetition of the syllabus and to engage the students. The interviews revealed that "the premise that everything has to work properly" and "the leader's role" were two great factors that influence user engagement in classes where SRS is used. This included the negative effect technical issues have on engagement, and how the instructor's ability to integrate SRS sessions in a suitable way to fit the rest of the context plays an important role. The responses to the user engagement scale in the questionnaire did not result in any significant findings considering engagement aspects when Kahoot! is used in different roles. Neither did it reveal any differences in the users' perceived engagement when they have experienced technical issues. The results are further discussed in the next chapter.

Chapter 5
Discussion

Till now, the motivation for investigating user engagement in the context of educational learning technology with Kahoot!, as a concrete case, has been presented. This, in addition to existing work and literature related to this specific research. Thereafter, the methodology used to investigate the research questions, followed by results from doing the studies chosen, were given.

Based on what is reported in the previous chapters, we will in this part of the thesis elaborate on the research questions set; the importance of user engagement in SRS; aspects of user engagement taken into account when developing GSRS in general, and Kahoot! in particular; factors, in general and of technical nature, influencing user engagement in GSRS, and specifically in Kahoot!. We do this by discussing the findings from the study of the literature and the two empirical studies more in-depth. To structure this chapter in a clear way, we review the research questions in a chronological order. Lastly, we reflect on the limitations of this research.

5.1 The importance of user engagement in SRS

Prior to this research, we already presumed that user engagement is an important element of SRS, and this assumption is in turn the main motivation for further investigating its importance. The literature study illustrated the strong interest in the fields of both classroom technology and user engagement. Previous studies have shown the importance of understanding user engagement and how this understanding can be exploited in the area of new service and technology development. Some of these works were described in Chapter 2, in addition to how user engagement has also been linked to QoE (and positive user experiences in general), as an aspect of it. This idea may indicate that user engagement contributes to good QoE and pleasurable experiences, but that it is a sub-element of it (and that other elements are important as well).

The study of user engagement also includes an unique time aspect, making it

possible for engagement investigators to gain insights into the periods of time users are engaged with a service and those when they are not (or not any longer). This was presented in Figure 2.1. In a broader context, such insights might help in making better services and technology, underlining the field of user engagement's importance in the big picture.

In Chapter 2, we argued for the close relationship between student engagement and user engagement. In the more specific area of classroom technology, it is apparent in several studies that such technology can increase the students' engagement, augmenting our prior assumption. Commonly, these studies refer to SRS as a well-known classroom technology, and that the engagement part in them is elementary for learning to take place. Moreover, users should be left with certain gains, such as the feeling of the engagement process as rewarding and that the tasks were mastered. In the case of SRS, such feelings can be the achievement of learning something and that the questions asked are answered correctly. As described earlier, these kind of feelings are related to engagement through aspects such as Endurability (i.e., rewarding and worthwhile experiences) and Perceived Usability (ability and efforts to accomplish tasks). In addition, literature on classroom technology has shown that the focus on the engagement dimensions (i.e., cognitive, behavioral and emotional) should be included in fields of educational research, stressing user engagement's prevalence. Background studies on SRS thus highlight the importance of user engagement indirectly, by shedding light on aspects that must take place in a learning process, which again can be related to aspects of engagement found in the literature on that specific concept.

A number of observations based on the first empirical study (i.e., the interviews) can also be mentioned here. Though statements from the small number of two SRS developers cannot answer for all SRS in general, the findings from interviewing them might, to a certain extent, give an indication of why user engagement is important in SRS. According to Wang (Kahoot!) and Stoica (ONE2ACT), user engagement is definitely playing an important role in their respective SRS. An interesting difference was their perspective on user engagement, with Stoica seeing it as a consequence of good design, intended to make people learn, and Wang seeing it as the main design goal (see #3 and #5 in Table 4.1). One possible interpretation of these different attitudes, is that they are linked to the importance attached to engagement in traditional SRS versus game-based SRS. Based on their views, engagement is not necessarily more important in game-based SRS than in traditional SRS, yet it seemingly is more focused on. This is supported by the findings from the literature review, addressed in Section 2.3.2, where we highlighted how different game mechanisms combined with educational elements for engaging learning, can increase the user engagement. Further, their statements about how user engagement is crucial for enabling learning, and that interactions increasing the engagement and motivation to keep focused

attention are needed, really point to the direction of user engagement being important in SRS.

As mentioned, in this work, the intention was also to cover the different user perspectives of Kahoot!. This, in order to investigate whether the role one has when using a game-based SRS (student versus. teacher) has implications for user engagement and the relative importance of different engagement dimensions. Generally, user engagement's prominence in Kahoot! was high for both groups according to the results from the questionnaire. This was illustrated in Figure 4.4. These findings also support Wang's statement about Kahoot! being "designed for engagement". The construct Focused Attention and the items PU1 and PU2 were the statements with the lowest ratings. Both PU1 and PU2 are related to feelings during a Kahoot! session, more concretely frustration and discourage. These are feelings which can occur due to the competition aspect of Kahoot!, for instance, due to answering incorrectly or losing the leading position. The respondents may, therefore, have interpreted the statement in that way, resulting in the relatively low score in PU1 and PU2. Thus, a possible interpretation of these lays in the nature of the game Kahoot! and not in how Kahoot! facilitates user engagement. Focused Attention, on the other hand, can be explained by the fact that many users consider Kahoot! as a game, and not a formal test one needs to perform on. This was also revealed by the open-ended questions in the questionnaire. When comparing the results for teachers and students more in-depth, no striking or significant differences could be observed. However, this does not imply that we can state with 100% certainty that there are no variations. Rather, it implies that given the sample and used data collection method, we could not unravel any significant differences. What might is worth noting in this respect, is the high ratings from the teachers/professors participating in the questionnaire. These numbers illustrate that using Kahoot! in the role of an instructor leads to engaging experiences as well. Whether they really rated the engagement statements solely based on their role as instructors of Kahoot! sessions, or also based on how they think players perceive the Kahoot! experience, or even based on the broader engaging experience that Kahoot! may trigger in the classroom, is unclear. Assuming the former idea, Kahoot! must have done something right to make teachers engage to such a great extent in a service meant for students. If some of Kahoot!'s seeming success-factors discussed in this thesis can be applied to other classroom technologies to engage both students *and* teachers, this thesis has hopefully contributed to the field of studying educational technology.

To summarize, the importance of user engagement in SRS is definitely a matter of fact. This is supported by both findings from the literature on user engagement and educational technology, and statements from two SRS developers. From these studies, it is revealed that user engagement is very important, further emphasized by the claim that engagement in SRS must be facilitated for in order for learning to

take place - the prime intention of using SRS in classes.

5.2 Aspects of user engagement taken into account when developing GSRS, and Kahoot! in particular

From the literature review, we saw that user engagement is complex, but can be viewed in the light of several attributes and dimensions, as described in 2.1.1. When viewed in a technology setting, the six attributes Focused Attention, Perceived Usability, Felt Involvement, Endurability, Novelty and Aesthetic Appealing have been used to describe user engagement. These have been elaborated on in earlier chapters and are focused on in this thesis. However, additional aspects of engaging experiences have been identified in other settings/use cases in which user engagement has been studied (see Section 2.3.2). Among these were typical characteristics used in engaging educational systems, and characteristics used in video games. The combination of these characteristics is the main essence in Kahoot!, making it a game-based SRS,or GSRS.

Previously, we stated that user engagement does play an important role in SRS. The development of a SRS, and especially a GSRS, therefore requires knowledge on how engagement can be facilitated and on how to integrate elements that increase the engagement into the design. We aim at providing a more clear picture of which aspects that are being taken into account when developing a GSRS by comparing aspects of engagement that are included in Kahoot! and aspects of engagement that are included in traditional SRS (having ONE2ACT in mind). This, based on the aspects found from the literature review, and findings from the empirical studies carried out in this research. Table 5.1 illustrates this:

Engagement aspect	**SRS**	**Kahoot!**	**Comment**
Focused Attention	✓	✓	In the literature, it has been reported that using SRS in classrooms can motivate students to keep focused and pay attention. From the questionnaire, Focused Attention did not have highest score, but the overall rating was relatively high anyway.
Perceived Usability	✓	✓	Necessary for an educational service to be really used. Instructors must feel in control, and students must feel they are able to perform system tasks. Both Stoica and Wang stressed this with the premise that everything works properly, illustrating that this attribute is focused on in both SRS in general and Kahoot!.
Felt Involvement		✓	The importance of users being immersed in traditional SRS was not found in the research. However, the attribute scored highly in the questionnaire, and theory on games includes the element of giving users immersing experiences. As Kahoot! can be considered as a game in addition to a SRS, the importance of this attribute is likely taken into account when developing it.
Endurability	✓	✓	Definitely an aspect of interest in SRS as this must be present for users to keep using the tools. The attribute scored highly in the questionnaire, underlining that it is highly considered in Kahoot!.
Novelty	✓	✓	Curiosity and interest can be viewed as triggers to engage in services. Thus, to actually start using SRS, the aspect Novelty is essential.
Aesthetic Appealing		✓	The importance of how attractive SRS in general must be was not found in the research. In Kahoot! however, the attribute was brought up by the respondents.

Enjoyable (fun) situations	✓	✓	Both Stoica and Wang reported that students find the use of their respective SRS in lectures fun, and this was supported by the answers from the respondents.
Ease of use	✓	✓	Emphasized in both interviews and in answers from respondents.
Variety	✓	✓	To some extent based on traditional SRS' functionality. A respondent mentioned the having a lot of choices in Kahoot! as engagement aspect.
Interactivity	✓	✓	Definitely main elements in SRS in general.
Surprise/unexpected delights		✓	Unexpected questions in Kahoot! was reported by a respondent as an engaging aspect.
Feedback	✓	✓	Both the developers and some respondents elaborated on this.
The widespread use of music, graphics and colors		✓	Core elements in Kahoot!.
Problem solving/challenge	✓	✓	To some extent in general SRS with questions to answer, but questions in Kahoot! are probably viewed more as obstacles to overcome (due to the game aspect).
Leaderboards		✓	Integrated in Kahoot!.
Points/rewards		✓	Integrated in Kahoot!.
Levels			Not integrated in SRS or Kahoot!.

Table 5.1: Aspects of engagement taken into account in general SRS and Kahoot!.

The gathered aspects of user engagement and characteristics of engaging experiences in Table 5.1 were described or mentioned in the Background and Related Work. Based on previous research done on video games elements combined with educational tools, we know that game mechanisms can increase student engagement. Table 5.1 illustrates how well Kahoot! has seemingly facilitated for characteristics used to increase the engagement via game mechanisms. Additionally, it shows that Kahoot! has more of these aspects/characteristics integrated than traditional SRS, supporting what is said in the literature about how the game-element can trigger engagement to another level. This stresses the fact that Kahoot! is really designed

for engagement, and that the development process of it is influenced by developers with knowledge in how user engagement can be promoted.

The table may describe which aspects we can recognize in both traditional SRS and in Kahoot!. However, it does not provide any information about how important each of the aspects and characteristics when it comes to having engaged users. A natural question here, is whether or not users will stop using the system if the engagement level is too low. From O'Briens work on the engagement process [1], we know there is a conceptual way of viewing engagement as a process model, and that the attributes of engagement have varying levels of intensity. As stated in Section 2.1.2, developers ought to know which attributes initiate and which ones sustain the engaging experiences. In a future study, it might be interesting to compare Kahoot! with a traditional SRS to find out to which extent each of the aspects are important. For this thesis however, we need to use the developers' and the questionnaire respondents' answers in the best possible way to gain any insights in this area.

Whether or not users actually stop using the service if the engagement level is too low, was not investigated directly, but answers from both Stoica and the questionnaire respondents indicate to a certain degree that users loose their motivation in using a SRS if they are not engaged enough. Stoica mentioned that experiencing issues in the beginning of using new technology is very damaging, insinuating that one becomes discouraged for later usage. This again can presumably lead to abandonment or disengagement: users that quit using the service. Some respondents brought up technical issues as concrete cases which trigger frustration and annoyance. We know from previous studies that such emotional states affect the user engagement in a negative way, by having an impact on the engagement attribute Perceived Usability (see user engagement scale in Appendix A or [9]). The findings of Sunde and Underlaug, reported on in Section 2.3.3, support this by showing how annoyance is triggered when QoE is low, which we in turn argued is closely related to user engagement in Section 2.1.2. Thus, we cannot claim that users of SRS will stop using the services if the engagement level is too low, or if there are barriers to engagement when using the system, but we can argue from our findings so far that maybe certain aspects of user engagement, such as Perceived Usability, are more exposed to negative influences. This again may make users feel that they are not able to accomplish tasks in a SRS, or that accomplishing tasks requires too much effort. From there, the way to disengagement is most likely short.

To summarize, by the overall investigation of engagement aspects taken into account when developing a GSRS, the six attributes of engagement in technology suggested by O'Brien [9] have been identified in this research. Also, other characteristics such as various game mechanisms have been highlighted, proving Kahoot! as not

just a educational tool, but also as some kind of game. Beside the six engagement attributes, the competition element is probably the most prominent aspect of GSRS. This element was an underlying aspect in several answers from the respondents, and Wang emphasized its prominence by stating the importance of having someone to compete with, either other students or even yourself. Due to Kahoot!'s success, there is reason to believe that similar approach with including these aspects and elements will result in other good GSRS when developing classroom technology.

5.3 Factors influencing user engagement in GSRS, and specifically in Kahoot!

So far, the importance of user engagement, especially in GSRS as the focus of thesis, has been examined. Further, elements that are integrated in classroom technology for triggering this actual engagement - as an essential element for learning to take place - among students were discussed. The last research question discussed here is centered around factors that influence user engagement in GSRS.

In this context, it is relevant to revisit the conceptual "User Engagement Process Model", mentioned earlier (in Section 2.1.2). This model illustrates that user engagement and its aspects vary in intensity because of various factors influencing this broad concept. As explained in previous chapters, this understanding is important for being able to determine why users, here students and to a slight extent teachers, engage in technology and why they keep using it. Naturally, it is desirable to give users the most enjoyable experiences as possible to not lose them to other applications, services or technologies. By gathering insights into the most relevant influencing factors, our hope is to contribute to future development of classroom technology, and particularly GSRS. The influencing factors discussed here have been identified in the literature, and in findings from the conducted empirical studies. In these studies, we showed that broader established perspectives such as the Influence Factors (IFs) categories and engagement attributes can be used to discuss identified factors and get an understanding of them in a broader context. Also, other categories were found during the phase of identifying influencing factors by studying the respondents answers. Figure 5.1 is provided here as an attempt to illustrate a simplified version of the user engagement process model, and in which stages the identified factors may play a role. Such a conceptual picture may be utilized in future development of GSRS.

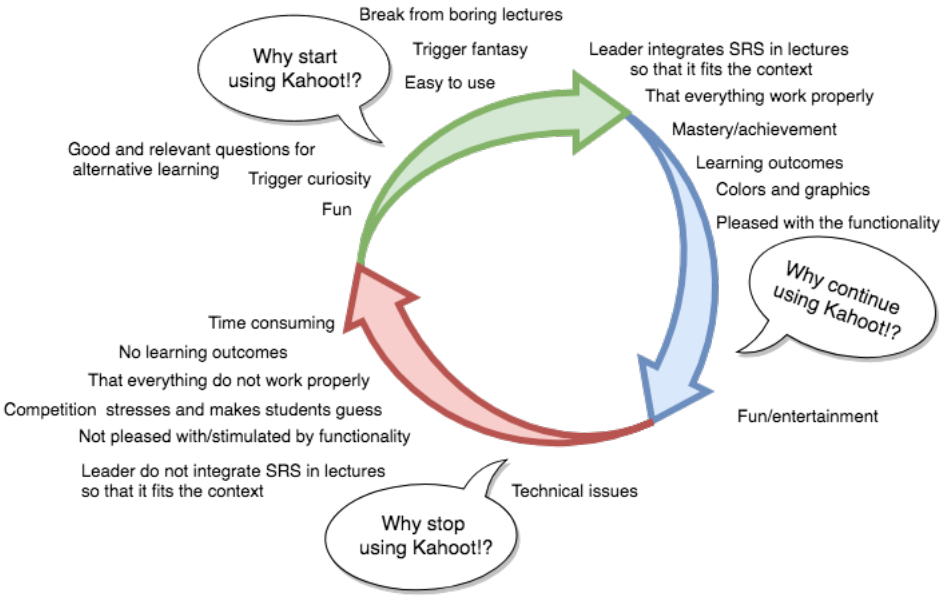


Figure 5.1: A simplified process model for user engagement with factors associated to each stage.

A specific aim of RQ3 has been to more specifically shed light on the role of technical influence factors. As seen in Figure 5.1, there are various ways of increasing an engaging experience by including factors influencing engagement in a positive way. Nevertheless, disengagement can be a result of negatively influencing factors triggering this process stage. Thus, developers should try to avoid the possibility of letting such factors influence the technology experiences. Put differently, they should not only enable user engagement by including engagement triggering elements, they should also actively try to remove barriers to engagement. However, this turned out to be one of the greatest challenges to developers, as was revealed through the interviews. Wang mentioned the handling of issues related to network (e.g., lost connection) as an obstacle hard to overcome for developers, but also as a potential barrier for users to engage with services. To consider positively influencing factors is indeed important, but as negatively influencing factors can make users disengage and stop using technology, they are as important, if not more.

Sunde and Underlaug [37] reported that technical issues, as a subgroup of negatively influencing factors in this respect, lead to poor QoE by triggering frustration and annoyance in users of Kahoot!. Their findings are augmented by Stoica and Wang in their citations about negative factors influencing user engagement, along with what the respondents answered to the open-ended questions about such factors.

Based on this, when relating the user engagement attributes to respondents' experiences with technical issues, it was expected that the negative impact of technical challenges would have been reflected somehow. Surprisingly, this was not the case. According to the observations (and contrary to what was reported in the work of Sunde and Underlaug [37]), technical issues do not seem to influence user engagement. However, these results can possibly be explained by the chosen research method, which we will elaborate on in Limitations. A potential explanation can be that as a (cross-sectional) questionnaire was used, the respondents had not been exposed directly to negatively influencing factors when asked about them. This could have resulted in completely different outcomes, which in all likelihood would have turned out differently if similar experiments as Sunde and Underlaug [37] would have been used. However, the relatively low importance attached to technical impact factors in study 2, also indicates that positive enablers of user engagement are more prevalent and better remembered than negative barriers that one may have experienced at some point.

Another relevant issue to comment on and that is related to this, is that the users were in the beginning of the questionnaire asked to recall their usage of Kahoot! during *the last month*. This reference period was included in accordance to common methodological guidelines when asking for aspects such as use frequency or use duration in a questionnaire. Considering the fact that Kahoot! is particularly used as an educational tool, the usage of it is presumably low as opposed to more everyday used applications such as Facebook. Some even specified that they only use Kahoot! in one semester a year, leading to a half year old memory of Kahoot! and their last usage. Therefore, most respondents answered based on their overall impression of Kahoot! with memories going weeks, and even months back. The high score of user engagement regarding technical issues (in this case bad Internet connection) can thus indicate that most people are satisfied with how engagement is facilitated in Kahoot! and that earlier problems, technical issues or negative factors they have experienced do not weaken their general impression of Kahoot!. In all, this might imply that the developers of Kahoot! have managed to both integrate aspects of, and facilitate for, user engagement in a way so that the presence of negatively influencing factors is hardly affecting the long run/cumulative impression that users report on when asked about this, from the top of their minds.

To sum up, several examples of factors influencing user engagement positively or negatively have been identified. These can be seen in the light of the Human, System or Context IFs, or the engagement attributes as shown in Results. Further, limitations in the strategy for approaching the given results are presented.

5.4 Limitations

Naturally, the various choices made for methods to include and how they are carried out have influenced the outcomes of this research. In this section, possible limitations of the work presented in this thesis are discussed. These limitations may have impacted the gathered data and the validity of the results.

It was made clear in Methodology that by gaining adequate insights into the advantages and disadvantages of different research methods, one can try to limit quite a number of potential weaknesses of a study/research project. Such limitations may have an impact on the validity and reliability of the obtained results. Yet, there are many ways to understand and assess validity and reliability, typically based on what discipline and which assumptions the research relies on. This is in turn a limitation, as one can not possibly cover all perspectives. However, the approach for this research is inspired by the citation "We analyzed threats to validity and reliability in quantitative and qualitative parts of mixed methods research using the quality standards of each" in [58], illustrating that this limitation has been considered.

Generally, the methods used are highly subject to subjective perceptions and opinions concerning user engagement in both Kahoot! and ONE2ACT. This also implies that they are sensitive to subjective biases (e.g., memory bias). First of all, a less subjective approach including more objectively gathered types of data could have contributed to lower the subjective bias, e.g., through logging of performance related events, experimental laboratory studies objectively capturing the behavior of the participants (e.g., through eye-tracking, facial expression analysis). However, as we have seen in chapter Background and Related Work, engagement is an inherently subjective process, involving behavioral, cognitive and affective processes. An approach based predominantly on objective measures would be limited the possibilities for further exploring exactly the inherent subjective character of engagement.

In addition, the number of people included in this research could have been increased in both the interviews and for the questionnaire to provide more trustworthiness to the results. However, as explained in chapter Methodology, a lot of effort was put in the recruitment of potential survey respondents. In addition, the time and resource constraints of the project also played a role in this respect. Still, we argue here that the quality and volume of the gathered data enable us to provide meaningful answers the research questions. Nevertheless, as mentioned earlier, the results cannot be generalized to all Kahoot! users.

To dig deeper in the interviews carried out, only the first interview was accompanied by an experienced interviewer. The second on the other hand, was conducted by a novice, which may have resulted in a less thorough interview. An expert could have supervised throughout the conversation, and filled in with questions where lack

of information was considered. However, the interviews were thoroughly prepared and based on a consultation of literature on how to conduct an interview, what to pay attention to etc. Finally, the interview was based on an interview guide, which lowered the chance of overseeing an important topic/question.

Moreover, the decision to only include Kahoot! in further studies, can also be questioned. This, because Kahoot! is well-established and seemingly stable when it comes to its susceptibility to technical problems as the results showed. How Kahoot!'s users engage with the application is not easily affected by negatively influencing factors such as technical issues in the long run. Most likely, these results are consequences of a good management and developers continually working with the robustness of the service. Nevertheless, if ONE2ACT had been the service in focus (or the second one, next to Kahoot!), other outcomes could have been expected, given the earlier indicated lack of interest and resources to further developing it. However, due to the time-related and other resource constraints associated with the master's thesis project, it was not possible to consider both SRS.

Considering the questionnaire, a limitation worth taking into account for future work, was the lack of time to carry out follow-up interviews with the respondents. It would have been interesting to ask the respondents follow-up questions regarding their answers to influencing factors, to maybe get more detailed information about how they think such factors influence their further engagement in Kahoot!, and whether such factors are essential for them to sustain engaged in the service, or could trigger disengagement. More time could thus have resulted in a broader and more concrete insight.

As described earlier in Chapter 5, no significant differences were found in any of the observations done from the questionnaire by first glance or when using the Pearson's Chi-square test. We argue however that this does not imply a weakness in the choice of method, as there is reason to believe that more differences, for instance between different roles when using Kahoot! or between those that have experienced/not experienced technical issues, would have manifested themselves. Statistically significant differences are not a goal in themselves - in this case, the lack of such significant differences actually lead to interesting observations and conclusions.

As already mentioned, approaches leading to a direct exposure (e.g., to technical issues), such as in an experimental laboratory study, could have been used to let the respondents have a fresh memory of their experience with Kahoot! instead of having them answer with what is on top of their mind. Such approaches often tend to lead to statistical significance, as triggered by certain manipulations or conditions. However, as argued earlier, such approaches are limited in terms their external validity (being the extent to which they actually resemble more natural settings as well, and can be

generalized beyond the precise settings and conditions of an experiment).

Lastly, the limitations in the adjusted UES included in the questionnaire may have affected the data, and subsequently, the results. As explained in Methodology, three items per construct were used, reducing the scale size significantly. The original scale was already validated for a specific context, so the simplification of it for this context may have lead to other unexpected outcomes. A well-known characteristic of Cronbach's α, is its scaling based on numbers of items. By including more than three items in each construct, the α values would probably have been higher, which in turn could have further strengthened the reliability of the scale. Additionally, the construct Perceived Usability may have yielded an acceptable Cronbach's α value and may thus have been included. However, as explained, the shortening of the UES was not taken lightly and was done the optimize the length of the questionnaire and to minimize the risk of drop-out. This April, a refined UES with a short form was published by O'Brien [61], which could have been used to limit the weaknesses in this research's questionnaire scale. Unfortunately, by the time the new scale was published, the questionnaire was distributed and processed. Using the refined scale in future studies is suggested to avoid as many adjustments and reductions as possible.

Chapter 6
Conclusions and Future Work

In this thesis, the concept of user engagement has been investigated in the context of classroom technology. The educational tools falling under the term student response systems (SRS) have been focused on due to their ability to make students engage in classrooms by providing digital interactions. Previous work has shown that this engagement can be highly increased by integrating game mechanisms into the SRS's design, making them game-based SRS (GSRS). However, few studies have investigated what the most prominent engagement-influence factors are in this respect. In particular, the role of system-related technical aspects on engagement has received little attention. Thus, to gain a better insight into the concept of user engagement and the factors bearing an influence on it in the context of GSRS, this research focused Kahoot! as a concrete example of a GSRS where user engagement is possibly playing a huge role.

A mixed methods research design was used to examine the importance of user engagement in the context of SRS, aspects taken into account when developing GSRS, and factors that trigger and influence user engagement positively or negatively. This design included a literature review, semi-structured interviews with two SRS developers, and a larger-scale study based on an electronic questionnaire.

Generally, the research illustrated how identified aspects of user engagement in SRS, and particularly GSRS, should not be viewed isolated but rather in the light of broader, established experience concepts for understanding user engagement better. More specifically, Influencing Factors (Human, System, and Context) and the engagement attributes (Perceived Usability, Focused Attention, Felt Involvement, Endurability, Novelty and Aesthetic Appealing).

Results from the questionnaire indicated that users' feeling of being drawn into/involved in the experience with Kahoot! (Felt Involvement) is high, yet that the feeling of completely forgetting the world around when using/playing Kahoot! (Focused Attention) is overall rather low. Interestingly, the level of user engagement

did not seem to differ when Kahoot! is used by a student or by a teacher (instructor). This observation might imply that the extent to which one feels engaged with Kahoot! is thus not related to the role one has when using it. A slight tendency of a higher engagement when Kahoot! is used in smaller groups could be observed, but further research is needed to confirm this.

Considering influencing factors, the consensus in the answers (from both developers and questionnaire respondents) was that there are several factors contributing to both positive and negative experiences with Kahoot!. However, further observations illustrated that technical issues, as negatively influencing factors, do not seem to affect user engagement to a very large extent (and do, e.g., not lead to disengagement). Thus, this research signals that Kahoot! as a GSRS manages to facilitate user engagement in such a way so that negatively influencing factors - even though they manifest themselves and are noticed - barely affect the general impression users have of Kahoot!.

Further work on this specific subject should, first of all, aim at deepening and validating the findings on engagement aspects and influencing factors in this thesis, for instance by conducting in-depth interviews with teachers/instructors and students using Kahoot!. Additionally, a survey targeting larger groups of users of different types of SRS and GSRS would be valuable. O'Brien's refined UES [61] should, in this case, be implemented as a part of the methodology to possibly disclose other differences than found in this research. The combination of additional qualitative and quantitative insights could form the basis for a set of experimental follow-up studies, focusing more on technical influence factors (and how it can be prevented that they form a barrier to user engagement). Such follow-up studies may include observation of Kahoot! users (e.g., measure their level of engagement by using performance indicators), focus groups, and experimental laboratory studies (e.g., modulation of network metrics) to extend the range of domains engagement with Kahoot! has been explored in.

Furthermore, the conceptual "User Engagement Process Model" has been mentioned throughout the thesis, but was not used to study Kahoot! extensively, as this would have required a longitudinal study set-up. Research basing its methodology on this process model might bring findings beyond those found by this research, for instance, distinct crossings for each stage and which concrete factors trigger these. Such research could be carried out by means of a longitudinal panel study with the UES distributed over a longer period of time, gathering feedback on Kahoot! users' engagement at different engagement stages.

Finally, one could also consider investigating user engagement with other GSRS. Kahoot! in this respect has managed to become successful and is a well-established

educational tool. Indications thus imply that user engagement in Kahoot! really is high, and that other outcomes could be expected by looking at other similar tools not fully developed. It would be interesting to see whether or not similar findings of user engagement can be found in other GSRS as well.

Hopefully, this research has contributed to the field of studying classroom technology in general, and GSRS in particular. However, the notion of user engagement is still immature, reflected by the still evolving theories related to it and the ever emerging exploratory studies done to investigate the concept in various settings. Thus, more research needs to be done to fill the broad concept with knowledge one can make use of when developing engaging technologies.

References

[1] H. L. O'Brien and E. G. Toms, "What is user engagement? A conceptual framework for defining user engagement with technology," *Journal of the Association for Information Science and Technology*, vol. 59, no. 6, pp. 938–955, 2008.

[2] U. Reiter, K. Brunnström, K. De Moor, M.-C. Larabi, M. Pereira, A. Pinheiro, J. You, and A. Zgank, "Factors influencing quality of experience," in *Quality of experience*. Springer, 2014, pp. 55–72.

[3] S. Ickin, K. Wac, M. Fiedler, L. Janowski, J.-H. Hong, and A. K. Dey, "Factors influencing quality of experience of commonly used mobile applications," *IEEE Communications Magazine*, vol. 50, no. 4, 2012.

[4] Y. H. Kim, D. J. Kim, and K. Wachter, "A study of mobile user engagement (MoEN): Engagement motivations, perceived value, satisfaction, and continued engagement intention," *Decision Support Systems*, vol. 56, pp. 361–370, 2013.

[5] F. Dobrian, V. Sekar, A. Awan, I. Stoica, D. Joseph, A. Ganjam, J. Zhan, and H. Zhang, "Understanding the impact of video quality on user engagement," in *ACM SIGCOMM Computer Communication Review*, vol. 41, no. 4. ACM, 2011, pp. 362–373.

[6] M. Z. Shafiq, J. Erman, L. Ji, A. X. Liu, J. Pang, and J. Wang, "Understanding the impact of network dynamics on mobile video user engagement," in *ACM SIGMETRICS Performance Evaluation Review*, vol. 42, no. 1. ACM, 2014, pp. 367–379.

[7] J. Webster and H. Ho, "Audience engagement in multimedia presentations," *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, vol. 28, no. 2, pp. 63–77, 1997.

[8] "Kahoot! ABOUT US," (Date last accessed: May-01-2018). [Online]. Available: https://kahoot.com/company/

[9] H. L. O'Brien and E. G. Toms, "The development and evaluation of a survey to measure user engagement," *Journal of the Association for Information Science and Technology*, vol. 61, no. 1, pp. 50–69, 2010.

[10] S. Machajewski, "Application of gamification in college stem introductory course: A case study (doctoral dissertation)," *Retrieved from ProQuest Dissertations and Theses database*, 2017.

[11] T. Y. Lim, C. Y. Khor, and Y. B. Oon, "Measuring user engagement in mobile classroom response system: A case study," in *International Conference on Learning and Collaboration Technologies*. Springer, 2017, pp. 375–388.

[12] A. I. Wang and A. Lieberoth, "The effect of points and audio on concentration, engagement, enjoyment, learning, motivation, and classroom dynamics using kahoot!" in *European Conference on Games Based Learning*. Academic Conferences International Limited, 2016, p. 738.

[13] A. I. Wang, M. Zhu *et al.*, "The effect of digitizing and gamifying quizzing in classrooms," in *European Conference on Games Based Learning*. Academic Conferences International Limited, 2016, p. 729.

[14] Cisco, "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016–2021 White Paper," (Date last accessed: June-04-2018). [Online]. Available: https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.html

[15] S. Attfield, G. Kazai, M. Lalmas, and B. Piwowarski, "Towards a science of user engagement (position paper)," in *WSDM workshop on user modelling for Web applications*, 2011, pp. 9–12.

[16] C. Moldovan and F. Metzger, "Bridging the Gap between QoE and User Engagement in HTTP Video Streaming," in *Teletraffic Congress (ITC 28), 2016 28th International*, vol. 1. IEEE, 2016, pp. 103–111.

[17] J. Lehmann, M. Lalmas, E. Yom-Tov, and G. Dupret, "Models of user engagement," *User Modeling, Adaptation, and Personalization*, pp. 164–175, 2012.

[18] H. L. O'Brien, "Theoretical perspectives on user engagement," in *Why Engagement Matters*. Springer, 2016, pp. 1–26.

[19] H. L. O'Brien and K. E. MacLean, "Measuring the user engagement process," in *Digital Life New World Conference, Boston, MA*, 2009.

[20] H. L. O'Brien, "The influence of hedonic and utilitarian motivations on user engagement: The case of online shopping experiences," *Interacting with computers*, vol. 22, no. 5, pp. 344–352, 2010.

[21] ITU-T Recommendation, "E. 800: Definitions of terms related to quality of service," *International Telecommunications Union, Geneva*, 2008. [Online]. Available: https://www.itu.int/rec/T-REC-E.800-200809-I/en

[22] ——, "P.10/g.100: Vocabulary for performance and quality of service," *International Telecommunications Union, Geneva*, 2017. [Online]. Available: https://www.itu.int/rec/T-REC-P.10-201711-I/en

[23] S. Möller and A. Raake, *Quality of experience: advanced concepts, applications and methods*. Springer, 2014.

[24] K. De Moor, M. R. Quintero, D. Strohmeier, and A. Raake, "Evaluating QoE by means of traditional and alternative subjective measures: an exploratory 'living room lab' study on IPTV," *Vienna, Austria*, 2013.

[25] A. Bouch, A. Kuchinsky, and N. Bhatti, "Quality is in the eye of the beholder: meeting users' requirements for internet quality of service," in *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. ACM, 2000, pp. 297–304.

[26] A. Balachandran, V. Sekar, A. Akella, S. Seshan, I. Stoica, and H. Zhang, "A quest for an internet video quality-of-experience metric," in *Proceedings of the 11th ACM workshop on hot topics in networks*. ACM, 2012, pp. 97–102.

[27] P. Juluri, V. Tamarapalli, and D. Medhi, "Measurement of quality of experience of video-on-demand services: A survey," *IEEE Communications Surveys & Tutorials*, vol. 18, no. 1, pp. 401–418, 2016.

[28] A. Tarute, S. Nikou, and R. Gatautis, "Mobile application driven consumer engagement," *Telematics and Informatics*, vol. 34, no. 4, pp. 145–156, 2017.

[29] H. L. O'Brien, "The influence of hedonic and utilitarian motivations on user engagement: The case of online shopping experiences," *Interacting with computers*, vol. 22, no. 5, pp. 344–352, 2010.

[30] ——, "Translating theory into methodological practice," in *Why Engagement Matters*. Springer, 2016, pp. 27–52.

[31] C. Wankel and P. Blessinger, *Increasing student engagement and retention using classroom technologies: classroom response systems and mediated discourse technologies*. Emerald Group Publishing Limited, 2013.

[32] Y.-C. J. Wu, T. Wu, and Y. Li, "Impact of using classroom response systems on students' entrepreneurship learning experience," *Computers in Human Behavior*, 2017.

[33] W. P. Boyd, *Bring your own technology: The effect of student-owned technology on student engagement*. Trevecca Nazarene University, 2015.

[34] A. I. Wang, "The wear out effect of a game-based student response system," *Computers & Education*, vol. 82, pp. 217–227, 2015.

[35] D. Bruff, *Teaching with classroom response systems: Creating active learning environments*. John Wiley & Sons, 2009.

[36] P. K. Dunn, A. Richardson, F. Oprescu, and C. McDonald, "Mobile-phone-based classroom response systems: Students' perceptions of engagement and learning in a large undergraduate course," *International Journal of Mathematical Education in Science and Technology*, vol. 44, no. 8, pp. 1160–1174, 2013.

[37] M. T. Sunde and A. G. Underdal, "Investigating QoE in a Cloud-Based Classroom Response System," Master's thesis, Norwegian University of Science and Technology, 2014.

[38] "ONE2ACT," (Date last accessed May-11-2018). [Online]. Available: https://www.one2act.no/index.php?lang=no

[39] Julie Alice Skøien, "User engagement in response systems: A case study comparing two educational technology services," November 2017, NTNU,Unpublished preproject report.

[40] A. Stoica, T. Thorseth, R. Pein, G. Hansen-Nygård, and J. Stav, "User experience design for the interactive classroom technology," in *ICERI2012 Proceedings*, ser. 5th International Conference of Education, Research and Innovation. IATED, 19-21 November, 2012 2012, pp. 1507–1515.

[41] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From game design elements to gamefulness: defining gamification," in *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments*. ACM, 2011, pp. 9–15.

[42] D. S. Perdue, "Increasing student engagement in math with online games and elements of game theory," *Shining a Light on Mathematics Learning*, 2016.

[43] C. Robson and K. McCartan, *Real world research*. John Wiley & Sons, 2016.

[44] J. W. Creswell and J. D. Creswell, *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications, 2017.

[45] R. B. Johnson and A. J. Onwuegbuzie, "Mixed methods research: A research paradigm whose time has come," *Educational researcher*, vol. 33, no. 7, pp. 14–26, 2004.

[46] R. B. Johnson, A. J. Onwuegbuzie, and L. A. Turner, "Toward a definition of mixed methods research," *Journal of mixed methods research*, vol. 1, no. 2, pp. 112–133, 2007.

[47] K. Yilmaz, "Comparison of quantitative and qualitative research traditions: Epistemological, theoretical, and methodological differences," *European Journal of Education*, vol. 48, no. 2, pp. 311–325, 2013.

[48] P. Cronin, F. Ryan, and M. Coughlan, "Undertaking a literature review: a step-by-step approach," *British journal of nursing*, vol. 17, no. 1, pp. 38–43, 2008.

[49] J. Dudovskiy, "Literature review: Measures for validity," (Date last accessed: June-04-2018). [Online]. Available: https://research-methodology.net/literature-review-measures-for-validity/

[50] A. Tjora, *Kvalitative forskningsmetoder i praksis*. Gyldendal akademisk, 2010.

[51] D. R. V. Labaree, "Organizing your social sciences research paper," 2018, (Date last accessed: June-04-2018). [Online]. Available: http://libguides.usc.edu/writingguide/

[52] S. Z. Abdullah, N. M. Ali, and H. Lee, "Exploring the user engagement in interacting with game interfaces," in *International Visual Informatics Conference*. Springer, 2013, pp. 231–240.

[53] A. B. Dellinger and N. L. Leech, "Toward a unified validation framework in mixed methods research," *Journal of Mixed Methods Research*, vol. 1, no. 4, pp. 309–332, 2007.

[54] A. J. Onwuegbuzie, R. B. Johnson, and K. M. Collins, "Assessing legitimation in mixed research: a new framework," *Quality & Quantity*, vol. 45, no. 6, pp. 1253–1271, 2011.

[55] C. Livesey, *Exploring the use of qualitative data-collection methods and analysis in the context of research.* Philip Allan, 2012, pp. 138–159. [Online]. Available: https://www.shortcutstv.com/blog/wp-content/uploads/2017/09/06-OCR-Qualitative-Methods.pdf

[56] C. Harrison, "Tip sheet on question wording," (Date last accessed: April-03-2018). [Online]. Available: https://psr.iq.harvard.edu/files/psr/files/PSRQuestionnaireTipSheet_0.pdf

[57] O. A. Bolarinwa *et al.*, "Principles and methods of validity and reliability testing of questionnaires used in social and health science researches," *Nigerian Postgraduate Medical Journal*, vol. 22, no. 4, p. 195, 2015.

[58] E.-M. Ihantola and L.-A. Kihn, "Threats to validity and reliability in mixed methods accounting research," *Qualitative Research in Accounting & Management*, vol. 8, no. 1, pp. 39–58, 2011.

[59] A. J. Onwuegbuzie and C. Teddlie, "A framework for analyzing data in mixed methods research," *Handbook of mixed methods in social and behavioral research*, vol. 2, pp. 397–430, 2003.

[60] A. Field, *Discovering Statistics Using SPSS (third edition).* SAGE Publications, 01 2009.

[61] H. L. O'Brien, P. Cairns, and M. Hall, "A practical approach to measuring user engagement with the refined user engagement scale (ues) and new ues short form," *International Journal of Human-Computer Studies*, 2018.

Appendix A
The User Engagement Scale

Appendix 1. The User Engagement Scale

1. I lost myself in this shopping experience.
2. I was so involved in my shopping task that I lost track of time.
3. I blocked out things around me when I was shopping on this website.
4. When I was shopping, I lost track of the world around me.
5. The time I spent shopping just slipped away.
6. I was absorbed in my shopping task.
7. During this shopping experience I let myself go.
8. I was really drawn into my shopping task.
9. I felt involved in this shopping task.
10. This shopping experience was fun.
11. I continued to shop on this website out of curiosity.
12. The content of the shopping website incited my curiosity.
13. I felt interested in my shopping task.
14. Shopping on this website was worthwhile.
15. I consider my shopping experience a success.
16. This shopping experience did not work out the way I had planned.*
17. My shopping experience was rewarding.
18. I would recommend shopping on this website to my friends and family.
19. This shopping website is attractive.
20. This shopping website was aesthetically appealing.
21. I liked the graphics and images used on this shopping website.
22. This shopping website appealed to my visual senses.
23. The screen layout of this shopping website was visually pleasing.
24. I felt frustrated while visiting this shopping website.*
25. I found this shopping website confusing to use.*
26. I felt annoyed while visiting this shopping website.*
27. I felt discouraged while shopping on this website.*
28. Using this shopping website was mentally taxing.*
29. This shopping experience was demanding.*
30. I felt in control of my shopping experience.
31. I could not do some of the things I needed to do on this shopping website.*

The scale was administered using a five-point scale with "strongly disagree" and "strongly agree" at the respective endpoints. Items identified with an asterisk (*) indicate items that were reverse-coded.

Figure A.1: The User Engagement Scale, copied from [9].

Appendix B
Notification Form for the Research

In order to carry out the interviews and use the obtained information in the thesis, a notification form was sent to NSD - Norwegian Centre for Research Data. This, to inform them of the processing personal data in the research project. Notifying NSD about the questionnaire was also considered, but not needed according to one of their employees in a mail exchange. To cite: *"As we consider it, this is not a significant change in the project. We take note of the email and archive it in the case file. You can complete the survey without submitting a change message [translated from Norwegian]"*.

The notification receipt is attached as a PDF in the next pages (in Norwegian).

Poul Einar Heegaard

2821 GJØVIK

Vår dato: 03.04.2018 Vår ref: 59683 /3 /OOS Deres dato: Deres ref:

Vurdering fra NSD Personvernombudet for forskning § 31

Personvernombudet for forskning viser til meldeskjema mottatt 07.03.2018 for prosjektet:

59683	*User Engagement in Game-Based Student Response Systems: A Case Study on Kahoot!*
Behandlingsansvarlig	*NTNU, ved institusjonens øverste leder*
Daglig ansvarlig	*Poul Einar Heegaard*
Student	*Julie Alice Skøien*

Vurdering

Etter gjennomgang av opplysningene i meldeskjemaet og øvrig dokumentasjon finner vi at prosjektet er meldepliktig og at personopplysningene som blir samlet inn i dette prosjektet er regulert av personopplysningsloven § 31. På den neste siden er vår vurdering av prosjektopplegget slik det er meldt til oss. Du kan nå gå i gang med å behandle personopplysninger.

Vilkår for vår anbefaling

Vår anbefaling forutsetter at du gjennomfører prosjektet i tråd med:

- opplysningene gitt i meldeskjemaet og øvrig dokumentasjon
- vår prosjektvurdering, se side 2
- eventuell korrespondanse med oss

Vi forutsetter at du ikke innhenter sensitive personopplysninger.

Meld fra hvis du gjør vesentlige endringer i prosjektet

Dersom prosjektet endrer seg, kan det være nødvendig å sende inn endringsmelding. På våre nettsider finner du svar på hvilke endringer du må melde, samt endringsskjema.

Opplysninger om prosjektet blir lagt ut på våre nettsider og i Meldingsarkivet

Vi har lagt ut opplysninger om prosjektet på nettsidene våre. Alle våre institusjoner har også tilgang til egne prosjekter i Meldingsarkivet.

Vi tar kontakt om status for behandling av personopplysninger ved prosjektslutt

Ved prosjektslutt 18.06.2018 vil vi ta kontakt for å avklare status for behandlingen av personopplysninger.

Se våre nettsider eller ta kontakt dersom du har spørsmål. Vi ønsker lykke til med prosjektet!

Marianne Høgetveit Myhren

Øyvind Straume

Kontaktperson: Øyvind Straume tlf: 55 58 21 88 /Oyvind.Straume@ nsd.no

Vedlegg: Prosjektvurdering
Kopi: Julie Alice Skøien, julieaskoien@ gmail.com

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 59683

INFORMASJON

Du har opplyst i meldeskjema at utvalget vil motta muntlig informasjon om prosjektet, og samtykke muntlig til å delta. Vi gjør oppmerksom på at for å innhente et gyldig samtykke må utvalget minst motta følgende informasjon:

- hva som er formålet med prosjektet og hva opplysningene vil bli brukt til
- hvilke opplysninger som samles inn og hvordan opplysningene samles inn
- at deltakelse i prosjektet er frivillig, og at man kan trekke seg uten begrunnelse
- hvem som vil få tilgang til opplysningene
- når prosjektet vil bli avsluttet og hva som vil skje med opplysningene ved prosjektslutt
- navn og kontaktopplysninger til behandlingsansvarlig institusjon
- navn og kontaktopplysninger til den daglig ansvarlige for prosjektet, samt til studenten

INFORMASJON TIL TREDJEPERSONER

Opplysninger om andre personer enn informantene selv regnes som informasjon om tredjepersoner. Ifølge meldeskjema vil det kunne bli innsamlet data om to utviklere av responssystemer. Det er lagt opp til skriftlig informasjon til disse. Personvernombudet har ingen innvendinger til fremgangsmåten.

INFORMASJONSSIKKERHET

NTNU er behandlingsansvarlig institusjon for prosjektet. Personvernombudet forutsetter at du/dere behandler alle data i tråd med NTNU sine retningslinjer for datahåndtering og informasjonssikkerhet.

DATABEHANDLERAVTALE

Du har opplyst i meldeskjema at det tas i bruk surveytjenesten SelectSurvey, som er et survey-system levert av NTNU. Personvernombudet har ingen innvendinger til dette.

PROSJEKTSLUTT

Prosjektslutt er oppgitt til 18.06.2018. Det fremgår av meldeskjema at du/dere vil anonymisere datamaterialet ved prosjektslutt. Personvernombudet gjør oppmerksom på at anonymisering innebærer å:

- slette direkte identifiserbare opplysninger some-post
- slette eller omskrive/gruppere indirekte identifiserbare opplysninger som bosted/arbeidssted, alder, kjønn
- slette lydopptak
- slette eller sladde bilde- og videoopptak

For en utdypende beskrivelse av anonymisering av personopplysninger, se Datatilsynets veileder: https://www.datatilsynet.no/globalassets/global/regelverk-skjema/veiledere/anonymisering-veileder-041115.pdf

Personvernombudet gjør oppmerksom på at også databehandler må slette personopplysninger tilknyttet

prosjektet i sine systemer. Det inkluderer eksempelvis transkripsjoner, filer, logger og koblingsnøkkel mellom IP-/epostadresser og besvarelsene.

Appendix C
Interview Guide

The interview guides brought to the interviews are attached as PDFs on the following pages. They were not followed to the letter but were rather used as supplements and assistance during the conversations.

Interview guide - ONE2ACT

Name: _____

E-mail: _____

Workplace and postition: _____

[*I think I will hand out a sheet where they can write down their name, e-mail and workplace, and give them a definition of user engagement. They can also potentially get a bullet list about the themes I am going to talk about, and then they can write down keywords in case they think of something on the way.*]

Several definitions of *user engagement* can be found in the literature, but I have chosen to work with the following definition further on:

> *"User engagement* is the quality of the user experience that emphasises the positive aspects of the interaction, and in particular the phenomena associated with being captivated by a web application, and so being motivated to use it."
> *J. Masthoff et al. (Eds.): UMAP 2012, LNCS 7379, pp. 164–175, 2012. c Springer-Verlag Berlin Heidelberg 2012*

[*Warm-up questions: I want to know who is behind ONE2ACT and what ONE2ACT is.*]

1 Overview ONE2ACT

As far as I am aware, ONE2ACT consists of several services, all response systems.

1 What is ONE2ACT?

- What are the several services offered?
- Who is behind the service(s): Who came up with the idea, and who works with ONE2ACT today?
- Who is it made for?
- When was ONE2ACT released?
- How many users does the services of ONE2ACT have on a daily basis?
- What is your role in ONE2ACT?

[*Reflection questions: I want to investigate what the developer thinks about user engagement, specifically in ONE2ACT.*]

2 User engagement aspects

2 What do you put into the concept of user engagement?

- What is user engagement to you?

2.1 If you are to point out some aspects (i.e. feeling challenged, fun, etc.) that triggers user engagement in general, what would those be?

- Some more important than others?

2.2 To what degree do you consider (user) engagement to play an important role and why?

- In general:
  - For example, when developing an application or a service, how important is user engagement according to you?
- In terms of educational technology services
  - For example, when developing an application or service to be used in educational environments, such as in classrooms?
- In ONE2ACT?

2.3 When creating ONE2ACT, to which extent has it been an explicit aim to “design for” user engagement? To which extent was enabling an engaging experience a requirement?

If relevant:
2.3.1 Which specific aspects of user engagement did you want to “design for”?

2.4 What triggers/enables in your opinion user engagement in ONE2ACT/How is ONE2ACT engaging people?

- Any differences between
- Student Response System (SRS);
- Peer Learning Assessment System (PeLe); and
- Eval: evaluering på 1-2-3?

[*Reflection questions: I would like to investigate whether feedback from the users has been taken into account when looking for improvements.*]

3 User's involvement

3 In what way have users been involved in the process of developing the current response systems of ONE2ACT (in earlier stages and now?)

> 3.1 Do users provide informal feedback (for example suggestions for improvements gathered from informal talks)?
>
> 3.2 To which extent do you use more formal approaches to gather user feedback (e.g., actively involving users through tests, surveys, data on how the services are used, etc.,
>
> If relevant:
> 3.3 What is done with such user feedback? Is it taken into account for further developing?

[*Reflection question: I want to find out what the interview object thinks about technical factors that influence the response system and user engagement in general.]*

4 Factors influencing user engagement

I would now like to talk a bit more about factors that may influence users engagement with applications and services in general, and such as the response systems that you have developed within ONE2ACT more specifically.

4 What are in your opinion the most important factors that may influence user engagement?

> 4.1 Do you think that these factors are entirely system- and context-specific, or do you think that some factors are more general?
>
> 4.2 And if you think more specifically of response systems such as the ONE2ACT products? What are most prominent influence factors there, in your opinion?

[By technical factors I mean both external and internal factors that affect a system due to irregularities, changes, and ambiguity. Such factors could be the use of various mobile devices, web browsers, poor mobile coverage, lack of network access, power outage, network congestions, etc.]

4.3 To what degree do you think technical factors influence user engagement and why (for example the use of various mobile devices, web browsers, bad network access, network congestions, power outage, etc.)?

4.4 What technical factors do you think influence user engagement in general and why?

4.5 What technical factors do you think influence user engagement in response systems and why?

4.6 To make it very concrete: What technical issues are most crucial when you think of the ONE2ACT products?

If relevant:
4.6.1 To what degree do they potentially affect user engagement?

4.6.2 To what extent are technical issues handled? For example, is it a concern to minimise their their influence (if they influence in a negative way?

- Are some issues more accepted than others?

[Round-off questions: To hear more about future work.]

5 Future work

5 What does the future hold for ONE2ACT?

- Are there plans to add additional functionalities or to extend the portfolio?
- Is there anything you would still like to add here that you consider relevant (and that we maybe did not discuss yet)

I would like to thank you for your time, and I hope I can send you an e-mail later if I am missing some information. As long as you're fine with it, I would like to use your name in the project. The interview will be used for no other purposes than in this project and for my master thesis.

Interview guide - Kahoot!

Name: _____

E-mail: _____

Workplace and position: _____

> *"User engagement* is the quality of the user experience that emphasises the positive aspects of the interaction, and in particular the phenomena associated with being captivated by a web application, and so being motivated to use it."
> *J. Masthoff et al. (Eds.): UMAP 2012, LNCS 7379, pp. 164–175, 2012. c Springer-Verlag Berlin Heidelberg 2012*

1 Overview Kahoot!

1 What is Kahoot!?

- What are the several services offered?
- Who is behind the service(s)?
- To whom is it made for?
- When was Kahoot! released?
- How many users does the services of Kahoot! have on a daily basis?
- What is your role in Kahoot!?

2 User engagement aspects

2 If you are to point out some aspects (i.e. feeling challenged, fun, etc.) that triggers user engagement in general, what would those be?

- Some more important than others?

2.1 To what degree do you consider user engagement to play an important role and why?

- In general?

- In terms of educational matters?
- In Kahoot!?

2.2 When creating Kahoot!, what aspects of user engagement has been desirable to enable in regards to the response system?

2.3 What triggers user engagement in Kahoot!/How is Kahoot! engaging people?

[*Reflection questions: I would like to investigate whether feedback from the users has been taken into account when looking for improvements.*]

3 User's influence

3 In what way have users influenced the current response systems of Kahoot! ?

- Are their feedbacks taken into account for further developing?
- Do they provide informal feedbacks (suggestions for improvements gathered from small talks)?
- Through formal feedbacks - actively involving users through tests, surveys, etc.

[*Reflection question: I want to find out what the interview object thinks about technical factors that influence the response system and user engagement in general.]*

5 Technical factors influencing user engagement

By technical factors I mean both external and internal factors that affect a system due to irregularities, changes, and ambiguity. Such factors could be the use of various mobile devices, web browsers, poor mobile coverage, lack of network access, power outage, network congestions, etc.

5 To what degree do you think technical factors influence user engagement and why?

5.1 What technical factors do you think influence user engagement in general and why?

5.2 What technical factors do you think influence user engagement in response systems and why?

5.3 Can you think of any technical issues Kahoot! is exposed to?

- Yes:
- To what degree are each of them affecting user engagement?
- How crucial are the visibility of each of the technical issues?
- To what extent are technical issues handled?
    - Are some issues more accepted than others?

[*Round-off question: The future]*

6 Further research

6.1 Does Kahoot! have any further goals?

- Extending?

I would like to thank you for your time, and I hope I can send you an e-mail later if I am missing some information. As long as you're fine with it, I would like to use your name in the project. The interview will be used for no other purposes than in this project and for my master thesis.

Appendix D
Interview: ONE2ACT

The transcription of the interview with Adrian George Stoica is attached as a PDF in the following pages. The interview took place in a meeting room at NTNU, on 26th October. The first 04:23 minutes were lost while setting up the video conversation in Skype and ensuring that it was recorded. For obscure words not possible to transcribe, *** is used. His citations are transcribed by best effort, but it is worth noting that his English was slightly broken. 'A' refers to "Adrian" (interviewee), and 'J' to "Julie" (interviewer) and 'K' to "Katrien" (supportive interviewer and supervisor).

(...)

1 Overview ONE2ACT

A: ...system where they could borrow iPod Touch devices to use in class and at some point fewer and fewer needed to borrow them, and I think at one point it was for a class of 60 people… The teacher would bring together with him maybe few devices just in case and then just not needing anything like that... Because after a while the students get used to the system they know that "OK, we need something to run the thing on, they'll have a tablet, they'll have something to run on". It's not an issue anymore. I don't know if that answered your question?

J: It's nice, it's good. You said that ONE2ACT consists of several tools, right?

A: Yes.

J: And you mentioned student response system, what are the other tools?

A: We do have PeLe, which is the short for Peer Learning and Assessment Services, which the idea behind it is the formative assessment. They can prepare and they can select the… It's a part multiple questions. They prepare more task and select what alternatives are correct and which are not, and you put scores and all that, and then you have an interactive part where you could use the results you have in histograms and discuss with the class. And it supports various ways to discuss things with the class. You could show either the histogram or you could not show the histogram, and you can just show like a... You can call it some kind of percentage bar which is percentage of people which got it correct and the ones which didn't, and depending on what is your pedagogical strategy you can choose to do like peer instruction or peer discussions, you could make class discussion, you could take revotes on the same question, maybe one revote, two revotes, depends. It's just conducive doing this kind of class activities which can trigger maybe reflection and discussion to the students and that's another tool which we have, and the third one Eval, from Evaluation, which is in many ways very similar to PeLe, but support writing questions and open text. And the idea behind is to have it more like… To be able to make small surveys, prepare before the class. You could ask things like… Not only about the knowledge, but also about attitude, so you could write things, like get... Have like recap type questions. You could do some more things which basically the idea is to before or after the class so you could evaluate a bit what happens and interact more with the students. And therefore the thing we have is called iLike which is … iLike … and that is basically a tool for helping... Primarily, it started as language learning tool as for teachers which teaches languages which focus is mainly… It has a bit more extra tools for English, some kind of automatic tagging of parts of sentence and things like that. Finding synonyms, finding verb tenses and… Showing them in a way which could be used to discuss with the class. And theses tools are different for the features, it deals with the scenario which is... So, to target the certain type of activity for the teacher, then you use the same (-1:01:18) *** of clients. But the students, they have the same client. They have basic web app which can deal with all this. And the way it is… To get the students (-1:01:04) ***… The activities by… I think it's usually five letter session called. But display that on the board or write it on a wall, they can join and they can answer.

K: The iLike tool that is the most recent one? I didn't… Even the first time we met when I checked, I didn't find that one on the web site.

A: It's on the downloads page, but it's not that much text about it. Yeah, I think it was the latest tool, it was the latest… For a long while was deemed as a prototype. It's… I think it's quite okay to use… There are (-1:00:15) *** to basically merge them a bit, so you have less complexity.

K: Is that a short or a more long term thing?

A: Well, considering that we are in a process of huge merging, I don't know what kind of term to use.

K: No, I was just thinking… Because this could be maybe something relevant in like the master's thesis, like to gather some requirements or I don't know if you planned to do any kind of iterative user testing or maybe some prestudies with users and how they would like this integration to look like or teachers maybe or more in this case?… But that's maybe something to discuss later.

A: We already did some discussions with the users about this, so we normally have in our system or use a lot participants on design, so we had like walkthroughs with teachers, just going through the interface and discussing with them "do you like that", "can you do this", can you do that", and so on. And this is something we use over time, and with students we also did again interviews and user test and so on. We did some of that, but I think right now is more like trying to put together what you gather, so… So, maybe it will be in the future maybe to have an evaluation of the end product rather than trying to add more requirements.

J: Ok. So, who works with ONE2ACT today? Is it a team or is it a whole department or…?

A: It's fluctuated. During times we had peak times where we had people working on it, now we have actively developing, maybe three people in the departments of… It's more like maintaining now. It's maintaining, trying to fix things, and it's not so much developing going on. But at some point we had dedicated tester, and we had for each components we had at least two-three people in the main development phase. But now, kind of... Diminished the activity. But the activity diminished is not necessary... It's lack of interest I guess, it's more like… This changes, it came, and there are a lot of modifications in the way things went, so… And yeah.

J: And you're role in ONE2ACT, what have your position been?

A: I have been working with things in designing and doing user testing, and things like that, and also some parts of the time I have to take the hat of the developer and work on that on the teacher clients. Which is probably not... How to say this - prescribed way of doing it. If you don't have enough people you don't have a choice.

J: And how many users does the service has on a daily basis? Approximately?

A: Well, again it fluctuates because it depends on the time of the year, but probably have the level of tens of sessions every day, probably more, depends. If you look at the number of users registered, probably that's not relevant, it's about 4-5000 of students and maybe 4-500 teachers which are registered. I don't know how many are active, I haven't checked exact numbers, but it's significant number of people which touch the system.

K: Just a short follow-up question there, do you know if it's mainly used in former HiST, university students, or do you know if it's also commonly used by for example high school teachers and so on? Or you really don't have a view on that?

A: We don't keep much data on the users, but I know that… I mean the system have been used not only in Norway, we had at some point users in Moscow, Belgrade... We have for example some users in Sweden and depending… Some of them use some of the tools, or other tools, depending on what they are doing there, some are teaching languages, maybe they are fund of using iLike in class, and if they are doing something else, using PeLe or… Yeah.

2 User engagement aspects

J: Now, I would like to talk a bit about user engagement as a concept, so I want to hear what you put into the concept of user engagement. What is user engagement to you?

A: Well, what drives the users to use it, to get into the system and use it, is that… The students have feeling of ownership towards their learning, so they have… They are all in the lecture. They are not sleeping in a corner and waiting for it to finish. And then… With this system, it's always mixed feelings because we have teachers which say "oh, that's brilliant, I want to use it and I can do this and that", and some teachers are "oh, I can't understand, some other tool, I have to change stuff in my lecture, I don't want that, it's too much trouble, too much work", and like that. So, if you understand that getting the feedback would improve the learning, and improve the experience of the students in the classroom, as a teacher, then you want to use it. If as a students, you understand that participating, giving the feedback to the teacher and then getting back immediately when everything is fresh in your mind, you get the feedback and you understand better what you did wrong and what you did right and so on. That will help you on the long term, and then again it's something that drives you to use it. And we had interviews with students that said they like it because it's fun, they get to use their phones, and anyway they have their phones in their hands checking Facebook. So, maybe is a good idea to interrupt them and get them to answer a question or two sometimes.

J: You kind of already mentioned some, but if you are to point out some aspects like "feeling challenged", you said "feeling of ownership", right, that triggers user engagement in general, what would those be?

A: Come again?

J: If you are to point out some aspects of user engagement, like you said that “users feel kind of a ownership”, do you have some more examples of feelings that trigger user engagement like that?

A: Yes, let me think.

K: Or maybe, let me try to rephrase, actually, Julie is interested in also seeing if there are more in general elements of user engagement that you, as someone who has been actively involved in this project, consider to be kind of transferable to other types of applications. So really user engagement in general... Or would you rather say that we have to only look at the specific case because this learning context is very different than video streaming or what so ever, so that was kind of the distinct… User engagement in general and maybe it can be… I don’t know, maybe it’s interesting also to think back of earlier on and development stage. Because it was interesting to hear how you talked about, you know, the different products and the different kind of modules that you have, and I assume that there has been a logic back behind it on developing, OK - started with the student response tool, and then you had PeLe and then you had Eval, so maybe there was some considerations there as well or did it more have to do with teachers identifying needs to have another type... Kind of affordance of the different modules that they wanted to have different tools to do different kind of activities?

A: Yes, ok. So, first of all, I think that moderneric way you could engage users, is to... Trigger user engagement is some kind of perceived… The usefulness perceived… If you think that the thing you are offered is useful to you and you can get something out of it which otherwise you couldn’t, then you are likely to use it. They need to get that message across so they can understand that that is useful and in which way. And then we have seen some teachers that have some kind of hard moments, right “oh, you can do that”. You have… We had example where… It’s also the matter of how you communicate this because you had the manual for SRS which was some pages long or so. Probably it’s somewhere on the site and… Anyway, some teachers said “oh, 30 pages… oh, I don’t read that”. And then he saw someone using the tool, someone there was reading it. And then it was like started, begin two taps on the smartboard and done. He said “oh, that’s brilliant, I want to use it”. So, it’s that kind of things you see what you can do with it and how much time you need to deal with it. And referring to what said why you have this modules, it’s different for it. For example we started the SRS because it’s the simplest thing you can do, so it requires less possible effort from the teacher, you don’t need to prepare anything, unless you want to. So, you could just ask short questions from the heap and write in on the whiteboard and just choose how many alternatives you want, and you’re done! I don’t need to change on slides, I don’t need to change anything, you don’t need to write more documents or upload things, it’s the systems, nothing like … Just need to do very simple things. And then of course, it was… In the beginning it was much more team of teachers which were discussing with them all the time and showing them prototypes and getting feedback from them, getting them to trying new things in the class. We had a group of brave teachers which would go with half baked prototypes in class, and try them up, and… This is quite interesting to get it to development because it was much faster cycles, it was quite… A lot of combination of extreme programming and agile software management to deal with that, so it’s a prototype to get them to use them, and explaining them... It was fast cycles of usability kind of activities, it was interviewing them, walkthroughs with the interface, telling them what works and what’s not and why and so on. And, one or either thing is that it’s kind of logical progression, start

with SRS, it's multiple questions, simple, no preparation or nothing. Then we go to… Say ok, let's try to do some more things, let's try to do things more formative, assessments, why not have a set of questions which you can prepare and then you can have similar activity like SRS, but afterwards you have some kind of interactive… More interactive parts so you could take the formative parts, the assessment part, work with it, and they have… Which is correct and which is wrong, and (-45:21)*** and so on. Then you could go further. Then again, it's no text to the input, so you could just give them a piece of paper with the questions and alternatives, and then you just have the bare min, the bare-bones of the system, so (-45:01) *** select how many questions, how alternatives and done. That is another thing… And then you say ok, let's try to have a bit more question types, and be able to put text in them, and so on, and slowly we added more stuff, and also this was partially funded by projects like European Project, so behind each tool there is more or less one or more projects which had the development of it, so you can't… Have too many project develop in the same thing, you have to try to identify some niche which necessary, and which that can be developed into, and… So, it's a combination of these things like logical progression of finding more questions, more things, and exploring more territories and learning and classroom activities, and also how you manage to get funding and priorities.

K: Maybe just to come briefly back to this… You know, the question of elements of engagement, of course all of these tools, they are changing the classroom environment, or the interaction in the classroom environment, but in your opinion - how important is the aspect that evaluation is not just taking place individually or at home, but that… You know, everyone sees the responses of the others even though it's anonymous, but just this group aspect of it? This whole classroom aspect of it? How important is this in your opinion for triggering engagement, to make students more engaged as opposed to for example the traditional way of teacher asking a question, and the student in front row who is willing to answer? How important is this aspect of it? I mean, of course it's underline of the modules, so…

A: Yeah, it's very important because you see, what you just described there, the teacher asking something and the finger coming up is the same finger every lecture. Maybe. And you have a lot of students which they think that if they say something, they'll come out as stupid or things like that, so combining this kind of anonymity and putting out the (-42:29) *** result, they will get the sense of belonging to the group, they'll understand that it's nothing wrong in having a mistake in your answer, and it's... Many of them would do the same. It's a lot of psychological things that play because they see that learning means that you have to do a lot of mistakes until it's right. Things like that. That's one aspect of it. And then they have to participate in each lecture, if you just say "oh, I'll just do it at home", they'll probably not do it. Most likely they will not do anything. So, then you help them to be active in each lecture. Which is very useful. Because then they have to think about things you are talking about every lecture, they have to… You could even start the lectures with opening question which they probably should read something about it, and if you do that every lecture and they get used to it, they'll probably say "oh, he will ask us again something I have to read up, maybe take a look and see". And this can help them, and from our experience the biggest effects are on the students which struggle. So the one which normally struggle will get the highest effect in improvements. The ones who are brilliant, you can't do much with them. With the same tools, without the tools, they will be ok. But the ones that struggle they have the problems, and there you can help with this kind of things. And another point of engaging

teachers into using this… It's all revolving around this kind of less possible effort of doing things… If for example you have a group of teachers which are all engaged and kind of willing to share questions and share practices and that good. Get people to use it, it's even less effort, you don't need to think about how or what I need to ask or what kind of questions should I ask. Because tools are just tools, they are not magic, so if you as a teacher asks stupid questions, you'll not get an effect.

K: So the content also plays a role, I'd say.

A: Yeah, yeah!

J: So, when you were creating ONE2ACT - to which extent has it been an explicit aim to… Like, design for user engagement?

K: Would you say that it was more like the simplicity and so on, or was it really kind of a requirement that you had in the beginning that you want to kind of enable and experience that it's very engaging for both teacher and students? Or would you say that it was more kind of like starting from more pragmatic aspect…

A: More like design for learning.

K: Design for learning.

A: That was the main driving force. Design for learning. Design for getting people to learn more and be able to get the feedback and then understand what's happening. And the user engagement is like a consequence of that. You need people to be able to learn, they need to be engaged, and that's why we talked with the user target group and involved them in the process of designing. We had many iterations. For example to the student client there was very simple and (-38:18) in the beginning, and then we made a slightly fancier one that was working, unfortunately only on IOS devices and Android devices, and it didn't work so nice in other browsers, and then we had to make lighter version of that which worked everywhere, and now we just… Make just one single client that works everywhere. But this is a combination of… It's also the devices which have maturities and also the browser which have maturity, I mean in 2009 or 2010 - if you make things that is standard HTML, JavaScript, CSS and stuff like that, it has good chances not to work everywhere. Because you have all this processes which do crazy stuff an do whatever. So, you need to… And on top of that you have user which say "oh, I don't understand, what is this, how do I do this, I don't understand that". It's also very… Even if it's just formative assessment most of the times, you could also use it for summative assessments if you want to, but generally designed for formative assessment, so you don't care much for results, just learning. But it's still some kind of test feeling and it's a lot of stress involved, so the students think they have to perform and they have to focus to the task and not to the technology, so if something going wrong then there be like, it's aggravating the whole thing much more than if you just don't do anything important, so if you just sit in the class and you can't vote, that's important, but if you something like a test and you can't vote, then it becomes aggravating, so you have to balance quite well this kind of things. Also for the teacher, sitting in front of 50-60, 100 to 200 students is not easy, so if they miss the understanding of an icon or something like that, and they do something wrong, it's like half of brain is always (-35:42) *** with the students, you

can't assume that they are fully there, so it should be as simple as possible, and that's one reason we tried to have just the bare minimum out in this first level, the rest is down to the under the hood you can find more stuff. But the class perspective is simple as possible.

3 User's involvement

J: In the paper you sent me, it's written a lot about the users involvement, like in an iterative way, how you gather feedback and such, but I'll ask you some questions about it anyway… Can you just tell me a bit about in what way users have been involved in the process of developing the current response systems of the ONE2ACT? How do you involve them in like feedback way or have you performed surveys, or testing, or… yeah.

A: So there are many layers into that, so we had… For example we had users just got the system and used it and observed them, and had some sort of user testing, and this is our testing, could be the level of you have 1-2 users which go to the… You give them some task or ask them "ok, I put a question, answer this" and something like that, and then to… More like... Feel the based on what… So you have a laboratory where you have the groups of students bring something, and then you ask them to use the system, and then you record that and observe them, but that's more advanced user testing. We had interviews, we had questionnaires, and also we had some groups of teachers which were like recruited to be testing. They were somehow compensated for their effort to just test new versions and see what's wrong and give feedback and so on. So, it's a lot of things we have done to get the feedback, and also same goes for the features, we had a group of teachers which were more involved and testing very experimental prototypes, and then you had another layer of things with more stable prototypes which were used by more teachers and had interview with them and walkthroughs and user testing again, and so on.

K: So, how crucial would you say has this involvement been? In terms of the final results, the final product.

A: I don't think you can hit the target if you don't get the users to participate. You're not hit the target.

K: Maybe just very briefly to go back to like the team, so you said also involved in user testing, but has… Was there for example someone in the team who was really kind of working on this aspect to gain this insight in user feedback, translated into requirements for improving, or has it been like a shared loads of people within the team?

A: Yeah, we had people which were more into the gathering of feedback and talking to the students, yes. And it was… The team was kind of multidisciplinary, so we had background in software engineering and human computer interaction, and we had another software engineer, had people with background in psychology, people with background in mathematics and physics, so it's… A broad range of people trying to sort out things, and of course it the part where you go to the iLike, which is for language, we had people teach languages and deal with language learning. So it's… Yeah, you need to have right combination of people to do this stuff.

K: Sounds like such a fun project to have been involved in!

A: Yeah, it was very fun to be a part of it of course.

K: So, you already mentioned in the beginning that now it's more kind of like maintenance, but is there still some way, apart from this potential integration of the short or long term future, is there still some way you are gathering or doing something when you get feedback? Or is it kind of more like… You feel like now it's more stable version, and it's more maintenance thing than still kind of…

A: No, we still have a long list of things… A wishlist of things that could be done better and stuff like that, but it's like all this projects that never ends I guess. You always find something you can improve, and of course, if we get feedback we put it in our backlog there and try to get it done if possible. But the future, that is a bit blurry now, we don't know exactly what… How this will play out in the… Yeah, but we'll see. It's... I guess, It's a combination of what is the goals of the faculty. And we get, like, to be separated into different departments, it will be much difficult to work together. I don't know. It's stranger yes, and they have a consistent number of people which are not anymore because the activity dropped a bit more, so it's not so many people involved into the development anymore, and it's quite difficult. So for a while we used the trainees to help us, but now because our institute disappears, we cannot even get trainees because there are not as entity anymore, there is no… So they haven't started any entity which disappears, so that's a bit strange, so…

K: But you will be part of IDI, right?

A: I guess so, yes. That's correct.

J: I just was visiting the website, and there it says that you have to like get this… What it is called… 30 days trial, or is it… You have to buy it or some…?

A: No, you don't have to buy anything.

K: No, it's for free? Completely?

J: Ok, so what I was wondering about, is it required that you are a HiST student or can you… Can anyone download it?

A: Yeah, anyone can download it and use it, there's no limitations, no…

J: So… *mumbling*

K: Yeah, you can ask the question I think, it seems that it was very structured and an important element, as I understand, and I'm very happy to hear that you had such a multidisciplinary team, which is the way it should be done, but yeah…

J: But do you also consider, like… When you get informal feedback, like… Do you take notes when you hear, like, students smalltalk about the response systems, and do you, like… I don't know how to put it…

K: Yeah, so now you have talked a lot about kind of… That it was very systematic way of involving users and teachers, and doing something with their feedback, but I think you were also interested in knowing whether involvement was always systematic, or whether it also has been kind of informal. For example discussing with teachers or people sending you short e-mail, or…

A: I guess part of it was not that formal, but of course you can get feedback over a cup of coffee in the lunch room, and say “oh, I want bigger button, or bigger font”, whatever. Could be something like that. And always teachers… Some of the teachers, they start experimenting, so they… Some of them have this hacker mindset, so they say “oh, we get this, what can it do for me”, not “what is it designed for”, so then you get questions like, “oh, I want to display this in a different way”, or “I want this, and I want that”... It’s a combination, but of course, the main body of the requirements, the things in… You get, you need to be a bit more structured and get the feedback from the users, so it’s always… You have all this, like, heuristics and guidelines and so on, that say you should have this amount of users, or this amount people and so on, but sometimes it’s challenging to find certain number of people which are doing exactly thing you want, and… So it’s… You have to improvise sometimes, but most of it was quite systematic. At least in the first part when we gathered most of our intel of how to do it, that was a lot of effort into that.

4 Factors influencing user engagement

J: Ok, I think I have enough about the user’s involvement now. Now, I would like to talk a bit more about factors that may influence user engagement with applications services in general, and such as the response systems that you have developed within ONE2ACT more specifically. So, what are, in your opinion, the most important factors that may influence user engagement? And factors could be anything you can come up with.

A: Yeah, that’s a difficult question. It’s… For example, in our experience, is one factor which can deter users from using it. It’s starting on the wrong foot, so let’s say the first day you want to use it in class, and there is some IT issue and either the teacher client doesn’t work because of… Network, server, the system in the classroom is not updated to latest version or something crashes, whatever. The students have some issues with their devices, and… I don’t know… The server is down, and… If you have this kind of happening in the beginning, it’s kind of “oh, the system it doesn’t work, it’s that“... If you… One important thing is to trust that system works. If you use it a couple of times and everything is fine, then I guess they… The students get used to it and you might have some (-21:54) ***, might be some incidence, but it’s very damaging if it isn’t the very beginning when you started and… Another factor which is… Which has bearing on the engagement of the students, is the attitude of the teacher. If the teacher says “no, we have a system here, but use it, just try something”... Maybe not… The enthusiasm of the teacher is something to hide, and it has bad influence over the user engagement of the students. If you say “hello, we have this and you can use it, use it this and that”, and have some kind of idea, not hard to present there, “ok, you’ll be able to participate in the lecture, so we can discuss and get feedback faster, and forth… “. That’s what affects again the user engagement. And… Yeah, I think in teachers, it’s the… The things that affect the user engagement… They are related to the amount of time which they

are allowed to deal with new technology. And deal with… If they are pressed for time, and they know one way to do stuff and they do it well, maybe it's not the best way to do it, but any change that challenge their work in a way, so they'll have even more press of time. That's will not come well, it's one thing. So if you're for example have environment where… I don't know, the boss in the thing says "ok, you can use one hour of a week to play with your tools", and then if you started… Or give you cake in the end of the month if you start using it or whatever, I don't know. Something, but they need to be encourage to use it, and it's… To be secured that they can use it. Otherwise, this kind of fear of… You have one more thing to worry about, one more thing that could fail, one more thing that you need to learn. And something that change your lecture. If you have… If you are like these people which have the lecture set in stone, then it's not like that, because this brings you, like, unknown. Brings you open ended stuff, you don't know what you get. And we see this even more powerful in the iLike, which you have open text, and it happens that it started as language learning and it evolved into something that is used more for… Also for meta learning or something like that, self regulated, the teachers which ask "oh, how do you feel today" and things like that, and they get, like, different kind of… One cloud of feelings and they can start from there, and discuss about… It's a lot of stuff, and with that you can get, like, profanity word cloud… But in the beginning, we hadn't any filter or anything, you could get anything there, so many teachers which are not going to do that. Not brave enough to just ask out the question and get raw text on the board.

K: Yeah, but it's very nice example of how, as you say, like, teachers are playing around, or how it generates some unexpected use in a way, that you say, originates a language tool and… Nice example.

J: You mentioned some technical factors and also the teachers factors, and the amount of time. What would you say about the context where ONE2ACT is used? Like the amount of students in a room, or… Yeah, the context where ONE2ACT is used.

A: Yes, well it could… I mean the context affects of course, because you can have, not in every lecture it makes sense to use it probably. Depends on what you're doing. The context again affects the… If you have someone that uses the technology just to use it, disregards the context… Anyway, that can affect again the user engagement, because people don't see anymore the purpose to use it. And about the number of students, of course, there is maybe a limitation, maybe a technological limitation. We have used it efficiently from, like few people to few hundred people. But it depends a lot about… On the goal of the picture, and what you want to achieve. Because for example we ask them whilst using it in classroom of four, five. It was some kind of occasional thing, so it was adult students. (-15:04) *** Say "why do you use it" you could just ask them on use. I said "no, but this way they all ask individual, otherwise you get one answer, because you talk together and stuff like that, so you can just… Get… Then you have som base for a discussion. For example. And it depends… And there are many, many ways to can ask questions, it's a lot of reasons you could ask the questions, so that also is depending on the context of use. If you are doing a revision of some facts, you could use that... That it probably makes sense in that context, but if you just ask this kind of factual questions all the time, there is no meaning. You need to have a bit more advanced questions. Which are more conceptual, generate discussion and so on. Especially, for example, if we talk about SRS and these things you want to generate

reflection, discussion... If you just ask “ok, what voltage have that, this, this and that” - no meaning.

K: No, exactly. I think it’s better to… Because it’s almost done, maybe you have another appointment afterwards… Go to the last part...

J: So, you have already said a bit about it, but to what degree do you think that the technical factors are influencing the user engagement, and why?

A: Well, technology is… Is good when it is almost invisible. Should be blended into the thing. When you have to think about it, and you have to deal with issues, then it becomes the very big problem for the users. Especially for users which are not tech-savvy which they just take the smartphone as you take any tool. For them it’s no different than hammer, you take it and it should work. So if something stops working, then it’s a problem. So you can have… Yeah. It’s a combination of… You should have everything working and then is everything fine and nobody thinks about it, and if something goes wrong, then everybody has problem with it. Stuff like that, it’s a little bit black and white, and also you have the users which… In many cases they are not that advanced in terms of digital intelligence, so you might have some strange setting on a phone which prevents the software to work fine, and then… But they’ll still blame the application. Because we had… I think we had a case where they are using this private mode, they are not even aware that they are using the private mode… The device… But of course, then you log in, if you use anonymous and you go in again, you lost your progress. Of course, we cannot (-12:13) *** . They’re like “oh, that’s not working, not good”.

K: I think maybe... For the last minutes, we jump to this one…

A: Yeah, yeah, yeah, ok.

J: So, when considering the ONE2ACT products and all the tools that ONE2ACT consists of, what technical issues do you think are most crucial when you think of the ONE2ACT products?

K: You mentioned some of them already, like you talked about the browser, especially in the early phase, and the devices, but, like currently, what would you say are kind of the main showstoppers?

A: It’s not necessary that they are showstoppers, but it’s… The most difficult things to deal with, is this kind of heterogeneity you have between the platforms, and people… They all expect things to work on their platform. They are largely unaware that you have a huge variability, and you have… It’s very difficult to keep consistent experience over the full range of platforms. So in the teacher client, to give an example, when we started developing the teacher client to run on the Adobe I/O Runtime for the fact that it was multiplatform and they had support for Linux, Windows, Mac. And then I started develop the (-10:27) clients and so on, and so on and so forth, and then Adobe said “oh, it don’t support Linux anymore. Goodbye”. Then you are beyond the point of no return for the project, developing it, and you lost third of the support for the one platform, it’s gone. And then you have to spend time and effort to find solutions, and then I say “oh, ok, which version of this thing could work on Wine, Linux, have it like emulated” and things like that. And then you have each operating system

has differences, for example in the way they trigger fullscreen applications. And this… For example SRS aims at fitting on top of everything, so if you have a set of slides, you have it on top, and you have a small button in the corner which you could bring it up. And then Windows (-09:29) *** no problems stays there, all fine. On Mac, they have… At some point it was ok, and then there was… There is a issue that the slides come on top of the things, so it's not behaving the same way, and now they on Mac, when you have, like, fullscreen, it takes the whole thing, and puts it in a separate environment. So then you have to find solution. This aggravates the development process, because you have, instead of spending time on fixing and maintaining and making features, you need to sort out the intricacies of this new features of the other people are doing. And at some point you cannot keep up with the list if you don't have a huge team of developers which are specialized, because now we probably need someone which is specialized in developing Mac OS things to be able to separate it more properly, and so on. So it's this kind of stuff which makes it right difficult to… And you have surprises every time you get update of some framework or something you are using. You might be in for a surprise, for example in a previous version of the student client, we were using Sencha Touch framework, and they made some update, upgrade or something like that, and we… Not in the Sencha... It was in Chrome. They made some upgrade and that was breaking the framework. And then I had to scramble to find the solution. Hack the framework to work because it was killing all the clients and so on. And I think it was at some point an upgrade in the Runtime framework for the teacher client. It broke down the login. So, something was failing in the login because they just updated something and made a strange thing in the framework which should happen ever, but it happens. Then you use a lot of time just doing… Yeah, chasing your own tail and trying to fix things that other people do.

K: To which extent... I had just recently, when I attended the Forsker Grand Prix finale where we used the… I don't know exactly which of the three tools you have…

A: iLike…

K: Yeah… I got so frustrated because two of our colleagues that participated, and I had problems connecting… Or like the network connection was kind of going back and forth, so in several cases I couldn't vote. To which extent has, like, network access or network connection been coming up as an issue? In classrooms?

A: Not in classrooms. There we have very good connection in the classroom. It's always… I mean we had issues with network connections… I think in schools, they have some much stricter things to the network, and that could be an issue. And of course, this kind of… Like if you have conference in a hotel and you want to use the system, and they have this kind of rubbish Internet access which kicks people out, and interrupt with someone… Then it's tough. That's why we have most of the things is... More the same if you vote on something, it's stored. If you have a ten question assessment and you're going down for five questions and something goes wrong, and you have to reconnect or you have to something like that, then you find the progress on there. The one issue is if you use anonymous approach, then it will be not possible to change the device if something wrong with the device. But if you use… If you're logged in - you can use both anonymous and logged in system way - and if you're logged in, you could basically switch device to find your progress and continue. So also we had issues with network and stuff in… We had some project with Serbia and Greece, and in

the schools they don't have any good Internet, they had issues to that. They even had issues with… They were like using Windows 2000 or something like that. So how do we make it run there?

K: So yeah, I can imagine that there's a long list of things that you would ideally like to…

A: It's a very long list of things, but you need to… A lot of resources and… I mean if you are given an unlimited time or resources, you can do in perfect.

K +J: Yes.

K: Very interesting.

J: Bør vi avslutte eller…?

K: Maybe it's better to round off. I can imagine you have other things to do also.

A: Yeah… It's ok, no problem. Wrap it up then!

K: Ok, so if you want to…

5 Something to add?

J: Ok, then I can just ask you if there's anything you would like to add to this conversation that hasn't been mentioned or…

K: That you consider important… Yeah, I don't know. Many things came up already, but might be something that comes to your mind.

A: I'm not sure if… We went to most of the things, also in the paper, but… We already said that you need to understand the users and you need to basically try to blend into their life and their things because many systems, they say "oh, I'll do anything better and we change your life and whatever" and… But people are being (02:48) *** habit and just going and say "ok, you have to do everything different and go away. Good luck". It's not going to happen. Ever. And you need to understand the context of use and understand the users and walk a bit in their shoes, and… Maybe something that wasn't mentioned in this, is that most of the teacher interfaces are built with, especially the SRS and iLike, they are built with, having in mind, that user smartboard or interactive board to deal with the, so you can create a question, you have this huge button which you can touch on the interactive boards. And some decisions, for example the placement of the menus, the placement of the button, was driven by this, because they said "oh, what happens there". We had for example a close button at top, and then they said "oh, what do we do with the short people. So you have to have a button in the menu somewhere, down there, to be able to close the application, otherwise you cannot do it, or you have to go to check to get them out. So it's this kind of stuff. So it was a lot of work with interactive pools and things like that, and… Yeah. I guess we covered most of things. I don't know what else you would like to know, but… I don't have any in my mind, anything more to add.

J: If I have any more questions, I guess I can just send you an e-mail if that's ok?

A: Yes, if you don't have too many questions!

J: Just if something comes up. Then I would like to thank you for your time!.

A: Yes, you're welcome, thank you very much!

J: And I'm just wondering if you are ok with me using your name in my project?

A: Depends how you use it, but I guess if you mention me, I was interviewed and probably…

J: The purpose is just for my master thesis, so it won't be used any other places than in my project like in my master thesis.

A: Yeah, I guess that should be ok.

J: Thank you.

K: Great. Thanks a lot for you time! It was really interesting to hear the, kind of the story behind ONE2ACT I think. Many interesting things came up! Thanks a lot! Have a nice day!

A: You too! Bye.

Appendix E
Interview: Kahoot!

The transcription of the interview with Alf Inge Wang is attached as a PDF in the following pages. The interview took place in Wang's office on 27th October. The interview was carried out in Norwegian; thus the transcription is written in Norwegian as well. 'A' refers to "Alf" (interviewee) and 'J' to "Julie" (interviewer).

1 Overview Kahoot!

A: Jeg har en litt spesiell posisjon i Kahoot!, for jeg jobber ikke... Det er sånn sidejobb, men jeg har absolutt mye med Kahoot! å gjøre.

J: Ja, jeg kan jo egentlig si fort... Du har sikkert skjønt det ut ifra mailen også, men jeg skriver som sagt om user engagement og ønsker egentlig å se på litt tekniske aspekter i response systems. Så bare sånn helt innledningsvis lurte jeg på om du kunne fortelle meg litt om hva slags tjenester Kahoot! tilbyr nå om dagen?

A: Ja, hvilke tjenester? Eh, hovedsaklig er det "klasseromsgameshowet", eller quiz i klasserommet. Det er jo hovedfokuset som egentlig har vært hele tiden. I tillegg så er det en svært viktig bit det å kunne lage quizer der lærer veldig enkelt skal kunne samle på data. Og en annen ting, er også det at du kan ta og bruke andre sine quizer, og kunne skreddersy til egne. Det brukes mye. En annen ting som er viktig, er hjemmearbeid eller lekser, eller repetisjon, enkeltvis gjennom appen, som enten gjennom en utfordring som på en måte blir en konkurranse innad i klassen eller spill i mot AI, eller ikke virkelige personer. Så er det også tjenester mot næringslivet der du har... Kalles for Kahoot! Plus der du får litt sånn ekstra dataanalyse, og du får også en privat database for ditt selskap sånn at når du deler, så deler du innad i en organisasjon. Så har du også muligheten til å få egne logoer på quizene og sånn. Så det er vel det viktigste.

J: Mener jeg leste om dette på hjemmesiden, men kan det stemme at det ikke er lansert enda?

A: Det er lansert, men det er ganske nylig. Bare et par uker siden.

J: Det kan stemme, jeg var sist inne for tre uker siden. Nå har du jo for så vidt sagt det. Men sånn kjapt, hva har din rolle i Kahoot! vært?

A: Fra starten... Det var jeg som hadde ideen til hele greia. Så jobbet jeg med prototyping og eksperimentering i mange år for å komme fram til konseptet og fintune det. En av gründerne som var med på å starte opp det hele... Mitt hovedfokus har egentlig vært utvikling av spillkonseptet og det rundt det, engasjementsbiten, også har jeg laga alt av lyd og musikk, da. Pluss en del andre ting som å shippe t-skjorter, også være på konferanser og messer for å snakke om det.

2 User engagement aspects

J: Jeg tror jeg hopper rett over til dette som har med brukerengasjement å gjøre. Fordi jeg lurer litt på i hvilken grad du anser brukerengasjement til å spille en rolle med tanke på Kahoot!?

A: Det betyr alt. Det er hovedsaklig hovedgrunnen til at Kahoot! eksisterer fordi det gikk litt på erfaring fra egen undervisning at spesielt store klasserom, så er det vanskelig å holde engasjementet oppe, mye av poenget... Man skal ha interaksjon som øker engasjement og

motivasjon til å følge med og holde fokuset, så det er kanskje det som er annerledes enn mye annet.

J: Under utviklingen av Kahoot!, i hvilken grad har det vært et mål det å designe for engagement, hvordan har kravet rundt engagement vært, hva har vært et mål fra starten av?

A: Alt er designet ut ifra engagement, og user experience, da. Alt skal være enkelt og gi en god brukeropplevelse. Blant annet så har vi hatt en av de dyktigste i verden på user experience på teamet, som heter Jamie Brooker. Det andre er at vi har designa det her som et spill fra grunnen av, som er annerledes enn… Da vi kom, var vi alene i forhold til det, i forhold til responssystemer. Det spilldesignet er basert på et par forskjellige teorier, men det ene er at... Tom Malone er det en som heter, som har skrevet at "What makes things fun to learn" 1980, det er veldig mye av hovedprinsippene vi har basert oss på å ligge på. Den har en del prinsipper, blant annet å bruke fantasi, i våres tilfelle er fantasien at man transformerer klasserommet til et gameshow og for å fremheve den fantasien, bruker vi grafikk og lyd og musikk, alt det for å skape spenninga eller stemninga. Også bruke belønning i form av poeng og den sosiale komponenten er ekstremt viktig, hovedsaklig konkurranseelementet, det at vi har scoreboard for eksempel og viser topp 5 er veldig viktig, man har en pall til slutt for eksempel, ikke bare til sist, men også underveis, gir tilbakemelding på hvor langt ligger man bak nestemann. Alt er fokusert på det at det er et spill og det skal være morsomt, og det er gjort ganske mange eksperimenter i forhold til det med poeng og lyd eller musikk, og spesielt det med lyd er viktig i forhold til det å myke opp stemninga. Se på for eksempel det med at du bryter lydmuren på den måten, så er det enklere for elever og studenter å småprate seg litt i mellom, som gjør at det er enklere å stille spørsmål og ha en dialog i klasserommet etterpå. Det kommer litt an på alder, det kan jo bli for mye lyd og for yngre, men hvert fall i forhold til studenter har det veldig mye å si. Vi har også sjekka eksperimenter i forhold til å ha med poeng, ikke poeng, lyd og ikke lyd, og den optimale løsningen er nok kombinasjonen av lyd og poeng, og ser vi at hvis man har poeng og ikke lyd, så føles det mer som en test, det blir seriøst, ekstremt fokus, men litt mer stemninga blir litt mer eksamensstemninga. Mens hvis man har med lydbildet så løser det litt mer opp, og den sosiale erfaringa rundt det, det med at du får litt sånn latter og litt sånn smådansing, det…

3 User's involvement

J: Skjønner. Men over på litt sånn... Hvordan brukere av Kahoot har vært involvert underveis? Jeg er interessert i å vite hvordan Kahoot har jobbet med feedback. Har det vært mye brukertesting, service, hvordan har man gått fram?

A: Helt fra starten egentlig, jobbet vel i fire år med prototyping før det var et selskap, da kjørte vi eksperimenter med… Det var her på NTNU med studenter, der det var viktig å få feedback hele tiden med hvordan fungerte det her, hva var bra, hva var dårlig, og sånn egentlig har det vært hele tiden. Vi har vært veldig opptatt av hva brukerne mener om det, og

vi har fra nesten dag én, så har vi hatt mulighet til å få brukerne til å foreslå ny funksjonalitet og rapportere om ting de ikke syns er bra og ting som de syns er bra. Det som vi har passa på der og, det er at vi alltid har hatt en visjon om hva vi ønsker å oppnå, det betyr ikke at vi har gjort endringer... En del endringer har vi fått… Veldig mange har ønska spesielle endringer som vi ikke for eksempel har endra på fordi at det vil ødelegge den visjonen vi har. Det kan for eksempel være… En sånn enkeltting, det som flest ønsker seg, er at vi har hatt spørsmålene og svarene på mobilen, og det har vi bevisst ikke gjort fordi at det som skjer da, det er at... Vi har kjørt tester på det, da plutselig driver alle i sin egen atmosfære, det blir ikke sosialt lenger, alle bare stirrer på mobilen sin, da blir det på en måte individuelle opplevelser. For å beholde det sosiale har vi sagt “nei, vet du, det gjør vi ikke”. Så vi har gjort en del sånne bevisste valg, men vi har hele tiden hatt user feedback, og vi har fått veldig mye feedback både gjennom reviews, bloggposter, Youtube-videoer, masse e-poster og tilbakemeldinger, og det meste er jo veldig positivt, også er det en del ting vi ser på - det kan være sånne ting som juksing. Så ting som vi etter hvert som... For eksempel var det en del som begynte å lage innhold som ikke var helt forenlig med skole da, så måtte vi finne måter å luke ut det på og ja, det er alltids noen som prøver å utnytte systemet, da. Det er veldig bevissthet i forhold til det, da. Vi hadde folk fra … Vi startet egentlig opp med ganske få ansatte, så hadde vi et stort fokus på community, vi har jobba med community fra dag én. Så vi hadde stort fokus på det, også er det det at vi jobber også med enkeltindivider, de som for eksempel bruker det veldig mye, er folk som vi inviterer inn og intervjuer og kjører bloggpost på, og som vi også hører med hvis det er noe spesielt som for eksempel bruker de som tester av ny funksjonalitet. Så det er en veldig sterk bevissthet rundt det.

J: Jeg havna jo midt i glansperioden av lanseringen her på NTNU, føler jeg liksom har fått med meg alle stegene fram.

A: Jaha, når var det da?

J: Jeg begynte i 2013, så da var det liksom oppe og gå.

A: Ja, vi starta vel før jul 2012 med interntesting, men i 2013, da begynte det. Da hadde vi allerede egentlig mye data som vi hadde gjort på forhånd.

J: Ja, fordi jeg ser det står litt forskjellig på hjemmesiden og i ulike papers, men når er man sier at Kahoot! har blitt lansert og har vært ute på markedet fra?

A: Jeg tror mars 2013 er det som... For vi hadde en litt sånn soft launch, sånn at vi... Det er da det begynte å bli at folk bare kunne begynne å bruke det offentlig, da. For den tiden inviterte vi folk inn og sa “ok, du kan få bruke det”, men da åpna vi på en måte opp for at folk kunne registrere seg.

J: Etter forrige intervju jeg gjorde, så var det veldig klart at de hadde gjort veldig mye sånn systematiske... Brukt veldig mange systematiske metoder for å få feedback, men det høres jo ut som dere har brukt litt sånn uformelle metoder også, typ at man har tatt imot reviews og e-post og egentlig litt sånn på lav terskel.

A: Ja, fordi de som jobba på community følger jo med på Twitter og på blogger, og klart det kommer an på hvis du får veldig lite feedback - vi har fått veldig mye feedback på det, så da må vi nesten ha noen som følger med litt.

4 Factors influencing user engagement

J: Da vil jeg snakke litt om faktorer som påvirker brukerengasjement, og kanskje spesielt i responssystemer. Det er vel sikkert der du har mesteparten av kunnskapen din om. Jeg lurer på hva de faktorer du tenker at påvirker brukerengasjement? Det kan være generelt, det må ikke være teknisk.

A: Nei, det som jeg har lært fra jeg har jobba med andre ting, andre caser - nå er jeg jo veldig sånn spillbasert, da - så jeg har veldig trua på spill og litt av det som er viktig å få til, er en eller annen spenning, er veldig viktig. Å få til litt sånn usikkerhet. I for eksempel Kahoot!, så er spenninga stort sett om du har svart riktig og hvor du havner på scoreboardet neste gang. Og litt den der tida når klokka går ned og det skaper en sånn spenning som skaper et veldig fokus. Og det har jeg sett på... Jeg bruker masse forskjellig ting i klasserommet, og stort sett den eneste gangen jeg har 100% fokus, det er når jeg kjører Kahoot!. Da er til og med de som er på nettet og på Facebook og sånn, de må bare følge med, for det skaper en litt sånn spenning. Så det er en veldig viktig bit! Så tror jeg også at lyd, og det spesielt i klasserommet så er det littegrann for… Du skaper... Det er vanskelig å gjøre andre ting, ha fokus andre plasser når den lyden kommer, så det er veldig viktig. Design er også veldig viktig, for hvis ting er knotete å bruke, detter du litt ut av det. Og det er jo typisk de gangene det går skeis, så er det som regel et eller annet teknisk som går feil, nettet går ned eller noe sånn. Det er litt sånn ting som ødelegger, da. Andre ting.... Det med score og konkurranse, er absolutt noe som… Det trenger ikke være konkurranse, det kan også være samarbeid, men et eller annet som du måles mot, det kan også måles mot deg selv, men… Fordi jeg tror det er noe iboende ting at vi ønsker å gjøre det bedre, eller det kan både være mot deg selv eller AI eller hva som helst.

J: Sammenligningsbiten på en måte?

A: Ja.

J: Hvis du tenker på litt sånn konteksten man er i, hvordan tenker du at det kan spille inn?

A: Kontekst… Altså, en annen ting som er veldig viktig, er bruken av den som leder og gjør det, for eksempel vet jeg at det en lærer i USA som hadde tatt og brukt Kahoot!, og etter ferdig Kahoot!-session, så har han lastet ned regnearket, og vist bunnen. Vist dem som var dårligst i klassen og hengt ut dem. Det ble jo stikk motsatt av hva det er designa til, men det viser at hvis selv om verktøyet egentlig er et bra verktøy, så kan det radbrekkes, det kan misbrukes. Så det er en ting som jeg har forska også på, ikke bare på Kahoot!, men også andre verktøy brukt i klasserommet, hvordan det passer inn med resten, integrasjon, har ekstremt mye å si. At man ikke føler det er ute av kontekst, at det gir en god flyt i forhold til resten, hvis det er en time, så at spørsmålene er relevant i forhold til det som er gjennomgått, eller at det føles ut som en helhet, så bruken har ekstremt mye å si, da.

J: Hvilke tekniske faktorer er kritiske med tanke på Kahoot!-produktet vil du si? Har vært eller er?

A: Det som var for gjennombruddet, det var tilgjengeligheten av smarttelefon. Vi hadde prototype før smarttelefonen, det var noe herk. Trådløse nett, og nett generelt er en av de mest kritiske faktorene, men stort sett det eneste som kan bryte sammen, er nettet som gjør at for eksempel enkeltpersoner detter ut, eller flere detter ut, eller verste fall lærerens klient detter ut. Så nettilgang er nesten det viktigste, men i tillegg så er det andre tekniske ting. Det er størrelse på lerret, at alle klarer å se, for spørsmåla og svara står der, så det er ekstremt viktig å ha et godt designa klasserom i forhold til det. Det går jo og på projektor, at den viser det godt nok, har også noe med farger og gjøre, hvis man har veldig dårlig projektor så alle fargene går i saus, og da kan det være vanskelig å treffe, selv om man har symboler, så må man vite at det er riktig farge. Lydanlegg er også en stor fordel, ikke helt kritisk, men det er for å få en god opplevelse, så er lyd viktig. Det er ganske ulike ting å se også, litt... For læreren at det er enkelt å koble seg opp og for eksempel det at når du kjører Kahoot!, så bør du kjøre skjermen sånn speila, så det er det samme du ser på PC som man ser på skjermen. Det kan være en utfordring for enkelte. Det er en del sånne tekniske ting, da.

J: Og dersom tekniske feil eller uheldigheter inntreffer, hvordan er Kahoot! lagt opp til å takle dette, eller hvordan informerer de brukerne om det?

A: Det som vi på forhånd… For eksempel et problem kan være kapasitet, la oss si du skal kjøre det her på en stor konferanse med 500 deltakere, så har vi på hjelpesiden vår estimat på hva du trenger av nettverk, for eksempel, så vi har lagt til sånne praktiske guider, så du kan teste om det her faktisk fungerer, og vi har også masse sånne guides for å hjelpe deg gjennom. Som regel så er det nettverk som er problemet, og da hvis det oppstår et teknisk problem, så må man ta kontakt med IT drift eller noe sånn, så det går litt utenfor. Men en annen ting som går, det går på, hvis det er feil eller noe, så har vi ganske bra hjelpesider hvor man kan finne oversikt over tekniske ting.

J: Hvis en klient detter ut, vil den få noe tilbakemelding på…

A: Ja, det som er gjort, og det er noe som er jobba med for å gjøre det så robust som mulig, så det som skal skje, det er at den skal koble seg tilbake automatisk uten noe mer mikkmakk. Av og til, så er det litt sånn problematisk fordi at nettverket oppfører seg litt rart, så det er ikke bestandig at det tekniske går på grunn av nettverket, men i utgangspunktet skal alt skje automatisk, da. Det som er litt kjedelig da, er at den personen vil miste poeng og det er hvert fall, for den som er konkurransedrevet å plutselig miste poeng på grunn av nett, er ikke så morsomt.

J: Ja, for hvordan tror du det påvirker user engagement videre?

A: Jeg vet at for enkelte, så er det hvis dem for eksempel har vært i ledelsen også plutselig så ligger dem... Så ligger dem ikke på topp fem på grunn av nett detter ut, så mister dem litt piffen. Som regel så spiller dem fleste ferdig, men fra å stå halvveis oppreist, så kanskje de setter seg og litt sånn “nå har jeg ikke sjans uansett”. Så det er rett og slett litt utenfor hva vi kan håndtere da, så det er egentlig den nettverksbiten som er vår største utfordring. Men vit også at en skole i Afrika, som ønsker … Jeg husker ikke helt hvilket land, kanskje Sør-

Afrika, som ikke hadde infrastruktur og ikke hadde PC-er, de hadde hørt om Kahoot! og hadde vært på en messe eller en konferanse der dem viste fram. Så dem laga en papirversjon av det, så der hadde dem på en måte farger og sånn også… Så det var litt morsomt, da. Og forresten en ting som vi oppfordrer til, hvis vi ser at hvis det er veldig mange som skal spille sammen, og ser vi at nettet ikke takler det, så anbefaler vi å kjøre på team mode, det vil si at folk grupperer seg kanskje fem og fem, så bruker dem én device, da har du mulighet til å legge inn, du har et sånt gruppenavn, et teamnavn, også kan du legge inn alle navna som er med på gruppa, men da er det typisk en som må trykke, da. Så da diskuterer man, så er det en som trykker. Og da hvis man vinner, så vil det bli synlighet for alle som er med på gruppa, da. Så det er det vi anbefaler hvis nettet er dårlig, og det vet jeg det er mange som bruker i klasserom der de har fem iPader tilgjengelig.

5 Future work

J: Hvordan du ser fremtiden til Kahoot! ut?

A: Nei, foreløpig så har det jo gått veldig bra. Det er flere ting som jeg kunne tenkt meg at var med i Kahoot!, jeg har designa ting og planlagt ting som jeg ønsker skal komme i produktet, spesielt som går på enda mer læring ut av den sessionen. Nå er det veldig mye fokus på å være kjapp, så jeg har blant annet designa en spillmodus som går mer på å gi riktige og komplette svar, som jeg håper veldig kommer inn. Og den andre som er viktig firmamessig, er at vi tar jo ikke penger for bruken, bortsett fra bedrifter, så det er at vi for nok bedrifter, så vi har penger til å drive det videre. Også ønsker jeg på lang sikt at det skal komme mange flere typer måter type spill for å leke med kunnskap. Det som egentlig var planen fra starten, at ikke bare den type quiz man ser i dag, men masse forskjellige kunnskapsleker.

J: Bare helt på tampen, er det noe du har lyst til å legge til som jeg ikke har spurt om til nå? Du har jo snakket så fint og fritt.

A: Det jeg tenker på som har blitt gjort undersøkelser på og funn på, så er det sett på bruk Kahoot! første gang over tid, da har vi sett at det er ikke noe vesentlig statistisk signifikant nedgang om du bruker det ganske ofte, da. Det eneste var den sosiale interaksjonen i klasserommet som ble mindre. Det er en ting, og at når du kjørte det første gang så var det mye mer livlig stemning, og det sier egentlig litt seg selv, da er settingen helt annerledes. Også en annen ting, som det har vært veldig tilbakemelding på både gjennom eksperimenter kjørt også fra fag jeg har hatt, at hovedlæringen sånn som det brukes vanligvis, er på å få bekrefta at kunnskapen som er gjennomgått i timen er korrekt, at du får veldig sånn acknowledgement på det, også motivasjon i forhold til å følge med fordi du kan bruke kunnskapen med én gang. Og du får liksom andre knagger å henge det på, sånn at for eksempel hvis du etter er gitt et spørsmål, så diskuterer du med sidemann og da husker du ofte senere “ok, det spørsmålet der husker jeg fordi da tok jeg feil, men…” altså, du har en sosialkomponent å henge det på. Og en annen ting som er litt viktig, er at vi tok et eksperiment der vi sammenligna med papirquiz og et vanlig studentresponssystem som ikke var spillbasert, og et spillbasert, som var Kahoot!, da. Det jeg trodde i mitt hode var at papirquiz var minst engasjerende, så vanlig studentresponssystem som mer engasjerende enn papirquiz, så tenkte jeg kanskje at med spillelementet var mest engasjerende. Men

funnene var ikke det, da, det viste seg at papir og vanlig studentresponssystem var ca. akkurat like engasjerende, mens forskjellen var egentlig det spillaspektet som gjorde det mer engasjerende. Og jeg syns det var litt interessant, for jeg trodde egentlig ikke det var tilfellet. Jeg trodde kanskje at studentresponssystem i seg selv og det å bruke en mobildevice var mer engasjerende, men det visste jeg ikke. Så det var stort sett ingen forskjell på de to i det hele tatt. Så det syns jeg var litt interessant.

J: Jeg skal jo skrive master på dette rundt, tja, helt hva vet jeg ikke enda, men du kommer ikke på noe umiddelbart som, hva skal jeg si, ikke er skrevet master om enda, eller om du har noen tanker om det går an å trekke inn Kahoot! i på en måte?

A: Hva er det her forresten?

J: Det her er prosjektoppgave. Men prosjektoppgaven min er user engagement i ulike systemer egentlig, så ble det en enkel vei å velge responssystemer. Men jeg tror nok at jeg trenger å forme den litt bedre neste halvår. Jeg regner med at det meste er gjort.

A: Det er gjort litt på det, men jeg tror ikke det er sett så veldig mye på det med spillelementene i det her. Det er gjort mye på responssystemer, over mange mange år. Men har ikke sett så mye som tar inn spillelementet og hvordan det påvirker. Det har begynt å komme noe, men tror kanskje det er noe rom der. Hvilke andre studentresponssystemer er det du har…?

J: Jeg har sett på ONE2ACT, det som er på HiST. Det hadde jeg intervju i går. De har jo ikke noe spillelement, men har litt flere tjenester å velge blant.

A: På et tidspunkt var det et spørsmål om vi skulle merge, jeg valgte glatt ikke… hehe. Med det som er deres styrke da, det er funksjonalitet, vil jeg si. Og det som kanskje er litt svakheten, det er funksjonalitet. De har prøvd å gjøre veldig mye da, det som har vært fokus fra starten for Kahoot! har vært at det skal være veldig enkelt å bruke og ikke forvirrende og ikke introdusere så mye at det her… også, ja. De har ikke hatt helt ressursene til å utvikle så robust heller da. Men det er veldig sånn, fleksibel måte gi svar og alt mulig sånn, så det er veldig styrke. Hvem var det du snakket med da?

J: Åh, hva het han igjen da. George tror jeg kanskje, om det kan stemme. Han snakka engelsk, men var ikke engelsk. Tusen hjertelig!

Appendix F
Questionnaire

The questionnaire created in SelectSurvey is attached as a PDF in the following pages. The questionnaire was active in the period from 12th March to 30th April 2018 and received 106 responses.

NTNU – Trondheim
Norwegian University of
Science and Technology

Survey on User Engagement in Kahoot!

Hello!

This survey is a part of my master thesis in the Master's Programme Communication Technology. The focus of the study is to investigate the concept of user engagement in context of the game-base student response system Kahoot!. You will be asked questions regarding your experiences with Kahoot!, so only consider this survey relevant if you are familiar with the classroom service and have used it in one or more occasions (e.g. as a professor, teacher or a student, etc.)

Completion of the survey will take approximately 7-10 minutes.

Your participation in the survey is completely voluntary and anonymous, and all data will remain confidential.

For Norwegian participants: The open ended questions of this survey can be answered in Norwegian.

I would also like to get in touch with users of Kahoot! for a follow-up interview, so if you would be willing to participate in the follow-up study, please leave your email address in the last page of the survey.

Thank you in advance for your help and if you have any questions, please do not hesitate to contact me: juliesko@stud.ntnu.no

Julie A. Skøien - Master student in Communication Technology, NTNU.

NTNU – Trondheim
Norwegian University of
Science and Technology

Survey on User Engagement in Kahoot!

Use of Kahoot!

First, we want to ask you some questions about your usage of Kahoot!, and some questions about yourself.

1. **Do you use Kahoot!?** *
   - ○ Yes
   - ○ No

2. **How often have you used Kahoot! during the last month?** *
   - ○ Never
   - ○ Once
   - ○ 2-3 times
   - ○ Once a week
   - ○ Several times a week
   - ○ Daily

- Other, please specify

3. **Which of the following options best describes your main occupation?***
   - Student in secondary school or high school
   - Student in higher education (e.g. university college, university)
   - Teacher in secondary school or high school
   - Teacher or professor in higher education (e.g. university college, university)
   - Other, please specify

4. **In which role(s) do you use Kahoot!?***
   - Student (the role of player)
   - Teacher (the role of instructor who uses Kahoot! in the classroom)
   - Both

5. **What is your gender?***
   - Male
   - Female
   - Other

6. **How old are you?***

NTNU – Trondheim
Norwegian University of
Science and Technology

Survey on User Engagement in Kahoot!

More on use of Kahoot!

In this part, we would like to gain a bit more insight into how and in which settings you use Kahoot!.

7. **How has Kahoot! already been used in classes you attended as a student?**
   *Several answers are possible; if you have only used Kahoot! as a teacher, please select "not relevant".**
   - For repetition of the syllabus
   - To introduce new subjects/topics
   - To gather statistics and see the students' progress
   - To check whether the students understood what was just taught
   - For entertainment
   - To trigger discussion in class
   - To engage students
   - To motivate students to attend the lecture
   - Not relevant
   - Other, please specify

8. **If you have already used Kahoot! in a classroom setting as a teacher, which goal/intention(s) did you**

have?

Several answers are possible; if you have only used Kahoot! as a student, please select "not relevant". *

- ☐ Repetition of the syllabus
- ☐ Introduce new subjects/topics
- ☐ Gather statistics and see the students' progress
- ☐ Check whether the students understood what was just taught
- ☐ Entertainment
- ☐ Trigger discussion in class
- ☐ Engage students
- ☐ Motivate students to attend the lecture
- ☐ Not relevant
- ☐ Other, please specify

9. **I play/use Kahoot! with groups of around:** *
   - ○ 1-20 persons
   - ○ 21-50 persons
   - ○ 51-100 persons
   - ○ more than 100 persons
   - ○ It varies

NTNU – Trondheim
Norwegian University of Science and Technology

Survey on User Engagement in Kahoot!

Engagement attributes

This part of the survey focuses explicitly on attributes of user engagement, which is the central concept in my master's thesis work. We kindly ask you to rate the following statements related to Kahoot! and how you feel when using Kahoot! (if you are using Kahoot! as a teacher, we refer to the phase of actually running a Kahoot!). We use a scale ranging from strongly disagree to strongly agree.

10. **Please rate the following statements:** *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am feeling interested when I play/use Kahoot!.	○	○	○	○	○
I tend to get so involved in Kahoot! when I play/use it, so I lose track of time.	○	○	○	○	○
I have experienced that Kahoot! sessions do not always work out the way I planned.	○	○	○	○	○
I have felt discouraged while playing/using Kahoot!	○	○	○	○	○
I tend to get really drawn into Kahoot! when I play/use it.	○	○	○	○	○
I play/use Kahoot! out of curiosity.	○	○	○	○	○
I feel in control of my Kahoot! sessions.	○	○	○	○	○
Kahoot! is attractive.	○	○	○	○	○
I like the graphics and images used on	○	○	○	○	○

Kahoot!.					
My curiosity gets incited by Kahoot!'s content.	○	○	○	○	○
Kahoot! is aesthetically appealing.	○	○	○	○	○
I tend to feel involved when playing/using Kahoot!.	○	○	○	○	○
Using Kahoot! is rewarding.	○	○	○	○	○
Playing/using Kahoot! is fun.	○	○	○	○	○
I tend to lose myself when I play/use Kahoot!.	○	○	○	○	○
I have felt frustrated while playing/using Kahoot!.	○	○	○	○	○
I would recommend Kahoot! to my friends and family.	○	○	○	○	○
I have experienced that the time just slips away when I play/use Kahoot!.	○	○	○	○	○

Survey on User Engagement in Kahoot!

Factors influencing your experience with Kahoot!

In this part, we would like to gain some more insight into factors that may influence your experiences with Kahoot! (positively and negatively).

11. **Which aspects / factors contribute most to *positive experiences* with Kahoot! in your opinion?** Please try to explain briefly in your own words (if your are using Kahoot! as a teacher, this can also refer to preparing a Kahoot!, running a Kahoot! session in classroom, post-processing, etc.).:

12. **Which aspects / factors contribute most to *negative experiences* with Kahoot! in your opinion?** Please try to explain briefly in your own words (if your are using Kahoot! as a teacher, this can also refer to preparing a Kahoot!, running a Kahoot! session in classroom, post-processing, etc.).:

NTNU – Trondheim
Norwegian University of
Science and Technology

Technical issues in Kahoot!

Furthermore, we are interested in technical issues you might have experienced when using Kahoot!. Technical issues refers to problems or challenges you have met when using/playing Kahoot! (e.g. internet connection, the internet browser, the electronic device used, etc.). We kindly ask you to check the checkboxes for the following statements related to technical issues in Kahoot! (if relevant).

13. **I have experienced that Kahoot! sessions were affected by:**

- ☐ Bad internet connection
- ☐ Interruptions/disturbances
- ☐ Noticeable delay
- ☐ Other technical problems, namely

NTNU – Trondheim
Norwegian University of
Science and Technology

Survey on User Engagement in Kahoot!

End of survey

Finally, thank you for participating in this survey!
Your support in my work is much appreciated.

14. **For any comments, please leave them in the comment box below:**

15. **If you find yourself available, please fill in your email if I can contact you for further research regarding your personal use and experiences with Kahoot!:**