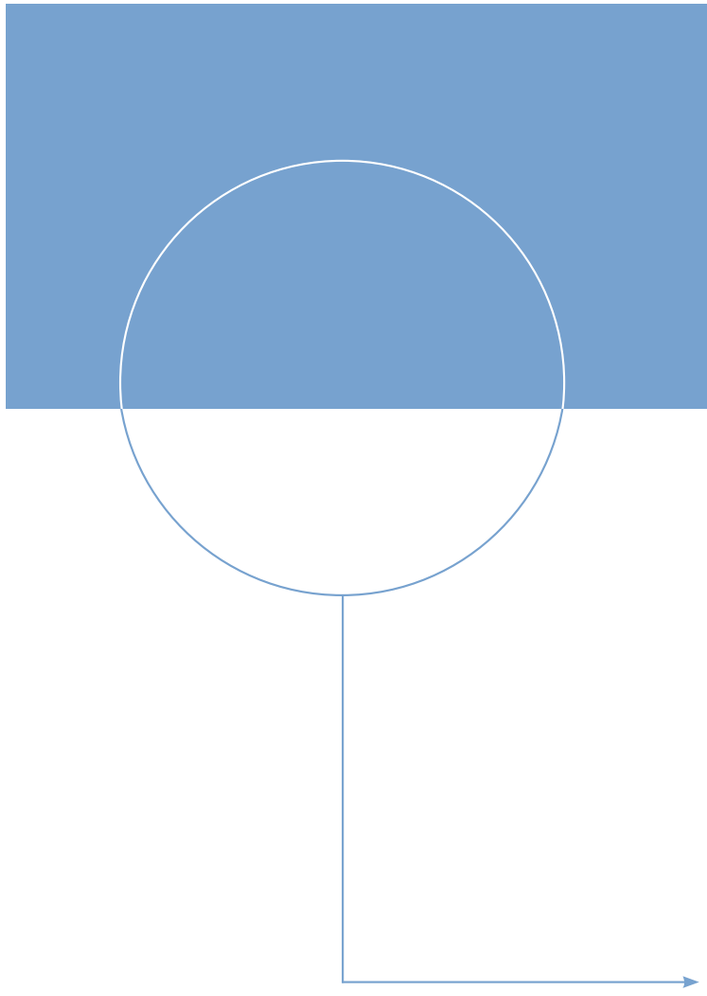

Master's thesis

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Kahoot Team Mode - Distributed collaborative learning through a gamified quiz experience

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IT3906 - Informatics Postgraduate Thesis

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Abstract

Today's classrooms look significantly different from what they did only a few years ago. Digital tools, both in the form of laptops and tablets, as well as a multitude of different software have gained a permanent position in education, and Norway has been a front runner in this development. The goal of these tools can be everything from simplifying or streamlining instructions for the teacher, to increasing the learning outcome and motivation among students.

The Norwegian game-based learning platform Kahoot! is already beloved by many, both in and out of the classroom. The quiz game utilizes the concept of formative assessment, in combination with competition and game elements, to engage and make teaching both fun and informative.

This Master's thesis aims to explore concepts and mechanisms for successful collaboration, in order to propose a Kahoot Team Mode solution. The need for this is particularly urgent due to the Covid-19 pandemic, which has seen students around the world relocated from the classroom to homeschooling through digital platforms. Technology that supports collaboration and interaction with fellow students can in such a case be an important contribution to both learning and social well-being.

A literature study formed the basis for a design suggestion for a Kahoot Team Mode solution where players can collaborate and play a kahoot together, without the need for being in physical proximity. Further work, and evaluation through a focus group, contributed to the solution evolving in a direction where the game could be used both in co-located settings such as classrooms, and also in distributed situations. The final solution was re-evaluated, this time through user tests with a higher fidelity prototype.

The feature suggestions that were considered potentially successful and valuable for learning, engagement and social dynamics in a team situation were as follows; a two-step modular voting process. The first step being an individual vote along with an assessment of this vote, and the second being a discussion and re-evaluation of the votes in a shared space. During this discussion and negotiation phase, emojis are used as the main form of communication. These mechanisms allow the players to share and build on each other's knowledge, with the added benefit of the two-step process functioning as a repetition of the educational topic.

Badges, or in this case hats, are also introduced in the new solution, with the purpose of encouraging players to participate actively throughout the game. Another novelty in the collaborative game is the teammates playing anonymously together. This feature was implemented to alleviate bullying and support confidence for the

weaker players, allowing them to engage freely, without fear of repercussions.

Additionally, if a team wins the kahoot, beating all competing teams, they will be given the opportunity to reveal themselves to their team, and thus get to know who they have collaborated with for the win. This added bonus was also implied to be a good motivator for performance and participation.

As the project duration was limited, further development and testing would be necessary to verify and validate the results. As such, this thesis' main function will be to form a basis for future research, by exploring possible concepts for implementation.

Sammendrag

Dagens klasserom ser betydelig annerledes ut en det de gjorde for kun få år siden. Digitale verktøy, både i form av PCer og nettbrett, samt en mengde ulik programvare har fått sin faste plass i undervisningen, og Norge har vært en pioner innen denne utviklingen. Formålet med disse verktøyene kan være å forenkle eller effektivisere undervisningen for læreren, eller å øke læringsutbyttet og motivasjon blant elevene.

Den norske spillbaserte læringsplattformen Kahoot! er allerede høyt verdsatt av mange, både i og utenfor klasserommet. Quiz-plattformen benytter formativ vurdering, i kombinasjon med konkurranse- og spillelementer for å engasjere og gjøre undervisningen både morsom og lærerik.

Denne masteroppgaven har som formål å utforske konsepter og mekanismer som bør ligge til grunn for vellykket og effektivt samarbeid. Basert på dette vil en ny Kahoot Team Mode-løsning foreslås. Behovet for en slik løsning er særlig relevant grunnet Covid-19 pandemien, som har ført til at elever over hele verden har blitt flyttet ut av klasserommet, og over til digital hjemmeundervisning. Teknologi som støtter samarbeid og interaksjon med medelever kan i et slikt tilfelle være et viktig bidrag både til læring og sosial trivsel.

En litteraturstudie formet grunnlaget for et designforslag til en løsning, der spillere kan samarbeide og gjennomføre en kahoot sammen, uten å trenge å være i fysisk nærhet. Videre arbeid og evaluering gjennom en fokusgruppe bidro til at løsningen utviklet seg i en retning der spillet kunne brukes både ved tilstedeværelse i klasserom eller andre fysiske omgivelser, men også i distribuerte settinger. Den endelige løsningen ble igjen evaluert ved hjelp av brukertester, og videre endringer ble foreslått.

Funksjonsforslagene som ble vurdert vellykkede og verdifulle for læring, engasjement og sosial trivsel i en teamsituasjon var følgende; en to-stegs evaluering av svaralternativene ble implementert. I første del gjennomfører spillerne en individuell avstemning, med tilføyelsen om å legge ved en vurdering av egen stemme. Deretter kommer diskusjons-fasen, hvor spillerne kan diskutere og argumentere for de ulike svaralternativene, og endre sin egen stemme etter ønske. Emojier er foreslått som kommunikasjonsform, for å forenkle prosessen og å gjøre spillet morsommere. Gjennom denne modulære prosessen kan spillerne lære av og bygge på hverandres kunnskap, samtidig som de får repetert temaet i løpet av de to stegene.

Merker, eller i dette tilfellet hatter, blir også utdelt internt i laget i løpet av spillet. Disse har som formål å oppmuntre til aktiv deltakelse, da de deles ut til lagmedlemmet som enten er raskest til å svare korrekt, eller til den som er mest kommunika-

tiv i diskusjonsprosessen. Disse hattene ble påpekt å ha en motiverende effekt på deltakelse og engasjement.

En annen introdusert nyhet i samarbeidsløsningen er at lagene spiller anonymt sammen. Denne mekanismen ble implementert for å forhindre mobbing, og å bidra til selvtillit hos svakere elever. Anonymiteten kan legge til rette for at alle skal tørre å bidra aktivt i diskusjonen, og ikke være redde for erting eller negative konsekvenser i etterkant, dersom de gjør feil eller er trege i spillet.

Dersom et lag vinner kahooten, vil de få muligheten til å avsløre seg selv for laget sitt, og dermed få vite hvem de har samarbeidet med til seieren. Denne ekstra bonusen ble i evalueringen også antydet å være en god motivator for aktiv deltakelse og ønske om å vinne.

Ettersom prosjektperioden var relativt begrenset, vil videre utvikling og testing være nødvendig for å verifisere resultatene. Oppgaven har som sådan som hovedfunksjon å danne et grunnlag for videre forskning, og å utforske mulige konsepter for implementering.

Acknowledgments

For guidance, motivational support and constructive feedback, I would like to thank my NTNU supervisor, Associate Professor Trond Aalberg. You have continuously helped me stay on track with my work, and steered me in the right direction when I have struggled with navigation in the process. I have highly appreciated our bi-weekly meetings, and am grateful for the amount of freedom and flexibility you have allowed me, in a well supervised setting.

I would also like to thank my mentor at Kahoot!, Padraic Woods for support and encouragement. Without you and the rest of the team at Kahoot!, this thesis would not have been possible. I am thankful for having been allowed to work to support such an exciting platform, and hope my work may contribute to an even more inclusive and fun way of learning collaboratively with Kahoot!.

Lastly I would like to direct a big thank you to the participants of both the focus group and the user test sessions. The feedback and results that came from these were invaluable for the process, and contributed significantly to the realization of this thesis.

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Terms and Definitions

Abduction In the context of logical formalism, abduction is the method of inference in which the goal is to produce a plausible result or claim, without the requirement of positive validation [1].

Affordances An affordance is by Cambridge Dictionary defined as "a use or purpose that a thing can have, that people notice as part of the way they see or experience it" [2]. Affordances in the field of information systems specifically considers how the design of a service determines how the users perceive the way it can or should be used [Jeong and Hmelo-Silver, 2016]. It can be viewed as an opportunity for an action within an information system or service, involving both the user and the service. As a result, affordances for a single system may vary depending on the user as well as the design [Jeong and Hmelo-Silver, 2016].

Computer Supported Collaborative Learning Considering the definition of collaboration, computer supported collaborative learning (CSCL) is the practice of how technology may enable and promote collaborative work between people [Halavais, 2016].

Cooperation vs collaboration Collaboration and cooperation are both ways in which two or more people may work together on a problem or task. Collaborative learning typically involves a joint effort of equal shares between team members, working towards a shared goal. Cooperation however, is differentiated from this in that it usually involves an initial division of the work, followed by individual problem solving by participants, before the efforts are joint together to achieve the team's common objective [Jeong and Hmelo-Silver, 2016].

Distributed Team Learning A distributed team is a group of workers or learners co-operating from different locations, often geographically dispersed. Distributed team learning includes the processes and methods through which the team members increase their knowledge base, building on each others' competence and experiences [Andres and Shipps, 2010].

Gamification Gamification is defined by the Cambridge Dictionary as "the practice of making activities more like games in order to make them more interesting or enjoyable" [3]. Concepts of gamification are often applied with the purpose of supporting learning or training, aiming to increase productivity and engagement.

[1] Definition of Abduction by Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/abduction/

[2] Definition of Affordance by Cambridge Advanced Learner's Dictionary & Thesaurus. https://dictionary.cambridge.org/dictionary/english/affordance

[3] Definition of Gamification by Cambridge Advanced Learner's Dictionary & Thesaurus. https://dictionary.cambridge.org/dictionary/english/gamification

1 Introduction

This introductory section will provide insight into the backdrop of the Master's thesis. The motivation behind the project is presented, with supporting context given in the succeeding section. Here, the contributors to the project are introduced, as well as the alignment with current technology and research trends. The research questions to be answered through the project work are stated, and the research method to be applied is explained and justified. Finally, an outline of the report is given, describing the following sections, and giving an overview of the structure of the paper.

1.1 Motivation

Technology today is rapidly evolving and changing the way we live our lives. The way we communicate and interact with each other is affected, and more and more of our everyday lives are lived through digital tools. Following this trend, technology has long ago claimed its place in education and in the classroom, and its impact is continuously researched and modernized.

Today's digital or technologically blended classrooms are looking quite different from the traditionally prevailing "pen and paper" based teaching method. Smart boards, iPads or tablets, laptops and mobile devices are often available to both students and teachers, and an abundance of software systems are developed to both promote learning, and to make it more fun. Particularly high in demand due to the ongoing Covid-19 pandemic are digital solutions for remote classroom education. In Norway, all schools closed down on March 12th of 2020, forcing teachers and school leaders to move to digital platforms to continue educating [Mælan et al., 2021]. These platforms have taken on the task of not only providing high quality learning, but also attempting to provide some of the social interactions and playfulness that normally would take place in a schoolyard.

From its beginning, Kahoot! has had the focus to facilitate an engaging, interactive, playful and fun way of learning across all grade levels. The company has had great success with this, and is currently used monthly by 70 million active users, including more than 50% of American students below university levels [Wang and Tahir, 2020]. As is evident from current stock listings and analytical evaluations, Kahoot! has thrived throughout the duration of the pandemic, and become an important part of the digital home schooling that has had to replace regular classrooms in many countries [Kahoot!, 2021]. In a literature review performed by one of Kahoot!'s early founders, the game platform was found to have several positive effects when used in education [Wang and Tahir, 2020]. Not only did the gamified quiz create

an engaging and fun atmosphere in the classroom, it was also reported to reduce student anxiety, lower the threshold for active participation, and to significantly increase learning outcomes. However, one area of classroom dynamics that Kahoot! is yet to sufficiently support is collaboration.

Computer supported collaborative learning (CSCL) is a topic that has been receiving much attention over the past few years. Collaborative learning in its normal form has proved to increase both engagement and learning outcome in traditional classrooms [Jeong and Hmelo-Silver, 2016]. The method of moving part of the responsibility for teaching away from the teacher, and more and more over to the peers is becoming increasingly popular. This is a trend both in primary schools, as well as at university and even professional training levels.

One challenge with digital platforms is implementing collaborative learning in a way that maintains social and cooperative aspects. Kahoot! already has the gamification and engagement in place, but has potential for improvements in ways for teachers to encourage collaboration and social interaction while playing kahoots. Having students be excited about collaborative work is easier in physical settings, where it means they can spend time with their peers. Using remote technology, however, largely removes the sense of "being together", and the excitement and motivation may need to come from elsewhere. Typical for playing kahoots in a physical classroom is the enthusiasm and expectations that arise when the game is started. Utilizing this, and transforming it into something that would spark the same excitement when working collaboratively in remote settings could be valuable.

As previously mentioned, extensive work and research has been done in the past to evaluate positive and negative impacts of both collaborative learning, computer supported collaborative learning, gamification in education, as well as Kahoot!'s influence on teaching and classroom engagement. The goal of this paper will be to bridge these topics, exploring, and ultimately proposing a solution for Kahoot! to provide their own version of a collaborative game experience.

Not only will this work be useful for Kahoot! as a company in order to maintain their relevance in the ed-tech market. It might also be an important insight for teachers and educators in how a collaborative technology option could be implemented to increase learning outcomes in an engaging and fun way.

1.2 Project and Context

This Master's thesis is written as the concluding work of the Master's program Interaction Design, Game and Learning Technology at the Norwegian University of Science and Technology (NTNU). The project work extends over two semesters, fall 2020 and spring 2021. The project is a collaborative effort between the author, Kahoot!, and supervisor Trond Aalberg at NTNU. The idea for the thesis materialized through meetings and brainstorming sessions between the author and representatives from Kahoot!, and was ultimately agreed on by all parts. The topic of distributed collaboration is especially relevant in the current state of the world at time of writing, and this is an area in which Kahoot! lacks a sufficiently effective solution.

Kahoot! has been doing increasingly well over the past few years, and thrived even through the ongoing pandemic. The gamified quiz platform has helped teachers keep students engaged and motivated when the physical classrooms have been unavailable. One aspect that has been harder to maintain after moving students out of classrooms and lecture halls have been the collaborative and cooperative elements. Designing a way through which students can work together and collaborate in a gamified and engaging platform could promote and facilitate this form of learning. This will be the main topic of this thesis project, focusing on gamification as well as computer supported collaborative learning(CSCL) in a distributed environment.

The work will initially revolve around an in depth literature study, aiming to evaluate and isolate the most important variables, problems, affordances and outcomes of CSCL, specifically focusing on the gamified arena that Kahoot! provides. The end result is a proposed Kahoot Team Mode (henceforth also abbreviated as KTM) feature that may be integrated with the platform ecosystem that Kahoot! is today. The solution will be designed, aiming to consider and explore the established points discovered in the literature review.

The topic of distributed collaborative learning has been thoroughly researched in the past, and there is an abundance of literature addressing the guidelines, affordances and pitfalls of such solutions. However, many of the research papers evaluate solutions for long term collaborative projects, which is not a relevant use case for KTM. The purpose of the following literature review will be to evaluate and extract the applicable findings of the relevant research papers, and combining these with theory and concepts of gamification in the classroom.

1.3 Research Questions and Objective

The overall goal of this research work is to extend existing research on the topics of CSCL, gamified learning and non-collocated collaborative learning. This combined knowledge will be used to propose a design solution for a collaborative version of a kahoot. The new game mode is meant to be supportive of distributed collaborative learning in a fun and engaging way. Principles of team based learning, gamification and computer supported collaborative learning will be considered.

The main objective of this Master's thesis is to explore concepts and opportunities, through research, design and evaluation. The research questions to be answered are therefore more general, to avoid the results being applicable only to the Kahoot! platform. Although the motivation and context of the work is heavily founded on the services and reach of Kahoot!, the gap in knowledge to be filled applies to the topic as a whole. The research questions are as follows:

RQ1: What mechanisms should be in place to facilitate learning in a gamified, distributed collaborative setting?
This research question covers the main ambition of the thesis work, and forms the basis of the initial literature review. The answer to this question will provide insight into how CSCL and gamified learning can be intertwined to benefit from each other. The mechanisms discovered through researching this question will also form the

basis of the design and development work, as the final product needs to consider the most effective mechanisms and affordances to best support learning.

RQ2: How can social dynamics be maintained and supported through gamification of distributed collaborative learning?
One of the more problematic aspects of distributed collaboration is attempting to maintain and promote positive social dynamics within the team. Group dynamics in any team based environment is a much researched and tried topic. When moving away from co-located environments to digital solutions, the dynamics may get even more intricate and fragile.

RQ3: What mechanisms from gamification may effectively promote engagement in a distributed, collaborative setting?

The solution proposed will aim not only to contribute to learning outcome, but also to increase student engagement and motivation. The goal is to explore methods and mechanisms that may make students want to spend more time and effort on the work, and potentially also encourage collaboration.

1.4 Research Method

The research method chosen for this Master's thesis is the design and creation methodology, as is thoroughly described in the book Researching Information Systems and Computing, by Oates [2006]. This research methodology is commonly used within the field of information system research. In contrast to other methods, it revolves mainly around the design and development of a product, or artifact, rather than collecting and processing data or information. Any literature reviews, user tests, conclusions and so forth that are made are primarily for the purpose of supporting the core product development. The artifacts produced can have varying characteristics and abilities, but should share the constructive goal of solving some intricate problem [Wirth, 2002]. One type of artifact are instantiations, which can be described as fully functioning IT systems, demonstrating some theoretical claim, function or idea, executed in practice. These make a contribution to knowledge by exploring and exhibiting technological possibilities and applications, supported by academic measures such as research, analysis, justifications, critical evaluations, et cetera.

The design and creation research methodology is at its core based on the well established fundamentals of system development. In order to apply this to research, a series of matters need to be addressed, often in an iterative manner. As a way to ensure that all required aspects are covered, and in order to substantiate any research claims, a five step process can be followed [Oates, 2006]. The process is iterative, and each iteration could provide new insights and knowledge to add to the research. The five step process is presented below, as described by Kuechler and Vaishnavi [2008], and complemented by Figure 1. The figure illustrates the iterativeness, and groups the processes, knowledge flows and logical formalism of the methodology. The steps are not necessarily required to be followed in a strict consecutive fashion, but they make up the foundation for an agile iterative process [Oates, 2006].

The Five Step Process

1. **Awareness** is the first step in the iterative process. It involves gaining knowledge and understanding of the problem to be solved by the research. Several approaches are available to achieve this. Existing research on the topic can be studied, field research can be performed to establish what needs should be met, or clients can be approached to help identify any "pains" in the market.

2. **Suggestion** involves taking the knowledge gained in the first step, and curating a tentative idea or suggestion as to how it can be used to solve the given problem. Creativity makes an important contribution in this process, although any ideas and decisions should be based on knowledge and the gained awareness from step one. The process of brainstorming ideas may effectively also contribute to further awareness of both the problem, as well as what should be prioritized for the finally suggested artifact.

3. **Development** is the phase where product implementation is in focus. The specific procedures included in this will vary, and are dependent on the type of artifact proposed in the preceding suggestion phase. An important practice during this phase is documentation of the process. The development phase will in some cases be a replacement for the traditional experiment or interview research methods, and this stage of the research should therefore be documented and explained sufficiently to be reproduced with an equivalent outcome. Similarly to the suggestion phase, new insights and theories may rise from the development stage, and these should also be considered iteratively.

4. **Evaluation** is taking a step back and assessing the finished or current state of the artifact. This phase is spent considering the product's quality and worth, and comparing it to the expected outcome established in the suggestion phase. This phase may also involve user testing and interviews, for artifacts where this is possible and relevant.

5. **Conclusion** has the purpose of identifying and processing any new information or knowledge gained from the process as a whole. Documentation from the former steps is rewritten to highlight new discoveries, and these are evaluated in conjunction with existing research. Any unresolved issues are addressed and suggestions for future research are made, either for a new iteration, or for the attention of other researchers.

By following the steps outlined above, embracing spontaneous re-iterations within the stages, and maintaining agility throughout, as shown in Figure 1, the outcome can be valuable new knowledge, gained through the process of creation.

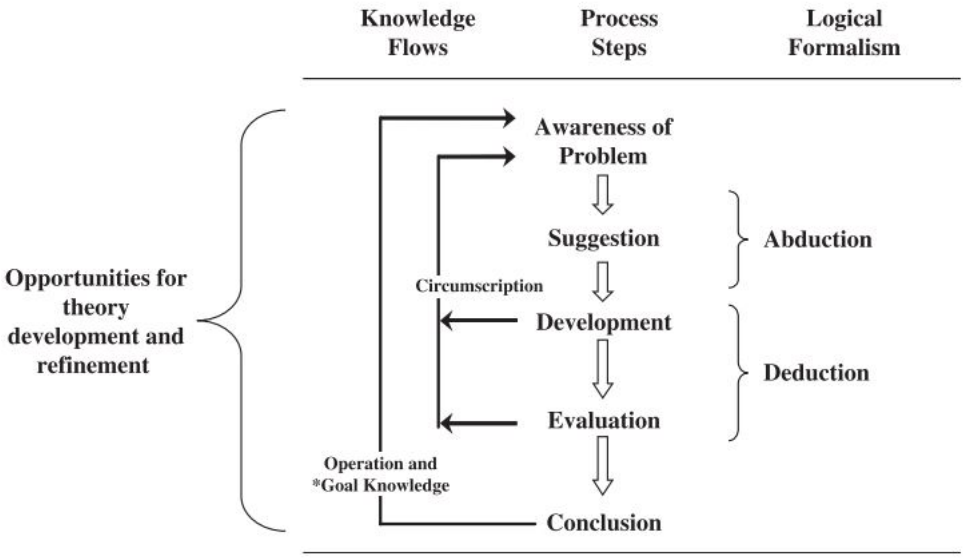

Figure 1: Illustration of the five step iterative process of design and creation, presented by Kuechler and Vaishnavi [2008].

Advantages and Limitation

The design and creation research strategy is very popular within the discipline of computer science. Although much of the rapid progress within the field is thanks to theoretical research and analysis, the market is also dependent on software development and testing of functioning systems, based on the conceptual research [Oates, 2006].

A significant benefit to the design and creation method is the end product of the process being a tangible artifact. This is an advantage compared to research methods where the final outcome is mainly knowledge based, such as new theories, statistical reports, or increased general understanding of a topic. The final artifact can be used as subject in a variety of in depth test and quality assurance procedures, e.g. user interviews, usability testing, acceptance testing, performance testing and so forth, depending on what the desired knowledge outcome of the evaluation phase is [Oates, 2006].

The design and creation methodology is often applied for projects sponsored or requested by a client, which is the case for this Master's thesis. This can be advantageous as it may increase the likeliness of a product being relevant outside of academia, as well as providing opportunities for useful problem solving input from the client. However, it may also present challenges, e.g. when the interests of the researcher and the client differs. To avoid conflicts it is therefore important to have clear goals for the research project, and to communicate unambiguously [Oates, 2006].

Other concerns when utilizing the methodology is to ensure the validity of the research process, and avoid the work resulting in a common design project. It is also important to pay careful consideration when applying concepts from literature or other studies into an artifact. A mechanism in an information system may be effi-

cient in one specific setting, but generalization to all situations is rarely applicable. Another limitation is the rapid evolvement of technology, and the risk that a solution resulting from a design and creation research process may quickly be out of date or invalidated in the market [Oates, 2006]. This again is very relevant in the case of this master thesis, as Kahoot! is a rapidly moving and evolving platform. The research should therefore aim to contribute to knowledge and development on a general basis, and not exclusively in context of the Kahoot! platform.

1.5 Report Outline

This thesis is structured following the stages of a design and creation research methodology, as described in Section 1.4 Research Method and further discussed in Section 3.1 Design Science. The current section has provided an introduction to the Master's thesis, stating the motivation, context and research questions to be answered throughout the project work.

Section 2 Background Theory presents relevant theory and concepts discovered in the literature study and awareness phase of the project. The three topics of Team based learning, Computer supported collaborative learning and Gamification in education are all investigated, aiming to find relevant information to base a design suggestion on. The topics are then bridged, before moving on to the suggestive phase.

The next section, Section 3 Design revolves around the actual suggestion of ideas and concepts for the new solution. Game and collaborative features are presented to support ideas and affordances discovered in the preceding section, and technical requirements are declared. A flow chart is used to illustrate the suggested gameplay of the solution, in order to give a visual representation of the suggested features.

Following the design and suggestion phase is Section 4 Implementation. The process of prototyping is outlined. The current team mode solution that Kahoot! uses is then introduced, in order to give context for the new development. Finally, the latest version of the suggested Kahoot Team Mode is presented, with screenshots from the prototype supporting the explanations of gameplay, collaborative aspects, voting process and other relevant concepts.

After the implementation comes Section 5 Evaluation. This section introduces the evaluation practices chosen for the project, and presents relevant information disclosed through the focus group and user testing sessions.

The penultimate section is Section 6 Discussion. Here, a taxonomy of different concepts and suggestions encountered throughout the project work is first presented. Following, the results from the two iterations, with the focus group and user tests, are respectively reflected on and discussed. Subsections 6.2 First Iteration and 6.3 Second Iteration are both structured by grouping discoveries relevant to each research question.

Finally, the thesis is completed by Section 7 Conclusion and Future Work, with concluding remarks, and summaries of discoveries made. The contribution to knowledge made by the thesis is presented, future work is suggested, and a final project evaluation is made.

2 Background Theory

This section will give a thorough review of the relevant literature to the research topics. In the early stages of the work with this Master's thesis, the primary objective was to build awareness and understanding of the problem addressed in the research questions. Three main areas of research were focused on to support the design and creation research. Existing research within these topics was studied and analyzed in order to extract relevant theory and insights. Wherever the relevant areas of research overlapped, topics were bridged and evaluated in context of each other, aiming to create new understanding, relevant for this particular study. Some of the concepts brought up in this section are defined clearly in the Terms and Definitions section at the bottom of the introductory chapter of the paper. References can be made to this section for a clear understanding of the differences and contexts of terminology within the relevant fields.

2.1 Topics of relevance

Before starting the literature review for the background theory, an assessment was made of what topics would be of interest to answer the thesis' research questions. The goal was to gain sufficient awareness, in order to be able to make an initial suggestion for KTM. As the research questions focus on mechanisms of team based, collaborative learning and gamification, these fields of research were deemed the most relevant. In order to support collaborative learning on the Kahoot! platform, the teamwork would necessarily take place in a computer supported environment. After considering these topics, searching for relevant research and literature in Google Scholar, the topics displayed in Figure 2 were identified.

At the intersection of the three research fields of Gamification in education, Team based learning and Computer supported collaborative learning is Kahoot Team Mode. The solution will ideally utilize elements and mechanisms from all three fields of research, aiming to incorporate them successfully in order to promote learning, motivation and engagement.

Section 2.4 Relevance to Project complements this section by bridging the concepts discovered in the literature study, and conceptualizing how these are relevant in context of each other, and also for KTM.

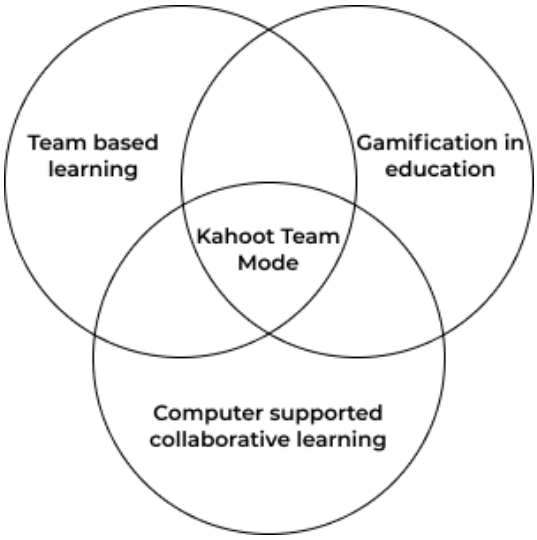

Figure 2: The chosen topics of interest to be explored in this background theory section. Relevant theory for Kahoot Team Mode is found at the intersection of the three.

2.2 Team Based Learning

Learning theory research has over the past several decades time and time again evaluated different learning and education methods, seeking an established "best practice" for any classroom. Several researchers have concluded that active and engaging learning forms may yield higher learning outcomes compared to traditional classroom settings, in which the teacher teaches, and students listen and learn. A meta-analysis of 225 studies within this field was performed by Freeman et al. [2014]. They concluded that active learning methods both increased examination results, and reduced the likeliness of students failing a course. The meta-study included papers evaluating college student performance rates, comparing traditional lecturing versus active learning. Although this study was focused results in science, technology, engineering and mathematics (STEM) university classes, the researchers also point to similar results being found in research on lower level student performance. The active learning form was found to have less of a positive impact on the lower grade levels, but the increase in results was still significant [Freeman et al., 2014]. This particular study groups a multitude of active learning methods as one, but highlight methods such as workshops, peer instructions, and group problem solving as examples.

Team based learning mechanisms

Among the different types of active learning, team based learning (TBL) is one that largely has been proved efficient, as studied by Kibble et al. [2016]. The general method of TBL was first introduced in the 1970s, when Dr. Larry Michaelsen was wanting to teach a topic to a large class, in such a way that the students would gain understanding of application to real-world problems, and encourage critical thinking [Kibble et al., 2016]. The solution has since been applied countless times across disciplines, and is a well validated and widely adopted teaching strategy.

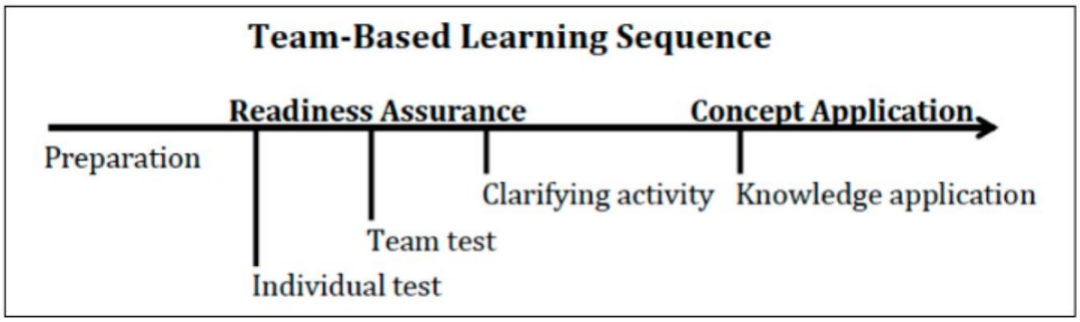

Figure 3: Illustration of a module sequence typical in TBL [Swanson et al., 2019].

TBL is a learning and teaching solution that supports collaboration within an established, smaller group, promoting student engagement, and social interactions. Group size, collaboration tools, project duration and other factors may vary, but the main objective remains the same. Team learning is meant to encourage peer to peer learning. This includes students sharing of their own knowledge, and reflecting and processing new information collectively. As defined in the Terms and Definitions section at the beginning of the paper, cooperation and collaboration can be distinguished as teamwork mechanisms. However, in real life team situations they are often both referred to and practiced interchangeably [Jeong and Hmelo-Silver, 2016].

There are a variety of different ways to implement a team based learning form. Factors such as number of participants, goal for learning outcome, age of participants and so on are important to consider when selecting the best suited approach. One common TBL solution is a module based one, where the process is divided into a number of modules, each with an enclosed set of activities [Swanson et al., 2019]. This model is illustrated in Figure 3.

The modular approach is often structured with the first module being for individual preparation and assessment. The following module will involve collaborative reflection and discussions. This is where the team comes together to combine their knowledge, negotiate, and build on each other's understanding of the subject. Finally there will be some form of application or assessment, to evaluate the collective learning outcome. This particular approach is evaluated in a meta study by Swanson et al. [2019]. This study considers 30 research papers, all concerning the effect of TBL on learning outcomes, i.e. content knowledge. The method is reported to potentially yield higher academic performance, engagement and persistence in the courses, and a more positive attitude towards learning. The study also reported the students gaining a deeper understanding of the course subjects, which was the main objective of the research to investigate. The authors also propose a framework for an ideal learning situation in which to apply TBL. Courses where the students need to gain understanding of a large amount of information, and this is to be achieved through complex problem solving or question answering [Swanson et al., 2019]. The two-step assessment form as illustrated in Figure 3 above is particularly useful in the described learning situation. It provides individual accountability, encouraging students to prepare for the lecture, while also giving them the opportunity to extend

their understanding of the subjects through immediate feedback and peer discussions. From the findings presented in the study, the main variable significant to improve the effects of TBL was group size. A statistically significant performance increase was found for smaller group sizes, i.e. five or less students [Swanson et al., 2019].

Although the results reported on the effects of TBL are mainly positive, some concerns are addressed as possible negative consequences. Cooperative learning can be challenging to manage and navigate for students, with issues such as workload distribution, interpersonal dynamics, free-riding, bullying, conflicts, and anxiety provoking situations mentioned [Swanson et al., 2019].

One aspect of team based learning that is important to avert is the risk of confirmation biases in a group, as thoroughly described by Nickerson [1998]. Confirmation bias is an effect that may occur when evaluating new information or evidence and making a conclusion. People are partisan to assess information in a way that only supports some preconception of their own, that is, interpreting evidence in their own opinion's favor [Nickerson, 1998]. The effect may also take form by the first piece of data presented to an individual carrying more weight than any successive data evaluated. This specific type of confirmation bias is referred to as the primary effect. People build their beliefs in a consecutive manner, and any contradicting information following one statement may be viewed with biased skepticism. The order in which information is revealed and assessments are made may therefore be significantly impactful in decision-making situations [Nickerson, 1998].

Computer Supported Collaborative Learning

Computer supported collaborative learning (CSCL) is the conjunction between technology and pedagogy, with the aim of increasing learning outcomes through computer aided collaborative tasks. Interactive dynamics in the classroom, both between teacher and students, and among students themselves have over the last few years been affected by the introduction of technology in education [Jeong and Hmelo-Silver, 2016]. These changes lay the foundation for extensive research on how this evolution can be used to ensure a positive impact in the classroom. From this comes the work on both CSCL, as well as other forms of technology supported learning.

In order for CSCL to be considered successful and contribute to greater learning, both cognitive and social dynamics need to be supported. Key processes and mechanisms from regular team based learning need to be implemented into the technology, while simultaneously addressing any practical demands or challenges [Jeong and Hmelo-Silver, 2016]. These demands or challenges may be access to technology and devices, but also the teacher's technical proficiency, or the required effort to adopt a solution. Collaborative technology in itself may often not be enough to get learners to work together and share knowledge and ideas. The task design and instructions are therefore also critical parts of the implementation process. The following paragraphs address a number of considerations important for CSCL.

Learning, both in individual and collaborative situations, as well as computer supported or not, require many of the same mechanisms and affordances. These include both technical and social affordances. A balanced and adapted combination of these may have positive effect on learning outcome and environment, as well as social constructs [Andres and Shipps, 2010]. The work of Jeong and Hmelo-Silver [2016] considers combinations of the above mentioned learning situations, extracting the most fundamental mechanisms and dynamics to form a framework specifically for CSCL. The study proposes seven affordances that needs to be covered in order to successfully implement computer supported collaborative learning. These are presented as conceptual qualities or properties that allow for actions, and are supported by suggested design strategies and technology examples in Tables 1 through 7 following each affordance.

Collaborative tasks

A key consideration when designing for collaborative learning in general, is to make sure the tasks provide the students with something to talk about. There needs to be a "common ground" for the students to base their conversation around, whether this is learning materials presented to them as a group, or a problem that needs to be solved collectively. Janssen and Kirschner [2020] point out the importance of tasks requiring participation and effort by *all* team members, for positive interdependence. When designing these tasks, technology may serve a variety of purposes, from a simple presentation tool, to entire environments or contexts in which learners are to cooperate within. Creating tasks through which technology facilitates and mediates negotiation of different perspectives and assumptions can be a beneficial learning mechanism [Jeong and Hmelo-Silver, 2016].

Jeong and Hmelo-Silver [2016] also point out the importance of correctly balancing the cognitive load on the learners with the learning outcomes. Implementing technology into an already complex task may only increase the difficulty level. There must be a clear benefit to utilizing technology with the assigned tasks, otherwise the technology may serve as a hindrance rather than an aid. One way to prevent this is to design a sufficient instruction strategy with the tasks. Such a strategy should encourage students to explore each other's perspectives and ideas, and facilitate a healthy discussion. The tasks need to align with the overall learning objective, as well as the basic classroom pedagogy. Table 1 summarizes the affordance of collaborative tasks by addressing needs, design strategies and examples of technology implementation [Jeong and Hmelo-Silver, 2016].

Communication

Communicating, i.e. exchanging ideas and opinions is an important part of collaboration in any situation. As opposed to traditional classroom settings, digital communication tools allow for both displaced and asynchronous communication. CSCL has in this way contributed significantly in helping students learn by working together, by granting flexibility in both when and with whom to collaborate [Jeong and Hmelo-Silver, 2016].

The most common way to facilitate communication through technology is by text or multimedia, e.g. voice or video calls. However a growing trend within CSCL is facilitation of distributed collaboration without direct communication. An example

Addressed needs	Design strategies	Technology examples
• Learners may want to collaborate, but collaboration cannot occur when there is no joint task for which they work together.	• Richer and more authentic problem contexts • Task within students' zone of proximal development • Active engagements (e.g., perspective tasking, milestones) • Alignment with pedagogy	• Multimedia • Simulation and modeling tools • Digital artefacts (e.g. games, Wikipedia pages)

Table 1: Addressed needs, design strategies and technology examples proposed by Jeong and Hmelo-Silver [2016], supporting the affordance of Collaborative tasks.

of this is team members' giving each other feedback, without directly exchanging messages or communicating with one another. Using artefacts or simply co-editing a piece of work may be the main form of communication. In the case of the latter, students may learn and gain knowledge simply from observing their team members actions. This form of indirect communication does not even require the learners to know who they are collaborating with, which can be beneficial in some cases [Jeong and Hmelo-Silver, 2016].

The need for technologically supported communication is heavily dependent on the context of the collaboration, i.e. both the task and the situation. Still, the common purpose of its implementation is to facilitate and encourage the students to talk and communicate, in a seamless and pedagogical manner. Table 2 summarizes the affordance of communication, addressing needs, design strategies and technology examples for implementation [Jeong and Hmelo-Silver, 2016].

Addressed needs	Design strategies	Technology examples
• Learners need to be able to communicate with their collaborators. This is often not a problem in face-to-face collaboration, but become an obstacle when learners are distributed.	• Synchronous versus asynchronous communication • Direct communication versus indirect communication (e.g., via artifacts) • Overcome media/modal distance	• Chat, threaded discussion, e-mails • Misc. (peer assessment or review systems)

Table 2: Addressed needs, design strategies and technology examples proposed by Jeong and Hmelo-Silver [2016], supporting the affordance of Communication.

Resources
The sharing of resources is another key to successful collaboration in a team. Tasks designed purposefully for collaboration should require integration of knowledge from different domains. A way of pooling the resources distributed between team members is therefore important [Jeong and Hmelo-Silver, 2016]. In CSCL, technology for resource sharing should be implemented in such a way that it exposes the learners to new ideas, and thereby widens the problem space. This new shared resource base may then be utilized for co-construction of new ideas and solutions.

In addition to sharing, these types of technologies often also provide tools for organizing, editing, combining and adding annotations to the knowledge resources. Particularly the ability to add notes and comments to the shared resources has proved beneficial in studies of CSCL tools, both for the students' comprehension of the material, and for their ability to share their knowledge [Jeong and Hmelo-Silver, 2016].

In order to gain the benefits of resource sharing in CSCL, learners need to understand and be encouraged both to share their own knowledge, and also to assess the available information properly. This requires both thoughtful design implementations for accessibility, as well as a clearly stated significance to the given task. Table 3 below gives a summary of the described affordance of resource sharing, with addressed needs, design strategies and technology examples [Jeong and Hmelo-Silver, 2016].

Addressed needs	**Design strategies**	**Technology examples**
• Learners may know or have resources relevant to the joint task, but it is not always easy to share their resources or access those of their partners.	• Sharing channels (e.g., tools and sites) • Incentives/rewards for sharing • Sharing strategy (e.g., what to share and when) • Uptake of shared resources	• Communication technology, data repository, websites • Digital concept map of partner's meta-knowledge • Annotation tools

Table 3: Addressed needs, design strategies and technology examples proposed by Jeong and Hmelo-Silver [2016], supporting the affordance of Resources.

Structuring collaborative learning processes
Learning processes relevant to CSCL are highly overlapping with those of regular face to face collaborative learning. Examples of these are asking and answering questions, agreeing and disagreeing, criticizing, giving feedback and so forth [Jeong and Hmelo-Silver, 2016]. For successful collaboration, it is sought that the group practices these processes, and refrain from digressions and distractions. Mechanisms should be implemented both to promote constructive collaboration processes, and to minimize off-task behavior in a group.

Within the field of CSCL, scripted collaboration has been adopted as a way to facilitate better reflection and co-construction in a team. This method takes some freedom away from the learners, but is implemented to encourage productive work and foster important collaborative activities [Jeong and Hmelo-Silver, 2016]. Instead of merely being given a task, the participants are asked to follow a series of steps, in order to reach the task objective in the end. Particularly in distributed CSCL settings, these instructions may be beneficial, as there is a higher need for structure, coordination and context. Scripted collaboration can also provide aid in cases where the technology restricts the possibilities of the learners, encouraging them to think in new directions and helping them approach the task within the provided problem space.

The application of scripts in online collaboration is also a safety for teachers, as they cannot always be present in these environments. Scripts and limitations can thereby be used as tools to prevent bullying, uneven workloads, inappropriate conversations, etc. Concerns when structuring collaborative learning processes, supported by design and technology strategy examples are given in Table 4 below [Jeong and Hmelo-Silver, 2016].

Addressed needs	**Design strategies**	**Technology examples**
• Learner may collaborate, but their interaction may be unproductive (e.g., off-task behaviors, superficial learning activities, conflicts, etc.)	• Task structuring (e.g., division of labor, role assignments) • Activity scripts to elicit productive collaborative learning activities (e.g., asking questions, argumentation sequences) • Avoid over-scripting	• Online interfaces for scripted collaboration • Pre-organized input areas and message labels • Message starters, sentence prompts, and question stems

Table 4: Addressed needs, design strategies and technology examples proposed by Jeong and Hmelo-Silver [2016], supporting the affordance of Structuring collaborative learning processes.

Facilitating co-construction

Co-construction in the context of collaboration refers to the creation of a shared mental space or framework, and building new knowledge or constructs from this [Jeong and Hmelo-Silver, 2016]. The process includes processing and combining the shared knowledge in such a way that the end product opens up for further insights. The result of co-construction should ideally yield greater cognitive understanding than merely combining the individual contributions in a team [Jeong and Hmelo-Silver, 2016].

The success of co-construction is heavily dependent on the above mentioned affordances of communication and a common understanding of the shared resources. This form of collaboration is complex in itself, and the integration of technology into the process needs to serve as a helping tool to avoid misunderstandings, and

decrease the cognitive load [Jeong and Hmelo-Silver, 2016]. Technology for this purpose should encourage integration of different perspectives, engaging discussions and a shared awareness of the knowledge base's potential.

In CSCL, particularly for distributed team settings, both individual and team motivation is crucial. Mechanisms to reward both types of efforts should be applied in order to keep the learners engaged throughout the processes.

As outlined in the above mentioned affordance, scripting may also be a helpful mechanism for facilitating co-construction. Using visualizations or representation tools to communicate has been successful in reducing misinterpretations while conveying knowledge and negotiating opinions [Jeong and Hmelo-Silver, 2016]. These tools form a common framework for communication, and can also help maintain the learners' attention, for example in a dynamic and action based shared workspace. The advantage of these workspaces need to be combined with the possibility for individual thoughts and work. This way, learners can take time to understand and prepare individually, while also using their preparations to dynamically co-create with their team. A number of design strategies and technology examples are listed in Table 5 below, along with an addressed need when working to facilitate co-construction [Jeong and Hmelo-Silver, 2016].

Addressed needs	**Design strategies**	**Technology examples**
• Learners may collaborate, but fail to process collaborators' contribution sufficiently to establish and maintain a common ground, build on each other's contributions, keep track of what is discussed/agreed, and co-construct a shared understanding.	• Shared goals and problem contexts • Referencing and grounding • Discussion supports (e.g., transactive discussion) • Persistent records and summary of what is discussed/agreed • Space for shared work • Socio-cultural norms and expectations (e. g., collective responsibility)	• Tangible technologies and shared interfaces • Dialogue or negotiation tools (to support grounding and transactive discussion) • Knowledge Forum • Representational tools • Joint workspaces (as well as or instead of private workspaces)

Table 5: Addressed needs, design strategies and technology examples proposed by Jeong and Hmelo-Silver [2016], supporting the affordance of Facilitating co-construction.

Monitoring and regulation
The ability for the learners to monitor and regulate the CSCL environment is important for both engagement and performance. Parts of the collaboration and interaction between them may be restricted by scripts or process rules. These limitations cause an increased need for a sense of monitoring and controlling the situation [Jeong and Hmelo-Silver, 2016]. In physical setting this need is met merely by seeing and experiencing everything that is happening directly, while in a CSCL setting, mechanisms need to be in place to support this.

Monitoring in this case involves obtaining awareness in the context of the collaboration. Learners need to be aware of their own state and opportunities for actions, as well as for their team members. This gives a mutual awareness of the collaborative situation and its state between learners. This again allows the learners to make decisions based on all available information, and encourages interdependent activities.

As described by Macmahon et al. [2020], successful collaboration requires each individual to self regulate and take responsibility for their own as well as the team's behavior. This regulation of the learning process is important for the learners to feel in control of the situation and take ownership of the progress. Regulation can be divided into three separate demands; self-regulation, co-regulation and shared regulation [Jeong and Hmelo-Silver, 2016]. Self-regulation indicates the learners ability to take charge of their own learning process, while co-regulation is the governance of team members' state and activities. Shared regulation is the combination of these, monitoring and regulating the overall progress towards the common team goal. The need for these regulation types increases with both team size and task complexity. A variety of different methods for this may therefore be implemented in CSCL, adjusted to the team and learning situation.

One way this has been seen implemented is through self- and peer-assessments by the learners. Assessing aspects such as participation, contribution and agreement of the team members have been reported to encourage learners to increase both their own performance, while also trying to help others do the same. These tools have in some cases had the effect of yielding less negative social behavior, more frequent communication, and fewer disagreements. In other cases however, the implementation of regulation and monitoring have not prompted any observable change in the learners performance. This indicates that the type of monitoring and regulation needs to be carefully considered in relation to the task. Sufficient instructions must be given for the learners to adopt the mechanisms effectively [Jeong and Hmelo-Silver, 2016]. The following Table 6 provides an overview of the addressed need for monitoring and regulation, along with suggested design and technology possibilities [Jeong and Hmelo-Silver, 2016].

Forming and building groups and communities
Peers in collaboration may be considered just as important as the task itself. The conception that the learners' own success is dependent on the success of their team members is a good motivational factor for active participation [Janssen and Kirschner, 2020]. Additionally, in collaborative settings, the team members function both as a source of new knowledge, and as tools for reflection and deeper insight into

Addressed needs	Design strategies	Technology examples
• Learners may engage in productive interaction, but are led to it by external scripts or prompts rather than monitoring and regulating collaborative processes on their own.	• What to monitor (e.g., participation, agreement) and how (e.g., login file, questionnaires) • How to use monitoring outcome for regulatory control (e.g., interpretation guidelines) • Coordination between self-, co- and shared-regulation • Developing students agency	• Awareness/mirroring tool • Visualization tool • Meta-cognitive tool with desired behaviors • Intelligent Systems • Learning analytics

Table 6: Addressed needs, design strategies and technology examples proposed by Jeong and Hmelo-Silver [2016], supporting the affordance of Monitoring and regulation.

the relevant topics. Particularly for learners who struggle with intrinsic motivation, community building can be important [Jeong and Hmelo-Silver, 2016].

A number of factors such as relationships, gender, previous experience and so forth should be weighed when deciding team size and structures. The team is as mentioned central as the "breeding ground" of new knowledge, and are often referred to as a knowledge-building community [Jeong and Hmelo-Silver, 2016].

In regular classroom setting, there is usually a teacher who decides the team constellations. However, in CSCL settings, technology may be used as a tool to help with group division. Depending on the system, this can be done at random, or based on previously collected data such as peer feedback, ability levels or other social criteria. In some cases, who a learner's teammates are can have a significant impact on the learning progress [Jeong and Hmelo-Silver, 2016]. The learners' strengths and weaknesses may complement each other, and their attitudes towards the work may align perfectly. However, this is not always realistic, and the wrong team composition may also have a negative effect on the learning. Collaborating anonymously has been successfully applied both to prevent the above mentioned scenario, or when the collaborative work does not require personal knowledge of the other workers. Learners may co-create and give each other feedback, without personal interactions, and the shared ownership of the product itself is the main focus of the team [Jeong and Hmelo-Silver, 2016].

The sense of community in a team situation is valuable to get all learners to participate and provides extrinsic motivation. Interacting with others in the community can both help the team reach their common goal, but also increase the individual's understanding and confidence in a topic. This again can contribute to longer main-

tained engagement in the learners, which is a common challenge in any learning situation [Jeong and Hmelo-Silver, 2016]. Individual confidence is also strengthened by the sense of safety within the team. This can be promoted by ensuring that everyone in a team feels supported, are given room for contributions and that every learner's effort is extended to the final result of the project. Finally, Table 7 summarizes the addressed need for forming and building communities, alongside supporting design strategies and technology examples [Jeong and Hmelo-Silver, 2016].

Addressed needs	**Design strategies**	**Technology examples**
• Learners may experience difficulty with finding and learning about collaborators, navigating the community in accordance to the norms and practices of the community, and participating in the community in ways that advance individual as well as collective understanding in a sustained fashion.	• Group formation (e.g., interests, competence level, expertise) • Learning about collaborators (e.g., developing transactive memory system) and navigation within the community (e. g., community norms) • Taking into account the diverse forms of interaction (e.g., indirect interaction via artifacts) • Advancing individual as well as collective knowledge through sustained participation and engagement	• Peer review/feedback system • Intelligent Systems • Visualization tool • Navigation supports • Social Networking Service

Table 7: Addressed needs, design strategies and technology examples proposed by Jeong and Hmelo-Silver [2016], supporting the affordance of Forming and building groups and communities.

Distributed Team Learning

Among theories used to evaluate human and social aspects of teamwork and collaboration are social impact theory, and the theory of affordances in learning contexts. Andres and Shipps [2010] study the facilitation of project work and problem solving in technology mediated distributed teams, focusing heavily on social impact theory. This theory considers how the presence or actions of others, whether real, implied or imagined, may affect an individual. The impact can include changes in feelings, motivation or behavior. Social impact theory focuses on three dimensions specifically in group settings, strength, immediacy and number [Andres and Shipps, 2010]. These three are equally important in distributed settings. The research specifically addresses the effect of the shift in technology on team learning behavior. Both the

technical and the social processes and interactions of the different situations are considered. This forms a basis for evaluation and comparisons when moving to technology based solutions and platforms.

Strength, as mentioned by Andres and Shipps [2010] refers to the degree of impact team members may have on each other. This can be dependent on roles within a team, either assigned or informally adopted. A person who exclaims themselves as an expert on a subject, or in other ways state their own position in a team as higher than the others, may obtain more strength in the sense of ability to affect their teammates. The impact may be positive or negative, and should therefore be adjusted so the balance shifts in a positive direction [Andres and Shipps, 2010]. Immediacy is the effect that distance or dissociation can have on individuals in a team. This can be with respect to time, geographical location, cultural alignment or other interpersonal disparities. Theory of immediacy suggests that higher immediacy yields higher learning outcomes. The numbers factors simply refers to the number of influences, that being team members, task complexities, activities etc. that are involved in the learning. As exemplified by Andres and Shipps [2010], if a higher number of individuals share a consensus, the influence they will have on others will be greater.

Several research teams have done significant studies on the impact of technology mediated collaboration versus face to face collaborations, e.g. Andres and Shipps [2010], Macmahon et al. [2020], Halavais [2016]. The results and conclusions of these studies often lean towards face to face options providing better facilitation of communication, both verbal and non-verbal [Andres and Shipps, 2010]. The complex social dynamics and communication forms in a team are hard to replicate digitally, causing the performance of the teams to suffer. However, the need for collaboration across spatially distributed teams is inevitable in today's globalized society. The goal of development for this practice is based on creating platforms and tools to mediate the shift, and push the boundaries of what digital communication may entail [Macmahon et al., 2020].

Regular face to face communication includes a variety of different cues and norms, such as facial expressions, hand gestures, body language, eye contact, pauses, interruptions, turn taking and so on [Andres and Shipps, 2010]. These are communication tools that are hard to replicate digitally. However, the methods to express emotions and cues in written communication is already heavily embedded into out daily non-verbal conversations. Emojis, GIFs and reactions in chat services are as expressive as written words. When designing the communication features of a digital collaboration platform, there is a weigh off between implementing sufficient communication methods to make the communication in the team as efficient and complete as possible, while avoiding too much communication overhead [Andres and Shipps, 2010].

By communication overhead, the additionally added effort when using a tool is meant. This should be as little as possible, while providing as much value for the user as possible. One way to ensure this is by providing methods for the team members to maintain a mutual awareness of both each other, and the task or project state [Andres and Shipps, 2010]. This reduces the need for continuous communication

and is suggested to help with engagement and motivation in the team. Team and team-situation mental models are examples of such methods, as described by Andres and Shipps [2010]. The team mental model is meant to model the team, roles, tasks, processes, available tools, possible strategies, etc., in order to give the team a shared understanding of the technological environment the task or project work will take place in. The team-situation mental model is meant to support the same goal of a mutual understanding and awareness in the team, continuously providing updated information of the state of the work, possible constraints and the status of the other team members. Combined, these two mental models should provide the team members with enough information to lighten the communication load significantly. In addition to this, the mental models may also facilitate improved coordination and productivity, by reducing dependency delays and coordination efforts [Andres and Shipps, 2010].

Past research concludes that distributed teams may experience a less urgent sense of immediacy. This in turn have been observed to have a negative effect on some of the team behaviors, and may result in team conflicts, weakened communication efforts, team members withdrawing from participation, etc. These claims were confirmed by the observations made in the study by Andres and Shipps [2010]. Their experimental results landed on three points that were understood to be the reasons for the difference in success for remote teams. These were lack of mechanisms for the support of 1) team wide participation, 2) clarity of information exchanges, and 3) ability to maintain a persistent and coherent shared focus [Andres and Shipps, 2010]. Technology-mediated collaboration is dependent on both the social, and the technological context for the teamwork to be successful. When implemented thoughtfully, considering the three above mentioned issues, Andres and Shipps [2010] found that remote collaboration could also have positive outcomes for information exchange, social structures and a mutually supportive atmosphere.

The social affordances, such as communication and community building, as previously described can have an impact on the sense of immediacy in a group. Facilitating trust, mutual support, common goals and team wide participation in a collaborative setting is important [Andres and Shipps, 2010]. If students start to experience a social disconnect to their team, this can severely impact motivation and learning outcome [Macmahon et al., 2020]. The sense of immediacy and thereby importance and urgency in a learning situation should be emulated by deliberately implementing social affordances [Andres and Shipps, 2010].

2.3 Gamification in education

Gamification is being widely adopted in the field of education, due to it's motivational benefits [Bovermann and Bastiaens, 2018, Şahin et al., 2017]. Elements like points, scoreboards, levels, rewards, etc. are implemented in fun and engaging ways, often supporting healthy competition between peers. Although results and effectiveness of gamification varies with parameters such as learners' age, context of work and amount of game elements, the general reception has been found to be positive [Bovermann and Bastiaens, 2018]. Some benefits and concerns when implementing gamification in education are presented below.

Gamification mechanisms

Gamification is often used today as a way to encourage motivation and participation in education. Gamification is as defined in the Terms and Definition section defined the application of game and competition concepts to tasks or systems that may traditionally be considered unengaging or boring. The purpose of applying gamification is often to motivate and help users achieve something. Şahin et al. [2017] argues that gamification in distance settings can have the ability to motivate and sustain the learning process, while also making it more fun. Motivation is at the core of keeping learners engaged, and is particularly key in a self-regulated learning situation, such as distributed learning where dropout rates are higher [Kirschner et al., 2004]. If gamification can contribute to increased motivation, it may subsequently support sustainability in the learning process.

When talking about motivation, there are two main types that are relevant to the learning process, intrinsic and extrinsic motivation. Intrinsic motivation can be said to stem from within, and is the internal drive or willingness to do or complete a task. Extrinsic motivation can largely be said to arise from a desire to be rewarded, or a fear of being punished, thus initiated by external factors. Both types of motivation are important to achieve efficient learning outcomes and withstanding participation from the learners [Şahin et al., 2017].

Combining finds from multiple recent studies on the topic of gamification, Garcia-Sanjuan et al. [2018] emphasize the importance of not only introducing gamification elements to any teaching situation, and expecting a positive outcome. For successful results, the elements should be integrated to juxtapose to a meaningful and cohesive game experience. Gamification concepts, although in actual games considered elementary, must be evaluated and adapted to serve a purpose in a learning situation. Studies of gamification e.g. by Garcia-Sanjuan et al. [2018], Sanchez et al. [2020], Şahin et al. [2017], Bovermann and Bastiaens [2018] mention concepts such as points, badges, levels, score and leaderboards and progress bars in this context.

The research by Şahin et al. [2017] argues that a leaderboard in particular can be a big part of the motivation to keep playing, learning, and thus gaining ground in a competition. Students may use it as an evaluation tool, comparing their own efforts to others, and consequently working to improve their ranking. An experimental study by Bovermann and Bastiaens [2018] also supports this, finding visible displays of points and a leaderboard to highly impact intrinsic motivation, compared to a non-gamified control group.

The leaderboard also add to the sense of a social context of the game platform. Seeing the names and avatars of other players is reported to increase the feeling of immediacy [Şahin et al., 2017]. Awareness of other students participating in the learning activity helps promote the sense of a social learning environment. Familiar game concepts such as badges and levels have also been found to promote friendly competition among students [Bovermann and Bastiaens, 2018].

Competitiveness is an aspect of gamification, that if applied correctly can have significantly positive results [Bovermann and Bastiaens, 2018]. However, research by Jagušt et al. [2018] suggests that competitiveness alone is not enough to constitute a

difference in performance. Their experimental study found that the most successful application of gamification was with a combination of several of the above mentioned concepts. Suggested mechanisms by the researchers were narratives and adaptations to individual levels, as well as allowing players to track their own performance and receive feedback from their peers [Jagušt et al., 2018].

The study by Şahin et al. [2017], focusing on the effects of using a gamified quiz application in distance education, reported that a messaging feature in their case was somewhat unnecessary. That is, only a minority of the students participating in the study experienced the need or want for it. However, the multiplayer aspect of the game was considered a positive mechanism of the game, with students reporting increased motivation and competitive encouragement due to being able to test or compare themselves to their opponents. This was also said to help keep the students' attention, as they could keep track of the other players' answers and scores continuously [Şahin et al., 2017].

Kahoot as a Learning Tool

Kahoot! has since its 2013 release become an increasingly popular learning tool, both in classroom and business training settings. The last year, with the Covid-19 pandemic causing changes in methods of education, the platform has not only withheld its popularity, but the user base has also increased, as reported in their 2021 Company presentation [Kahoot!, 2021]. A number of scientific papers have been posted on various consequences of using the gamified quiz platform in education. Kahoot!'s effect on classroom dynamics, teachers' perceptions, student engagement and student anxiety have been studied and evaluated, to mention some. Wang and Tahir [2020] have performed a literature review on 93 such research articles. Through systematic analysis the researchers aimed to determine trends in both positive impacts and challenges that Kahoot! has on learners and teachers [Wang and Tahir, 2020].

The Kahoot! game design is based on a combination of traditional classroom pedagogy and game concepts, that have also already been evaluated and established as impactful. Student Response Systems(SRSs) were introduced to classrooms in the early 70's, and have been applied with largely positive outcomes on both learner and teacher perceptions and performance ever since [Wang and Tahir, 2020]. The ability for students to contribute and participate actively in the learning process has, as formerly mentioned, had a welcome effect on attention, engagement, and performance. Studies have also found that SRSs have a positive effect on exam and assessment results, as well as student attendance [Wang and Tahir, 2020]. The use of SRSs was further facilitated by the introduction of technology into the classroom and has thereby stayed relevant.

In addition to working as a student response system, Kahoot! heavily utilizes concepts from game based learning. Gamification is all about making learning fun and enjoyable. However, it can also have the effect of increasing engagement and enthusiasm, and thus is another driving force that makes Kahoot! favored as a learning tool [Wang and Lieberoth, 2016]. Kahoot! combines the benefits of SRSs and game design, implementing the concepts in such a way that the learners may forget that

they are in fact learning. A game of kahoot changes the classroom atmosphere in an instance, with a well-recognized theme song, bright colors and designs, and fun and competitive dynamics. The findings from the literature review by Wang and Tahir [2020] are summarized in the following paragraphs, giving insight into the implications, positive outcomes and challenges of using Kahoot! as a learning tool.

The research addressing the learning effect of using Kahoot! in a classroom can be grouped in a few categories. Forty-eight research papers were evaluated for this topic. A fourth of these evaluated how the use of Kahoot! in combination with other tools in the classroom affected the learning outcome, compared to traditional lecturing. Although these articles did not explicitly claim that Kahoot! was the sole cause, all of them reported higher academic results when tools or methods for active learning were applied. The gamified approaches were reported to contribute not only to the learning outcome itself, but also to the students' attendance, punctuality, and overall classroom dynamic. The remaining studies on learning outcome considered purely the use of Kahoot! compared to traditional teaching, and could thereby provide more specific insight into the value of the platform. Out of these, seventy percent reported with statistical significance that the use of Kahoot! in education resulted in increased academic performance. The remaining studies yielded varying results, with some reporting no significant difference in the learning outcome [Wang and Tahir, 2020].

Sixty four percent of the papers evaluating only Kahoot! compared to traditional teaching were experiments conducted with control groups. In all of these papers the results reported were either significantly positive, or insignificantly positive, with the majority falling in the first category. Some of the evaluated papers compared learning outcomes of using Kahoot! versus other learning tools or methods. All of these concluded that the use of Kahoot! produced significantly better test or final grade results [Wang and Tahir, 2020].

Improved classroom dynamics were also mentioned as a side effect in the studies of Kahoot!'s impact on learning outcomes. Thirty-seven of the total ninety-three papers explicitly examined development in this aspect with the introduction of Kahoot! in the classroom. The results from these studies vary in significance, with some presenting positive results from using Kahoot! consistently in a classroom. One study however finds that the effect on classroom dynamics was significant when the game platform was first introduced, but decreased throughout the semester [Wang and Tahir, 2020].

Other research papers claimed a positive effect on interactivity and classroom engagement. The music/audio and scoring of points were found contributing to this, changing the atmosphere of the classroom, and lowering the threshold for active participation. One aspect of the classroom dynamic that was found to be especially affected in one of these studies was interaction among peers. Several analyses without statistical backing were also mentioned in the literature review, reporting largely positive feedback from the students themselves on how Kahoot! affected their classroom and learning [Wang and Tahir, 2020].

One concern teachers have had when using Kahoot! in education is that weaker students may experience anxiety and discouragement during the game. This particularly due to the scoreboards, points and focus on winning. A selection of the reviewed studies mentioned this issue in their research. The two out of these that reported statistically significant results both found that the use of Kahoot! reduced student anxiety. One compared Kahoot! to the use of another SRS called Socrative, and another compared Kahoot! with control groups not using any such tool. The remaining articles did not claim statistical significance, but largely reported positive results when using Kahoot! in education [Wang and Tahir, 2020].

Students in one study reported being less afraid of speaking up or asking questions in class when using Kahoot!, and gave the question of "Does Kahoot! build courage?" a score of 4.45 out of 5. Statements from several teachers involved in the different studies generally said that Kahoot! had a positive effect by reducing student anxiety and stress, and contributed to a fun and safe learning environment. Most teachers experienced a higher level of active participation from their students. One negative aspect that Kahoot! was reported to contribute to was classroom agitation, which can in some cases be a trigger for student anxiety [Wang and Tahir, 2020].

A large percentage of the papers reviewed reported on the students' perception of using Kahoot! for learning. The results on this varied with several factors, such as the use of audio and points, duration of application throughout the course/school year, and class size. Although varying in effect size (from insignificant to large) in the different studies, the results were principally positive. Statistically significant results were reported by the students on motivation, engagement, concentration, attendance, learning culture, course satisfaction and perceived learning when using Kahoot!. A number of the studies did not contribute with statistical significant data on this attribute. However these also reported positive changes in student perception, mentioning other aspects such as increased student confidence, excitement and efficiency in the classroom, and better exam preparations. Challenges reported by these studies included technical difficulties such as connectivity issues, and too small font size on the shared screen. Stress related to giving the right answer, not having enough time and not being able to change your answer were also mentioned concerns [Wang and Tahir, 2020].

Although only one article reported on the attribute of teacher perception with statistical significance, the positive impact on teacher motivation aligned with the described reactions of teachers in several of the other research papers. Among the positive results were claims that the use of Kahoot! made teaching more fun, and also added to the class' concentration and attention. Negative comments again revolved around technical difficulties, and stress from students failing the tests or not being able to answer quickly enough [Wang and Tahir, 2020].

2.4 Relevance to Project

The goal of the background theory for this project is to lay a foundation for the initial suggestion phase. Relevant concepts and mechanisms should be evaluated in context of each other, in order to best utilize their benefits in the suggested Kahoot Team Mode solution.

The modular approach to teamwork activities described by Swanson et al. [2019] can be an effective way of supporting the affordance of structuring the collaborative learning process [Jeong and Hmelo-Silver, 2016]. A simplified version of the sequence illustrated by Figure 3 could be implemented to divide the work into regulated sections. Providing structure and predictability is particularly important in a distributed setting. It helps streamline the work, and prevents misunderstandings and communication overhead [Andres and Shipps, 2010]. This modular approach, implementing an individual assessment before team interactions may also have the benefit of reducing confirmation bias, by mitigating the primary effect [Nickerson, 1998].

Applying rules and restrictions to the learners should be done in a way that reduces the complexity of the work. If done correctly, this can help foster positive collaborative behavior [Jeong and Hmelo-Silver, 2016]. The modular approach can also be well aligned with concepts of gamification. Games often consists of predetermined activities or tasks to be completed in a certain order. Making each module of work seem like a task or step in the process of reaching a goal could therefore be a good approach. At the same time, it is important to ensure that the constructs in each module is simple enough that it does not unnecessarily increase the task complexity [Jeong and Hmelo-Silver, 2016].

The number of participants or team members on each team is mentioned by several researchers as an important factor for success with TBL. Swanson et al. [2019] reports higher performance in groups as small as five or fewer learners. Andres and Shipps [2010] do not state a specific number for optimized collaboration, but use the "numbers" factor as a degree of complexity which should be kept relatively low. As mentioned, numbers here refers to the number of external factors that affect or influence an individual in a team situation, and covers both number of team members and number of activities, assessments etc. Smaller teams also mean fewer interpersonal relations and possibilities for conflicts, which is a better starting point for productive collaboration and team wide participation [Andres and Shipps, 2010].

Furthermore, the numbers factor is relevant for gamification concepts. As stated by Jagušt et al. [2018], a combination of mechanisms should be carefully considered, avoiding any concepts that are not purposeful or integral to the game flow. The two studies, although on different topics, align well in their philosophies of reducing complexity factors, and thereby cognitive load on the players or students.

Jeong and Hmelo-Silver [2016] point out the importance of community building in a team, which is affected by both team size and composition. They also pose the question of whether knowing the identity of your collaborators is always a necessity. Anonymity can remove the issues of preconceived roles, personal conflicts or mismatches, and allow weaker learners a "fresh start". Collaborating anonymously will inevitably change the social dynamics of a team, and a risk is that it will lower the sense of immediacy [Andres and Shipps, 2010]. Emulating a social learning environment can be a challenge in distributed teams, but is key for their success [Macmahon et al., 2020]. To alleviate this, personifying and social concepts from gamification can be applied. As described by Şahin et al. [2017], leaderboards can

be an effective way of increasing the sense of immediacy to peers, while also boosting motivation.

In the research by Wang and Tahir [2020], it was claimed that Kahoot! builds courage in students. Courage in learning can help students feel more confident, and give a sense of safety. Feeling safe and supported is especially important in computer supported team settings, as described by Jeong and Hmelo-Silver [2016]. They also argue that safety within a team can further build individual confidence. Obtaining such a self-reinforcing effect can be valuable for both learning outcomes, and for engagement and motivation. The generally positive perception of Kahoot! in education is also an invaluable aspect when it comes to adoption of the new solution [Wang and Tahir, 2020]. The cognitive overhead for the students may be reduced by them being familiar with the platform, providing additional safety as previously described.

The affordance of resource sharing is supported in the modular teamwork approach by Swanson et al. [2019] [Jeong and Hmelo-Silver, 2016]. A framework for sharing individual knowledge, and comparing and negotiating contributions can be built into a independent module. Facilitating specific activities for resource sharing not only supports the above mentioned affordance, it also encourages collaboration in a structured way. In order to maintain the gamified experience, the resource sharing process should be simple and easy. A simplification of this process may also contribute to fewer digressions and off-task behaviors. Jeong and Hmelo-Silver [2016] suggest scripted or clearly instructed methods for this purpose. Concealing the scripts as rules in a game can be a fitting and fun way to present instructions for each module. Additionally, awarding participation and resource sharing with badges or awards may be an efficient way to further facilitate communication of knowledge [Jeong and Hmelo-Silver, 2016].

Andres and Shipps [2010] also address the importance of awareness through shared mental models. As a game of kahoot is a relatively quick and intense session, any information for these mental models need to be very clearly available. Gamification concepts such as points, badges, scoreboards, and progress indicators can be used to visualize the state of both the game and the other players [Bovermann and Bastiaens, 2018, Sanchez et al., 2020]. By visualizing these states, the players awareness is continuous, and not dependent on communication or seeking out information themselves. Continuous awareness and limiting information overhead also reduces coordination efforts, allowing the game to maintain a faster pace and be more engaging [Andres and Shipps, 2010].

The above mentioned continuous awareness also supports the affordance of monitoring and regulation [Jeong and Hmelo-Silver, 2016]. Allowing players to regulate their own actions, while simultaneously monitoring what their team members are doing provides a sense of control. This aligns with the suggestion by Jagušt et al. [2018] of players benefiting from being able to track their own progress in a game. Basing own actions on the actions of others is also a key part of the co-construction process, which is important for successful collaboration [Jeong and Hmelo-Silver, 2016].

The most common methods of communicating in distributed CSCL is through text or audio [Swanson et al., 2019]. However, in a fast paced game platform like Kahoot!, typing text to communicate could take away from the gamified experience. Jeong and Hmelo-Silver [2016] describes communication through artefacts or co-editing a shared workspace as an alternative. Indirect interactions can in cases not only be sufficient, but even preferable as a communication method. Co-editing in a shared workspace would further support the above mentioned concept of continuous awareness through shared visualization. Limiting communication to artifacts in a shared workspace can also have the benefit of reducing miscommunications and simplifying negotiations [Jeong and Hmelo-Silver, 2016]. This again supports the concern of unclarity in information exchanges voiced by Andres and Shipps [2010].

Free-riding is a frequently mentioned issue in CSCL. Especially if learners experience a social disconnect to their group, dropping out from the collaboration is a common reaction [Macmahon et al., 2020]. Making sure all players feel responsible as a part of the team, and want to contribute to co-construction is important. This could be achieved with methods such as facilitated interdependent activities, social interactions and self- and peer-regulation and assessment. Some gamification mechanisms have qualities fitting for supporting the above mentioned concerns. Assessments can be done through points and leaderboards [Şahin et al., 2017]. Interdependent activities can be designed to emulate working together towards a common goal in a game. The timing aspect of Kahoot! introduces a sense of urgency in the game. This is another common concept in gamification, making the game fun and exciting. It also can have the effect of impacting the players sense of immediacy, by substantiating the game happening in real time. Timing does however remove some of the players' ability to self regulate, and should therefore be considered carefully in a collaborative setting.

The above mentioned anonymity within the team can also have impacts for other concepts of TBL. Negative social impact is discussed by both Andres and Shipps [2010] and Jeong and Hmelo-Silver [2016], and they suggest thoughtful composition of the teams, in order to avoid social mismatches. In longer term collaborations these considerations are important to make, while in a short span game like a kahoot, the identity of your teammates may be of less significance. Anonymity in the team may also remove any prejudice from students of their team member's strength, weaknesses, confidence and so forth, which may give them more of an equal ground to start from. This again can boost confidence, as the risk of making a mistake and being called out or picked on is removed. Although the research by Wang and Tahir [2020] established that playing kahoots in the classroom can have a reducing effect on student anxiety, any concerns of being "outed" through the scoreboard in the game would be even further diminished in an anonymous team situation. This again could lower the threshold for team wide active participation, as described by Andres and Shipps [2010].

3 Design

The research in this Master's thesis is as mentioned performed following the design and creation methodology. This section presents the design part of the project work, introducing the decisions made in the process, as well as their reasoning.

3.1 Design Science

The selected research methodology for this project work is the design and creation methodology. Several other methods were considered, and found less suited to answer the research questions and exploratory objective of the work. The book Researching Information Systems and Computing [Oates, 2006] was used for evaluating the different research methodologies relevant to the field. Initially a combination of two consecutive research methods was considered, as a way to provide a sufficient framework for design and development, followed by a thorough test phase of interviews or surveys. However, a decision was made to keep to the design science methodology, due to the timeline and scope of the project. The interviews and user tests are instead incorporated into the evaluation stage of the main methodology.

As illustrated in Figure 1, after the process step of gaining awareness of the problem to be solved, comes the suggestion, or design phase. During this phase, abduction is used as a logical approach to extract sensible solutions and concepts from the information reviewed in the background theory section. A set of concerns and concepts to address was first procured, before collaboration and game concepts were applied in a design prototype to answer to these.

3.2 Kahoot Team Mode Suggestion

Based on findings discovered in the literature review, as well as the initial focus group session, a list of suggested solutions for the new Kahoot Team Mode was generated. From the background theory, relevant concepts and affordances for successful collaboration were evaluated in context of the gamified experience that Kahoot! wishes to maintain. In the focus group, any concerns addressed by the internal experts were taken into consideration, aiming to generate a list of features answering to these as efficiently as possible. Engagement, social collaboration and increased learning outcome was prioritized.

Game feature suggestions

Table 8 presents all the established requirements to consider when implementing the new KTM solution. These are as mentioned based on both affordances described in the background theory, as well as suggested ideas proposed by Kahoot! experts in the focus group. Each affordance or idea is rephrased as a concern to be addressed, with a suggested solution to each.

Concept	**Addressed concern**	**Design suggestion**
Team size	The number of team members on a team needs to be purposeful with regards to the task.	The teams will consist of six or fewer players. This way there will be enough team members to have interesting an varying voting outcomes, without making the discussions too busy.
Synchronous game play	Immediacy is a challenge in CSCL, and a sense of immediacy can help increase motivation and engagement.	The players are present in the game at the same time. The presence of teammates is visible via their animal avatars.
Mutual awareness of team members	Also relevant to immediacy, the need for mutual awareness between team members help promote a sense of community.	Awareness will be supported by both the above mentioned avatars, and also by progress indicators throughout the game. The players will continuously be able to keep track of the state of the game, by seeing how many of their teammates have completed any step or stage of the game. Badges will also be awarded to players based on their performance, which gives the team as a whole another indication of the presence and actions of their teammates.
Communication	In order to collaborate, the players need to be able to communicate with their teammates.	The players will communicate with the use of emojis or symbols, as well as through their votes. Using these tools they can react to their own or their teammate's votes, to other reactions or to the answer options themselves. The emojis will be available in a custom, on screen keyboard, with drag and drop interactions.

Task awareness and understanding	All players on a team need to have a clear picture of the task ahead, and how to approach it collaboratively.	The players will be given instructions before each stage of the game. A short message will indicate opportunities for actions where possible.
Resource sharing	Players need a way to share their resources, which in this case is their knowledge.	The resource sharing will be through the above described communication form. The players will be sharing their opinion of the correct answer to a question, as a vote button, along with a reaction to that vote. With these attached reactions, the players will be able to indicate their confidence or uncertainty of their votes, by their own assessment, without influence by the other players' opinions.
Sense of co-construction	Players need the ability to use their shared resources and build on each others knowledge to produce an outcome based on common ground.	Players will have the ability to reassess their own votes, and change them if desired, after evaluating their teammates votes and reactions. The team's total score is dependent on all votes, so communicating and using each other's knowledge to make informed decisions is an integral part of doing well in the game. All communication happens in a shared knowledge space, giving the players a common ground for negotiations and re-evaluations.
Sense of community within team	The game should aim to maintain positive parts of the social dynamics that occur in a face to face collaborative learning environment.	Using emojis to convey meaning is hoped to give the players a sense of informality in the communication. This may contribute to the social environment in the game, as it is a much used form of friendly interaction in society today. The visibility of the avatars of the team is also meant to give a feeling of immediacy and social presence.

Competitiveness	To keep teammates engaged, and to encourage active participation, the sense of competitiveness is important. Friendly competition can have a motivational effect on players, which is particularly important in distance learning.	A kahoot in its normal form is already very competitive and exciting. This aspect will be largely maintained through the points, timing, music and scoreboards. Additional competitive elements will be the opportunity to win badges, or hats by participating actively, introducing a form of competition also within the team. The teams will also be competing for more than just their names on the podium. The ability to reveal their team, and see who they were collaborating with is an added reward. This is meant to be a supplementary incentive for the players to perform their best and seek to collaborate well.

Table 8: Suggested design solutions and mechanisms to support relevant concepts and concerns.

To give a visual illustration of the suggested concept, the flow diagram displayed in Figure 4 was created. The boxes represent a view or call for action for the players, while the arrows indicate a change, that is, progression caused by a timed delay, or some action by the player. The diagram was produced after the second iteration, and corresponds to the Figma prototype, with added functionality such as the badges(hats) and the team reveal screen.

Technical requirements

The technical requirements for the solution have not been heavily focused on during this project. The technical equipment needed to use Kahoot Team Mode will vary slightly from the requirements for playing a regular kahoot, as the solution is adapted to remote learning. The students playing KTM will need to have a personal laptop or tablet. The solution has not been fitted for smaller screen sizes, although this should be in the scope for future work. The players will need a stable internet connection, and access the kahoot website. As for a normal Kahoot! challenge, the players can enter the game, using either a URL-link or a pin provided by their teacher. Dependent on the teacher's selection of identification, the players may need to enter their name, email address or other form of student identification info.

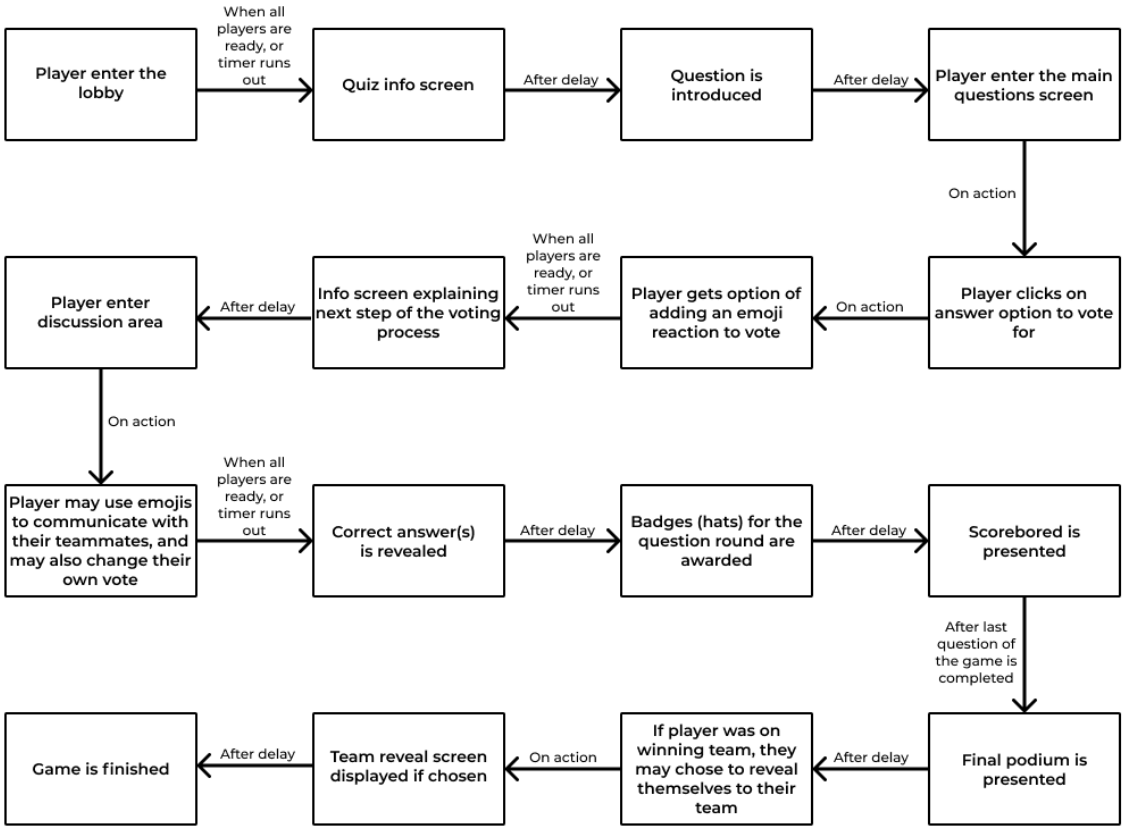

Figure 4: Flow diagram to better explain the flow and progression of the suggested game.

Additionally, the teacher, or whomever is assigning the kahoot, will need a device. As the creation and setup of the kahoot itself is not too different from for a regular game, this process will be familiar for those who have hosted kahoots before. The already existing app or website will be used for creation and initiation of the game.

For a game played in a classroom or a lecture hall, a large, shared screen displaying the progress in the game, as well as the intermittent leaderboards and the final podium is an option, but not a requirement. All necessary information will be available on the players own device screens, but the shared screen will, as for a regular live kahoot, contribute to an exciting, shared atmosphere.

4 Implementation

This part of the thesis starts out outlining the work with implementing the feature suggestion, i.e. the prototyping phase. Following is an explanation of the current state of Kahoot! and their collaborative solution available today. Based on the processes described in the preceding section, the final design implementation of Kahoot Team Mode is then described. The mechanisms and affordances established during the awareness, or background theory phase are implemented into the solution, aiming to design a functional and effective end product.

4.1 Feature design and Prototyping

The implementation process was done in the iterative nature described for the design and creation method by Oates [2006]. The first implementation was through a low fidelity paper prototype, primarily aiming to illustrate functionality, not the final design. The prototype was sketched out on regular paper, with minimal color use or intricate design elements. This was done to allow the focus to be on functionality and mechanisms, rather than things like color choices or fonts etc. Figure 5 displays the first screen of the paper prototype.

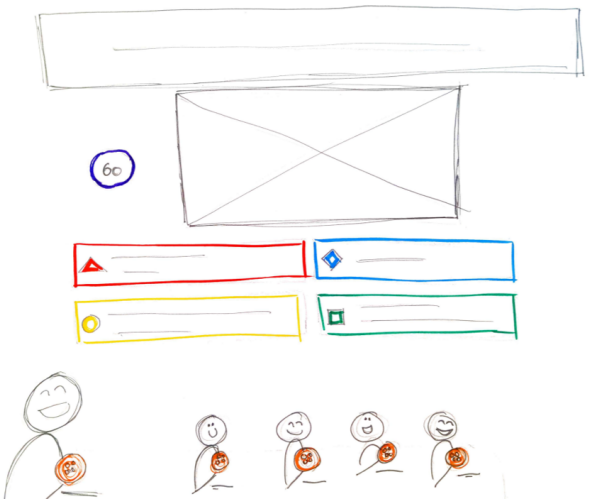

Figure 5: The very first screen of the paper prototype, illustrating the low fidelity and limited color use.

More examples of the paper prototype screens can be viewed in Section 5.1 Focus Group, as well as in Appendix A. The prototype applied the concepts suggested in the initial design phase, only based on the background theory discovered through

literature review. The players were visible in the game space through "bitmoji avatars", intended to resemble the players themselves, as personalized bitmojis do. This was intended to provide support for the concept of mutual awareness, with the players being visually represented in the game. Bitmojis are personalized cartoon avatars, examples of these can be seen in Figure 43 in Appendix A. Kahoot! already have an integration with bitmoji, which was the reason for this specific choice of avatar. The two-step voting process took place as follows; the player either dragged their vote button to the intended answer option, or clicked on it. An input box with a message then appeared over the selected answer option, inclining the player to "Add a note to [their] vote". The player would type a note if desired, and then click "Add note". This addition of a note to the initial vote was proposed to avoid confirmation bias in the team, and to ensure all players sharing their knowledge. When all players had completed this process, the game moved on to the discussion part of the voting process. Here, a modal overlay would be visible for a few seconds, telling the players whether they have a tie or majority vote, and urging them to discuss to come to a final conclusion. When the modal disappeared, a display of the votes for each answer option became visible, and the attached notes were displayed in a chat window. The players could then write messages to discuss with their teammates, or move their vote. This is where the co-construction of opinions and ideas would take place. In the event of a tie, the players would have to keep discussing to resolve the tie and come to a collective majority conclusion. When decided, the players would click the "Submit" button to proceed to the answer reveal and scoreboard. The scoreboard and podium was not included in the paper prototype, as they were intended to be equivalent to those in the already existing solution.

The described paper prototype was used to demonstrate the proposed solution in a focus group. An elaborate description of the focus group and discoveries made during this is found in the following section. Based on the feedback and suggestions made by in-house Kahoot! experts, a second design iteration was made, this time using the prototyping tool Figma. Following the idea of making the whole game anonymous, rather than only the first part of the two-step voting process, new avatars were needed. Animal characters were decided on, as they are familiar and relatable, without being human characterizations, as with the bitmojis. The animals selected were also chosen because of their colorful and "friendly" appearance. The avatars were downloaded from a website called PNG Free, and were licensed for non-commercial use. They must therefore be replaced if the solution were to be implemented with the Kahoot! platform. The complete set of animal characters can be found in Appendix B.

The change of making the players anonymous also affected other parts of the game. In order to compensate for the removal of the teammates identity, a suggested solution was to make the vote buttons color coordinated to the animal characters. This way, the players would maintain a different aspect of mutual awareness, being able to connect the opinions to the animal characters. A more descriptive information screen was also added between the first voting and the discussion phase.

Perhaps the most prominent change between the first and second design iteration was the move away from written communication, to communication through artefacts, in this case emojis. For the assessment or reaction attached to the initial

vote, a confidence percentage or another ordinal scale was also considered. However, to make the communication as coherent and meaningful as possible, emojis were decided on for this purpose as well. Emoji keyboards were created for the communication, with a bigger selection of them available for the main discussion part of the game.

Another addition to the game, made available by keeping the players anonymous throughout the game was the winning team reveal. Implemented to work as additional incentive for performance, the top team after the game would get the option of revealing themselves to their teammates. Figure 23 in Section 4.3 Kahoot Team Mode below illustrates how the reveal would happen, with team members having matching screen colors to identify each other.

This prototype was created to be used in more interactive user testing sessions, and a complete game experience was therefore implemented. Figma tools were used to simulate animations and transitions, aiming to make the experience as realistic as possible.

4.2 Existing Solution

A Kahoot! in its regular form is a live quiz game, in which questions are presented on a big, shared screen, and players answer the questions on their own devices. The questions are timed, with sound effects and music played in the background throughout the game. Players score points by getting a question right, and also by how quickly they answer. When all players have answered a question, immediate feedback is given by presenting the correct answer on the shared screen. The players also get a message on their own devices saying whether they answered correctly or not, as well as their added scores. After each question, the players are presented with a scoreboard, displaying the top five players along with their scores on the shared screen. The players can see their current ranks on their own devices. When the game if finished, a podium shows the top three players with bronze, silver and gold medals. Figure 6, 7 and 8 below illustrate how a live game looks on the shared screen, the final podium, and the players' own device during and after a question, respectively.

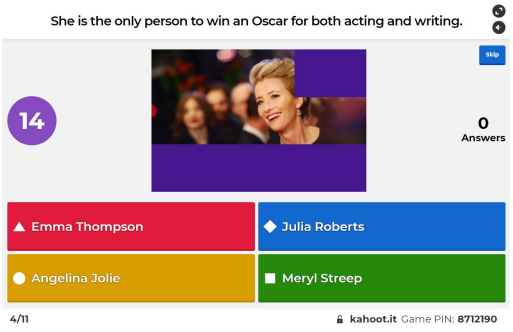

Figure 6: Shared screen in a live game, with question and answer options displayed.

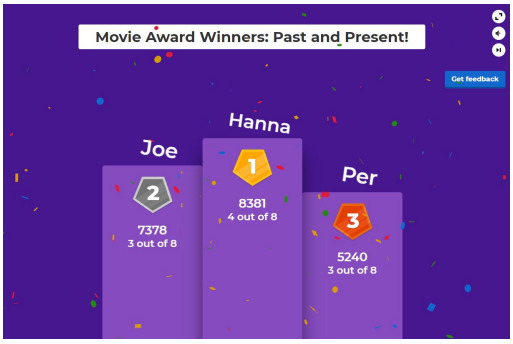

Figure 7: The podium after a Kahoot! live game is completed.

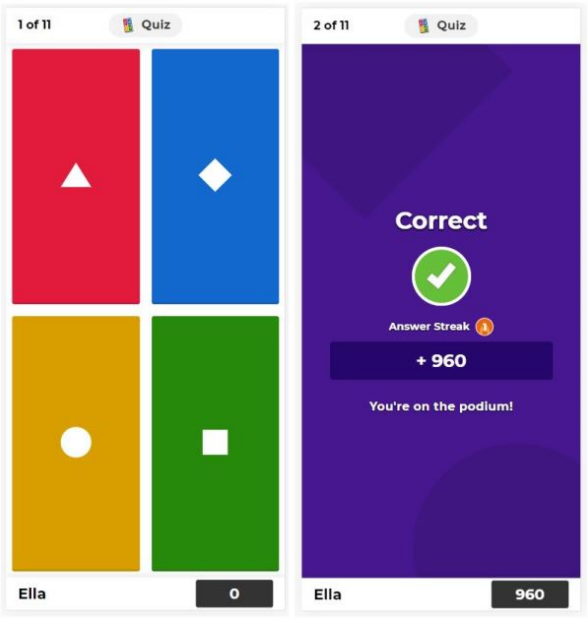

Figure 8: To the left: View of a players' device during a live game. The players answer the question on the shared screen by clicking the corresponding button on their own device. To the right: View of a players' device screen during a live game, after a question has been answered correctly.

Kahoot! challenges are a single player asynchronous version of the live games. Challenges are often assigned by teachers, and played individually by students. The same sound effects, music and scoring system is used, but both the question and answer options are displayed on the player's own screen. The players progress through the challenge partly timed (for the questions), but navigate from the scoreboards etc. on their own time. Figure 9 is an example screenshot of how a challenge screen may look.

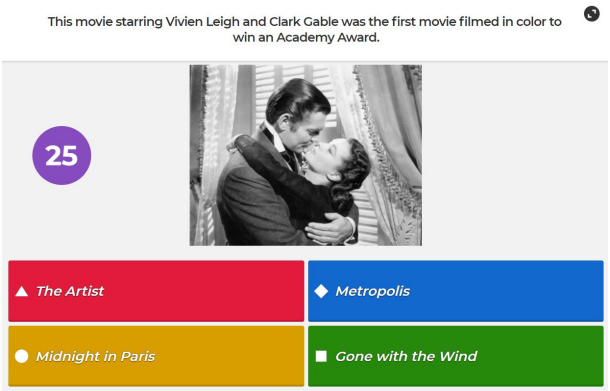

Figure 9: Illustration of the player's device screen during a challenge.

The current available team mode on the Kahoot! platform is a simple co-located, shared device solution. The concept is that each team plays on a single device, and before they answer each question, a five second timer goes down, as illustrated in Figure 10. During this countdown, the teams are encouraged to discuss the question and answer options, see Figure 11. This solution is only available for live

games. It has the advantage that it allows the teacher to decide what students to group together. The lobby of the current team solution can be seen in Figure 12. The solution helps prevent the problematic situation where the same few students are on top for every game, and equivalently on the bottom. Removing this "fear of losing" already contributes to the affordance of community and safety within a team. Figure 13 is an illustration of the temporary scoreboards displayed on the shared screen between each question. These are equal for Team Mode and regular live games.

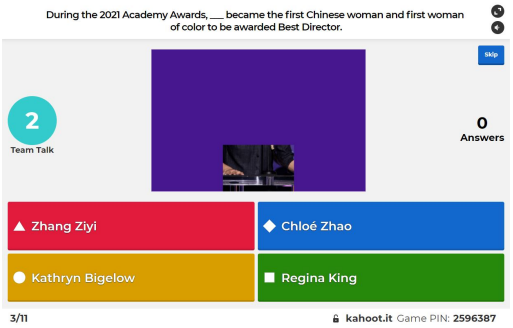

Figure 10: The players are given five seconds to discuss before the actual question timer starts.

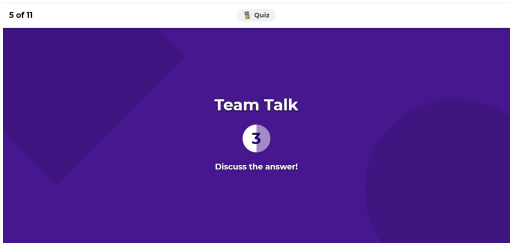

Figure 11: The team's shared device during the Team Talk.

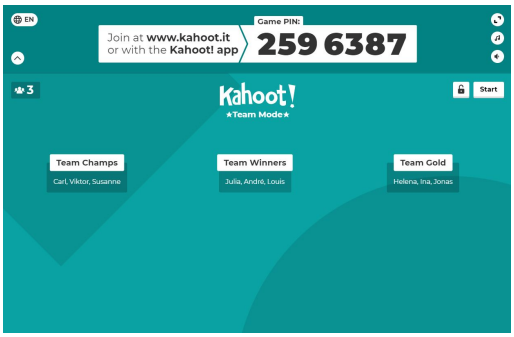

Figure 12: The lobby of the game, where the teams and players are displayed before the game starts.

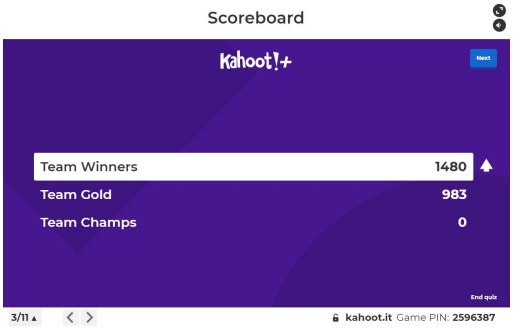

Figure 13: Scoreboard displayed between each question.

It is evident from the literature review performed by Wang and Tahir [2020] that Kahoot! overall has a very positive effect on several important metrics when used in education. When designing a team mode solution for Kahoot! it is vital that these positive effects are largely maintained. It is therefore useful to consider how each attribute will be affected when moving from a single player SRS game to a collaborative team learning experience. Table 8 below evaluates the most relevant concerns and affordances, and provides design suggestions as answers to these.

4.3 Kahoot Team Mode

This section will describe the new proposed Kahoot Team Mode solution in detail. The description will include all changes made following the two design iterations, and represent the final version of the game. Mechanisms implemented to support the concepts brought to light in Table 8 are presented and explained. The overall goal of the game is to collaborate with your teammates to get the most questions correctly, and as quickly as possible. Teams compete to get the most points, and climb to the top of the scoreboard throughout the game, with the added reward of getting to reveal their team if they win the game.

Gameplay

The game starts when the players enter the lobby of the game, as seen in Figure 14. Here, the player can see his or her team name and teammates as they enter the game lobby. The players are given an animal avatar at random, and inclined to generate a secret code name. Both the animal avatars and the code names are meant to facilitate a social environment, by providing the players with characters to relate to, although their teammates are anonymous.

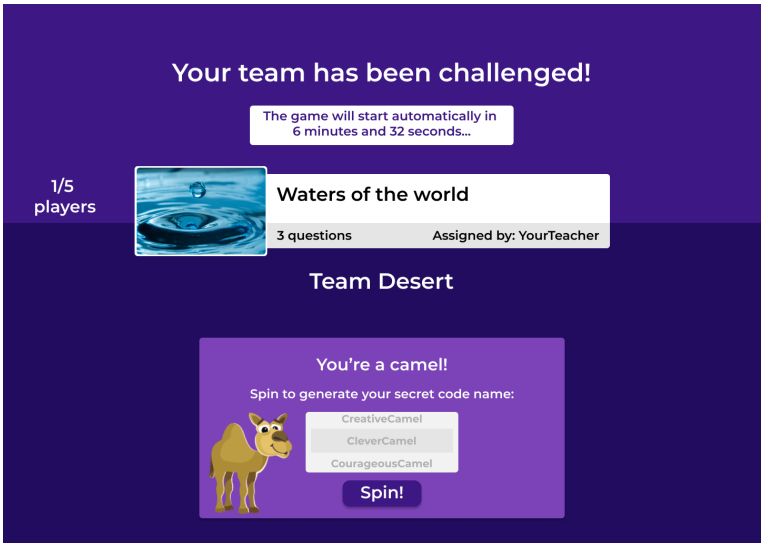

Figure 14: Initial lobby screen of the prototype, the player is assigned an animal character, and asked to generate a code name.

When all players are ready, or the timer runs out, the game starts automatically. Equivalently to a regular kahoot, some information about the game is displayed, before the players are taken to a question intro screen. This screen only contains a question and a timer bar at the bottom, see Figure 15.

When the timer is finished, the players move into the main question screen of the game, as can be seen in figure 16 below. The player can see their own avatar on the bottom left of the screen, and their teammates' avatars on the bottom right. At the top of the screen is the question to be answered, as well as an image to support it. To the left side of the image is a timer, counting down the seconds left to answer the question. The red, blue, yellow and green answer boxes are recognizable from

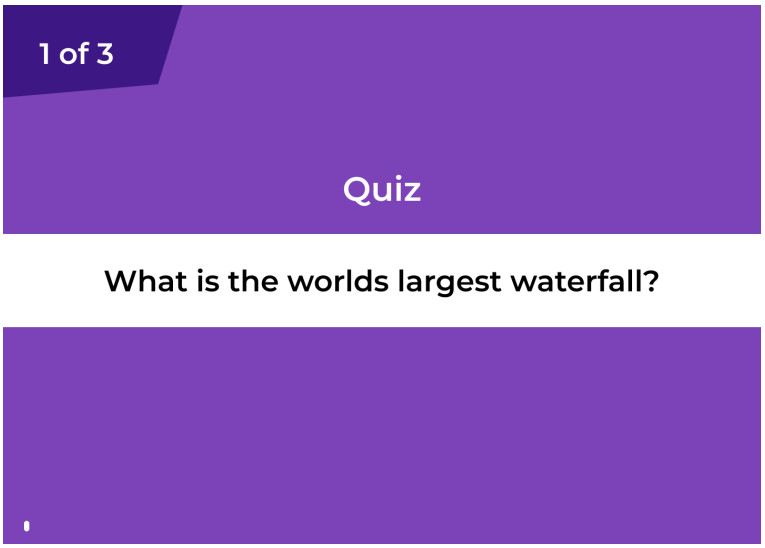

Figure 15: Question intro screen.

traditional kahoots. To answer the question, players click on the answer they think is correct, moving their vote button to this option. Above the selected answer, they will get a message inclining them to add an emoji reaction to their vote. If they want to, they can click on one of the emojis to add it to their vote, and if not they can click on the cross in the top right corner of the message, or anywhere else to exit the message, see Figure 29 in the following section. This initial voting round is meant to give the players individual responsibility, and force them to contribute equally to the knowledge base of the team.

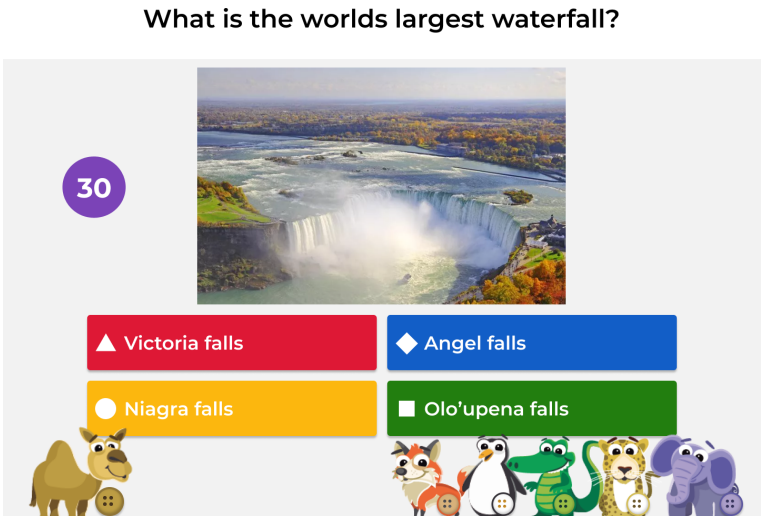

Figure 16: Main question screen where the players cast their initial votes.

When everyone have answered the question, or the timer runs out, the players are taken to the info screen seen in Figure 17.

From here they are automatically taken to the discussion part of the game, after a few seconds. An information modal is displayed over the main screen, letting the players know the state of the votes, and what to do next. The information given

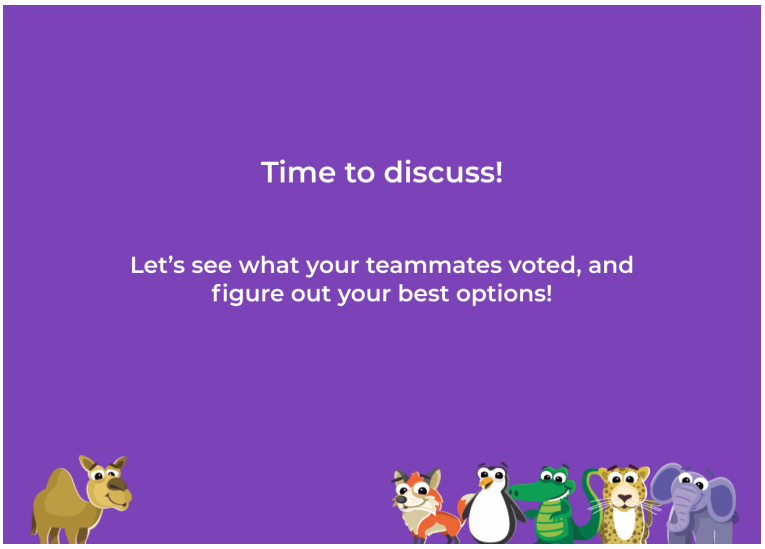

Figure 17: Information given before moving on to the discussion.

to the players throughout the game is meant to provide everyone with an equal understanding of the task ahead, as well as possibilities for actions.

The modal disappears and the discussion screen becomes visible, see Figure 18. This view is similar to the main question view, except the image is removed. Instead, the colored answer boxes are given more space, and now also contains all the players votes, along with any emoji reactions. Below the answer boxes is an emoji keyboard. Again, a timer is displayed on the left side of the screen, and to the right of the keyboard is a button for the players to submit their votes. Before submitting their votes, the players can move their own votes if they have changed their minds after seeing their teammates' votes or reactions. This option is a mechanism for building knowledge based on the team's shared resource base, which again is an important part of co-construction. The players can also use the emoji keyboard to drag emojis to anywhere on the answer boxes, indicating their opinion of the answers or the voting situation.

When all players have submitted their votes, or the timer runs out, the colors of the answer boxes change, and the correct answer is revealed, as seen in Figure 19.

After the correct answer is revealed, the players are taken to the scoreboard part of the game. Before the team is ranked as a whole, internal badges are awarded to the players. The player who was the quickest to get the question right at the first round of voting wins the "Speed helmet", and the player who communicated the most in the discussion part of the game is awarded with the "Speaker hat", see Figure 20 for Speed helmet example. These badges are meant to facilitate friendly competition within the team, which can be a good motivator for participation. Following this, the current scoreboard is displayed, showing the team's rank as a whole, compared to other teams playing, as shown in Figure 21 below. The team gets to view their position among the other teams, before moving on to the next question.

The above mentioned processes are repeated for every question, until the game is finished. The final podium is then revealed, and the teams can see their final

Figure 18: Discussion and second round of voting. Emoji keyboard with available emojis for reactions and communication.

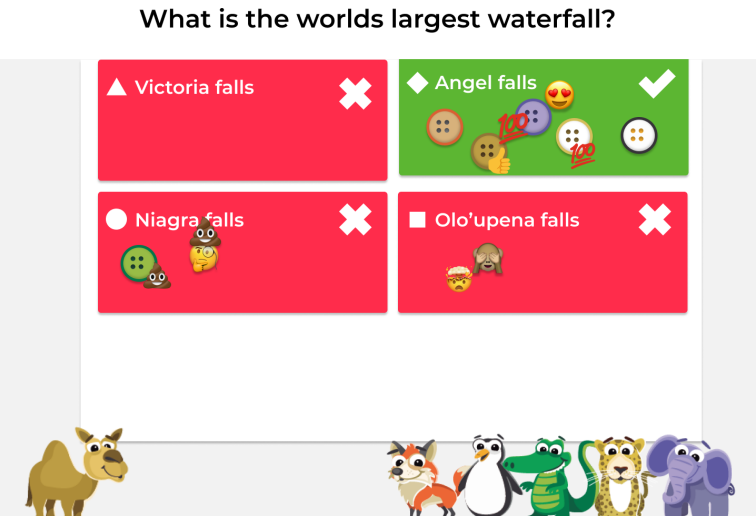

Figure 19: Answer reveal after second round of voting and discussion.

score and ranking, see Figure 22. The winning team gets the option of revealing themselves to their team, or exiting the game. If they select to reveal their team, the screen displayed in Figure 23 appears, and the players can look around for their teammates with matching screens.

Team and collaboration

The majority of team interactions, and thereby collaboration happens in the discussion stage of the game. The team's animal avatars are as mentioned visible throughout the game, as a way of promoting the sense of community and immediacy within the team. However, it is not until the discussion, or the second round of voting, that they actually interact with each other. The interactions occur through the shared "work space" that is the answer box area. Any changes or additions the

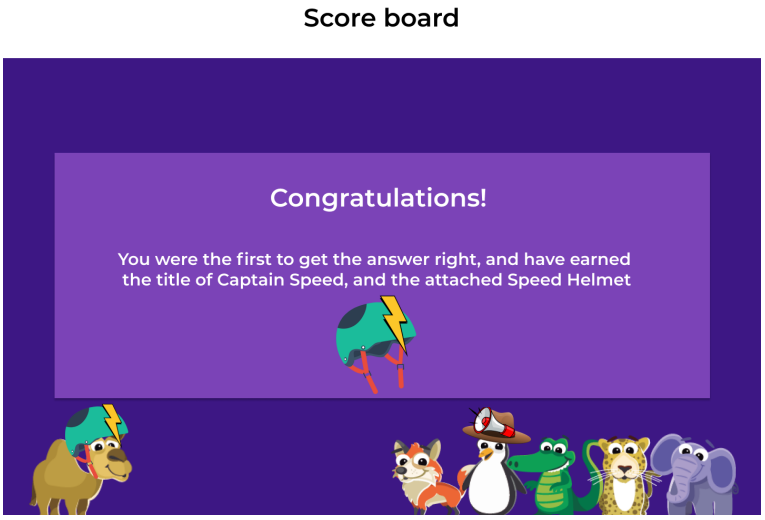

Figure 20: The Speed helmet is awarded to a player for answering correctly the quickest out of their teammates.

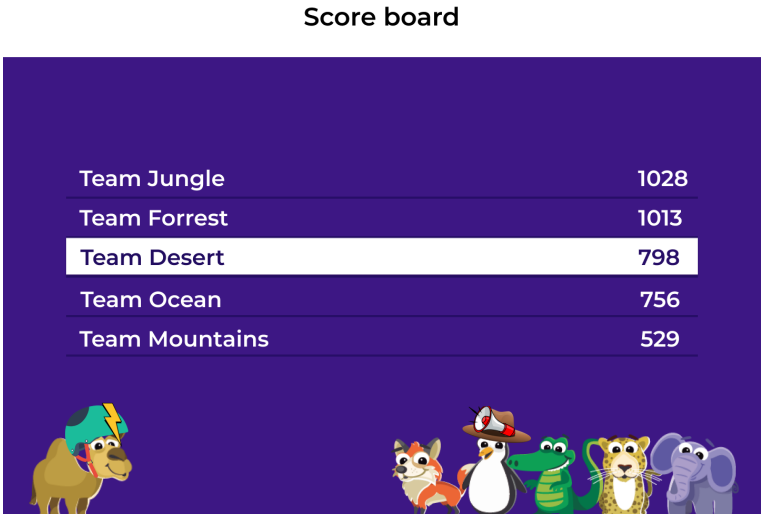

Figure 21: The scoreboard after a question is completed.

players make to this work space is visible to all team members, providing continuous mutual awareness of the state of the game and discussion. The players can take actions and base their decisions on each other's knowledge and participation, thereby co-constructing the voting outcome of their team. The team members communicate either by moving their own votes, or through using the emoji keyboard shown in Figure 24 below. These specific emojis were selected to give the players room to communicate a multitude of different meanings.

The players can use the emojis to react or to communicate in three ways. Firstly through the answer options themselves. If a player has opinions about any of the answers, this can be conveyed by adding corresponding emojis to these answers. The players can also use emojis to react to their teammates votes or reactions. This is a more direct communication, although with the players being anonymous at this stage, there is a degree of disassociation to the process. The idea is that the players

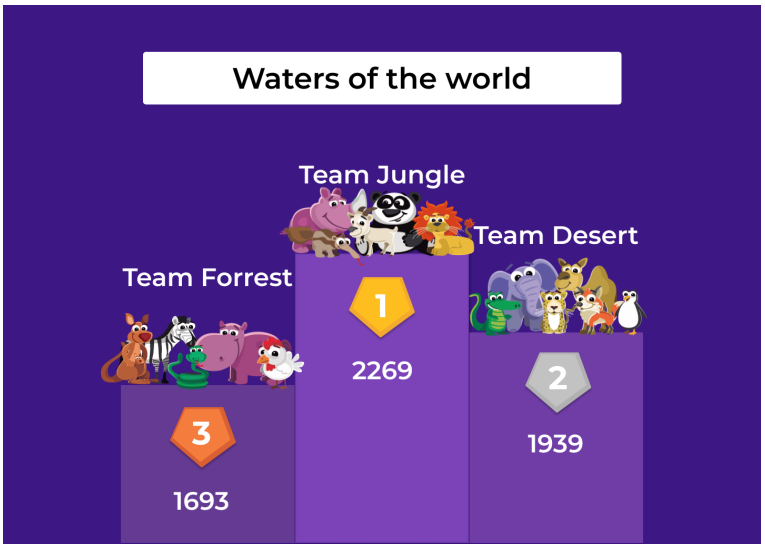

Figure 22: The final podium after the game is played through.

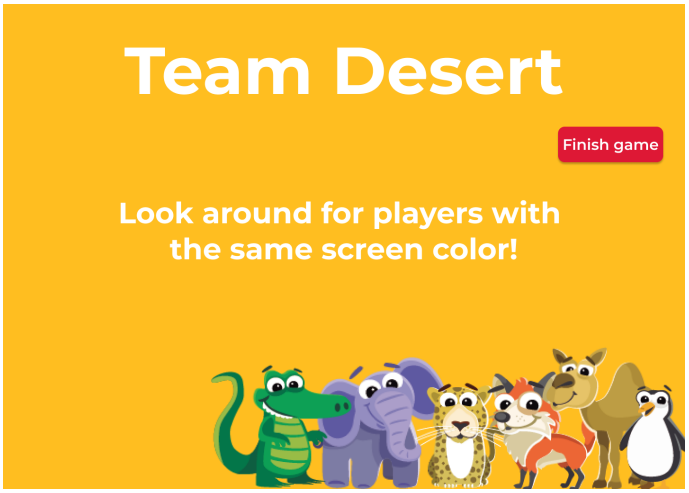

Figure 23: The color of the reveal screen will match the color of the player's teammates.

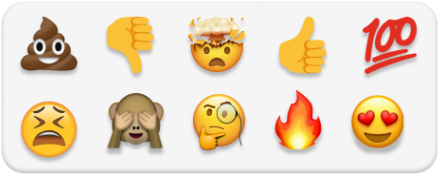

Figure 24: Emoji keyboard available to players for communication. Drag and drop interaction.

will feel that they can communicate freely, both without the fear of being called out for reacting to someone else, or of having someone else react negatively to their opinions. The final way that the players can communicate with the emoji keyboard is through reacting to their own votes. They can suggest that they are certain of their votes, hint that they are unsure of their standpoint, or react to indicate that they were wrong, and will change their vote.

Emojis were selected as the main communication form because they are familiar to most people today, and also because they carry informal and friendly connotations. Using emojis in interactions with friends is recognizable for many students. Utilizing these characteristics in a collaborative learning setting may therefore support the prenotion of playing a game with friends, further providing a sense of community within the team.

Voting process

At the very core of a game of kahoot is the objective of selecting an answer option, and hoping it is the right one. The main goal for KTM is the same, with the most fundamental change being that the players will get two chances of getting their answer right. The first round of voting is almost identical to that of a regular kahoot challenge. The main difference here is that the players have the option of adding an emoji reaction to their vote. The intended purpose of this is that the players can assess their own knowledge individually, without being affected by the opinions of their teammates. This reduces the effect of confirmation bias, particularly with respect to the primary effect. The players must evaluate their own insight, before knowing whether it will align with that of their teammates. It also gives a better starting point for the following discussion process.

When the players enter the discussion part of the voting session, they are met not only with the votes of their fellow team members, but also their reactions or evaluations of their own votes. This helps the team build knowledge and make better informed decisions, as each player have not only contributed with their own knowledge, but also an assessment of it. After the players have discussed, and if needed made any changes to their voting, they submit their votes, or the timer runs out. The correct answer is then revealed.

The two-step voting process has this advantage for the team, aiding them in making better informed decisions based on the co-constructed knowledge of the team. This will help the players compete in the game, by scoring points and climbing the leaderboard. It can however also have a positive effect on the individual learning outcome. The second round of voting or discussion may function as a form of repetition, making both the question and the answer easier to understand and remember for the players.

Scoring, rewards and timing

The scoring of the game is again very similar to that of a regular kahoot game. The teams get points for answering the questions correctly, and for answering correctly quickly. The quickness is evaluated at the first round of voting, while the correctness is only counted after the final votes are submitted. If everyone on the team ended up voting for the same answer option, and this was the correct one, they will get a full score for correctness. For a team of five, if one player chose to answer differently, and picks a wrong answer, they will only get four fifths of the points available for correctness. The points for quickness are also only awarded per player who answers the question correctly on the first try. This is an incentive both keep the speed of the game up, which can have an engaging effect. It could also encourage the players

to actually consider their answer options in the first round, and not merely depend on their teammates to get the answer correctly in the end.

The timing aspect, familiar from the original kahoot game is relevant also in a team situation. If there are no timing restrictions, the solution will lose some of its gamified experience, and the players can get stuck in longer discussions. There is also the risk of losing the participants' attention if they are given too much time. The game will therefore have timers for all the main sections of the game, i.e. the initial question introduction, the first round of voting, and the discussion part of the voting. This urges the players to stay active in the game, and also adds a sense of excitement and urgency. The information screens and scoreboards are also timed, but as they don't call for any actions by the players, the timers are not explicitly displayed here. The players get a few seconds to view these screens and read their content, before they automatically progress into the next question or podium.

Reward badges, or hats, are introduced in the collaborative mode of the game. These are awarded and move between the players in a team for each question, dependent on who performed better for the question. The first badge is the "Speed helmet", awarded to the player in a team that gets the answer to a question correctly first in the initial voting round. If no players get the question right on the first try, it is not awarded to anyone. The second badge is a "Speaker hat", awarded to the player who communicates the most in the discussion session after a question. This is meant to encourage the players to use the communication tools available. Neither of the badges come with points or other benefits, but are a visual addition to the avatar of the players. The hats are awarded in a session before the scoreboards between each question, and all team members will be able to see who wins the badges for a question round. This way they may also contribute to awareness within the team, by providing insight into who, that is, who of the animal characters are engaging the most.

Anonymity and team reveal

The concept of anonymity in the team mode solution has been mentioned briefly already. It is proposed to have the social benefits related to participation confidence and reduced risk of bullying. Being able to play and interact anonymously may give the students a sense of freedom, not having to worry about being called out if they make a mistake. It also removes the effect of already rooted biases of qualities such as who has the loudest voice or strongest opinions in a team situation.

Additionally, keeping the players anonymous can have advantages for the engagement and motivation when playing KTM. The winning team will get the opportunity of revealing themselves to their teammates, by moving on to the screen displayed in Figure 23. In a classroom or auditorium setting this can be an exciting end to the game, with players finding out that they have collaborated well with people they may never have worked with before. It works as an incentive as players will have to work well together and score high points if they want to know who they are collaborating with. Only the winning team will get the opportunity of revealing their team, which further encourages the players to engage in the game. The team reveal is also an added fun end to the game, with an element of surprise and excitement

integrated into the "prize" of landing on the top of the podium.

The short time frame of a game of kahoot also removes some of the need for knowing the identity of your teammates. Arguably, the awareness of who your teammates are may in fact introduce stress and confidence issues, particularly among younger or weaker students. Nonetheless, the concept of community building is important, and need to be supported in other ways. The team reveal feature is implemented not only to be an incentive to win the game, but also to be a mechanism for community building. After collaborating successfully, the players uncover their team, which could promote conversations and social interactions in the classroom.

The team reveal is mostly relevant in co-located settings however, as the mechanism of looking for other players with the "winner's screen" requires the players to be able to see each other's devices. In distributed settings, this will be difficult, unless the game is played during a video call or conference.

Game initiation

The game instantiation has not been considered explicitly for this project. The proposed solution for distributed teams will be for the teacher or assigner of the game to schedule and decide on a time when the teams are required to enter the lobby and start the game. For live games using KTM, the game will be initiated similarly to traditional live games, with players joining the game with an access PIN.

The teachers will have two options for team assignments. The teams may be put together purposefully by the teacher, using email addresses or other forms of student IDs to assign and group the players. The teams may also be assigned randomly.

5 Evaluation

This section will present the findings from the evaluation processes of the project. Discoveries made firstly in the focus group with experienced "Kahoot! experts" are elaborated on, before findings from the final user testing sessions are presented. Qualitative data was collected in the form of feedback and input from the participants in the evaluations. Justifications and explanations of the data collection methods are given.

5.1 Focus Group

To get feedback on the general concepts and proposed user interfaces at an early stage in the design process, a focus group was held. A semi-structured interview approach was applied, with prepared questions and topics of interest, but flexibility in order and other input from the participants. This type of interview is well suited for a discovery purpose, as the interviewees are able to speak their minds, giving qualitative insight into the topic [Oates, 2006]. In order to promote new ideas and inquire for consensus where applicable, discussions and brainstorming digressions were welcomed throughout the session. The participants were also encouraged to interact with each other.

Simple paper wireframes were used to illustrate the flow of the solution and to have a tangible focal point of the conversation.

Participants and setup

Due to the current government posed restrictions, a physical focus group was not possible, and the session was held over the video conferencing tool Zoom instead. In order to adapt to this situation, and ensure that everyone in the group would be able to voice their opinions without having to be strictly regulated by the moderator, a smaller group of three people were invited. There would be no recordings of neither audio nor video, and all data collected from the meeting would be written notes taken with no identifiable references to the people in the group. There was therefore no need for any formal agreements or disclosure of GDPR measures. The written notes were taken during the course the session, aiming to recount the essence of any opinions, ideas and suggestions, as well as a few direct quotes from the participants.

The participants invited to the session were all internal Kahoot! representatives, both using and working on the platform frequently, hence the collective title of "Kahoot! experts". Their areas of expertise varied within the fields of business

development, product management and concept design, which forms the basis for their thoughts and opinions in an early stage of the design process being particularly valuable. The participants were recruited through Kahoot!'s internal communication channel on Slack, and a meeting was set up over the above mentioned video conference tool. All three participants were of similar "status" within the company, recruited with the intent of avoiding hierarchical domination of the conversation [Oates, 2006].

Initial conversation

When all the participants were present in the video call, introductions were made, and some information about the proceedings of the focus group were given. The project was introduced to the participants, and the objectives of the focus group were listed. The following preliminary questions were prepared for a brief discussion before moving on to the wireframe.

1. How often do you use Kahoot?
2. Do you use challenges or live games most frequently?
3. How would you currently solve a situation where you would want participants to collaborate on a Kahoot?
4. What are the shortcomings of these solutions currently?
5. What would you expect from a service designed specifically for this purpose?

The participants answered the first two questions in turn, revealing that the frequency of use varied significantly from several times in a day, to a couple of times a month, and consisted largely of internal testing and demos. They all used live games more than challenges, but one of them also used challenges several times a week during busy periods.

For the third question, regarding how a team situation would be solved currently, all three participants had several examples of how they had heard customers and users do this. A reoccurring solution when playing kahoots as a team activity over various video conferencing tools was to use "break out rooms". The participants would be given a number of tasks in the shared conference environment, before they were sent out to the break out rooms to discuss. After a few minutes, they would return to the common "room" to answer a kahoot individually. In other cases, the facilitators had asked the participating players to form group chats on Microsoft Teams or WhatsApp, in order to communicate while they were playing the kahoot. With both these method, either only one player from each team can actually participate in the kahoot, or the players partake as if they were playing individually. In the case of the latter, the players will also appear individually on the podium, and the facilitator has to do extra work to combine the scores of the different players, in order to determine what team performed the best. Neither of these solutions are optimal, and underline the need for a solution in which participants can play and work together as a team, without requiring third party services. The conversation largely also covered the last two questions, which were consequently skipped.

Wireframe demo

Following the introductory conversation, the wireframe demo started. Figures 25, 26 and 27 are outtakes of the complete set of paper wireframes. The remaining prototype slides used the demo can be found in Appendix A. As this demo was not meant to be interactive testing of the user experience, each screen was merely explained and the flow of the interfaces presented.

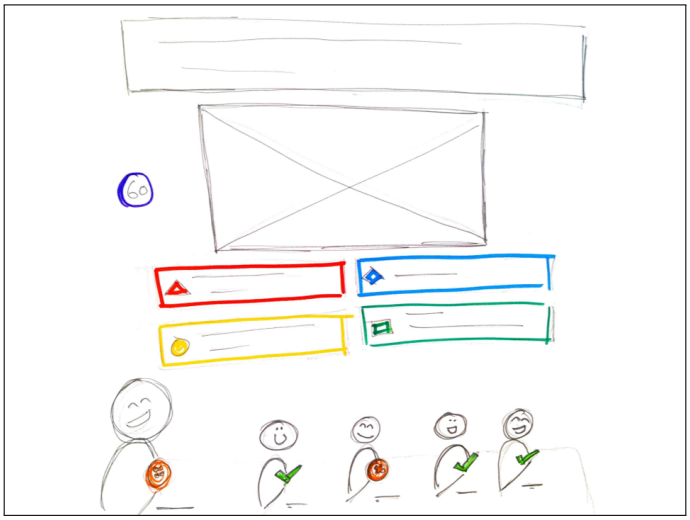

Figure 25: Paper prototype of screen during initial voting process.

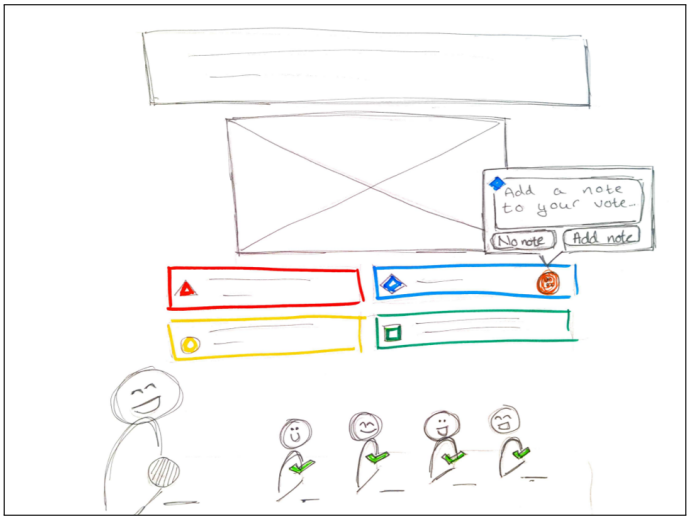

Figure 26: Paper prototype of screen where player has selected answer option, and is asked to add a note to their vote.

The wireframe sketches were displayed through a shared screen PowerPoint presentation, and each slide was explained with the user's possibilities for actions, intended tooltips and team dynamics. Comments were made on the underlying guidelines or pedagogical considerations for relevant features.

The demo started with a brief explanation of the lobby screen before the players entered the game, as this was not part of the wireframes. The first wireframe was then shown, and the course of actions through the different screens was presented,

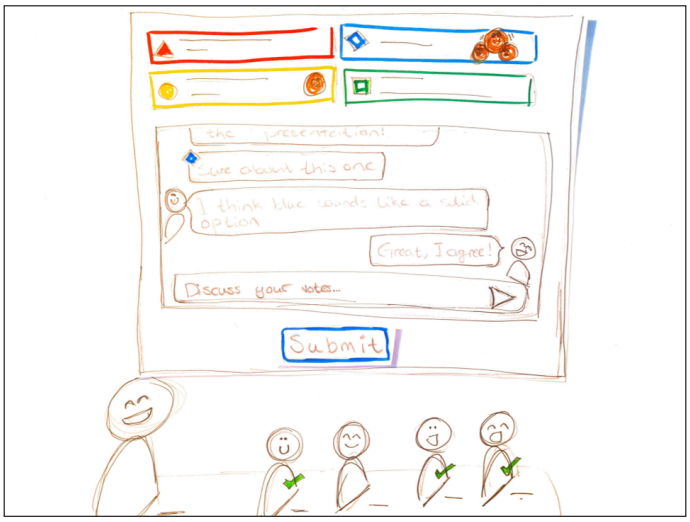

Figure 27: Paper prototype of discussion, or second round of voting screen.

describing the voting process, how to add notes to a vote, the proceeding discussion, and the finalizing of the team vote.

When all the wireframes were presented, the focus group moved on to the main discussion.

Discussion

Prepared before the focus group was a set of questions intended to be asked the participants in an orderly fashion. However, it was deemed more valuable to allow the discussion in the group to persist unconstrained. All three participants were engaged in the discussion, with both feedback and questions about the wireframe, suggestions for improvements and considerations, as well as their own ideas for next steps.

The discussion was initiated with an open inquire for any immediate questions or comments. The first thing that was brought up was the voting process and the idea of adding an anonymous note to your vote. Bullying, and the stronger players overruling the weaker was said to have been a significant issue with the current team mode solution.

> *"Anonymous voting and commenting gives everybody on the team a voice, and avoids the situation where only one person answers every time."*

This case was discussed thoroughly with input from all participants. As the Kahoot! platform strides to be inclusive and fun for anyone who plays, and children make up a large percentage of the user base, these are key considerations.

Further, a question of synchronization was raised. If playing an assigned homework kahoot, how would the students know when to sign in? Although not a central part of the game experience, this concern may be investigated in order to make the feature easily accessible, without having to apply third party applications.

The opportunity for playing team mode in live games, for instance in classrooms or social settings was also requested. Although these use cases were not the main intent of the feature design, adjustments to allow for this was suggested as an interesting extension of scope. Different possibilities and ideas relating to live games were discussed back and forth.

> *"In a classroom you need a tempo. This keeps the students engaged, and is also a great way of keeping scores."*

> *"Imagine you're in a classroom, no one knows who's on what team, and you help each other anonymously. You don't want to reveal your answers to anyone, because what if they're on an opposing team. Then when you finish, who was on the winning team is revealed to the players."*

> *"Especially for younger students, this game in a live setting could be great. It is easier to disagree with stronger students if you can do it anonymously, especially arguing with emojis for instance, could be a really fun time in the classroom."*

The means for communication with teammates was also thoroughly discussed.

> *"Writing words in a chat could be GDPR sensitive, especially if it's kids typing. Could it be an option to use pre-made phrases, symbols or emojis to communicate instead? This might also make it easier for children who are unable to type."*

The idea of using emojis or symbols to both vote, communicate and react to events in the game brought out excitement in the participants of the focus group.

> *"Avoiding writing messages would make it feel more like a game. Remember the players want to play a game, not just a gamified experience. Emojis are a much more playful way of communicating."*

The statement about making the solution a game, not just a gamified experience had ripple effects throughout the remainder of the discussion. Again when mentioning the voting process, this was brought up as important to consider. The proposed solution of not being able to move on until a potential tie was resolved was criticized.

> *"I'm skeptical about the ties, not sure if that's a good idea. I like games where you can do whatever you want. If you want to disagree you should be able to."*

The rest of the conversation briefly touched on all of the questions that were prepared for the group, and follow up questions were asked throughout, rather than breaking up the discussion to introduce new questions.

The main points, ideas and concerns addressed in the discussion are summarized and presented in Table 9 below.

Concept	Discussion outcome
Voting process	• In the second round of voting, the weaker kids are helped by discussing with the stronger kids. Peer to peer knowledge. • There should be an incentive to chose an answer first within the team. Why do you want to be a hero? Keep the concept of following your first instincts and going with your gut. • The solution takes a good consideration of the scapegoat issue, where if you are weaker than your teammates, you cause the team to struggle. This is important to keep in mind, as this is one of the biggest flaws with the current solution, and the avoidance of bullying is key for games with children. • Using emojis or symbols to vote in a playful way could make it feel more like a game. • There is something interesting about the process of "think about it, then see what your peers say and then discuss it". This two-step voting process could be very well backed up in literature, and is and important pedagogy aspect. • In a discussion, if you have an opinion, but someone contradicts you, then you're programmed to change your mind. The initial notes that start the discussion could help prevent this effect, giving everyone the possibility to voice their opinions simultaneously. • It needs to matter what the players vote in the first round. Perhaps this could count partially towards the total score as well, or the game gives you a status or a badge if you get the first round right.
Scoring and timing	• Room for creativity in the method for assigning points. • Timing is a great way to keep players engaged. In classrooms you need a tempo to keep things moving. • It is important to make the solution feel like a game, not just a gamified experience, and timing and scoring can contribute to this.

Communication	• Having kids type in open text fields could be both GDPR sensitive, and challenging for those who haven't learned to type yet. • Pre-made phrases, symbols, scales or emojis could be a clever workaround, that would also add to the fun game experience. • Writing in the chat and notes could make it feel more like a learning tool than a game. Emojis for communication and reactions could be a solution. • The ability to react to other players' votes or messages could make the game more of a fun "argument". • Consider the benefits and restrictions with both emojis, video, audio and text.
Anonymity and confidence	• The suggested solution gives everybody a voice, which has been an issue with the current solution. It's important to avoid one person answering every time, and the weaker participants being pushed to the side. • The reevaluation of votes prevents the weaker players worrying about bringing the score of the team down, as the voting is anonymous, they may feel more confident "throwing an answer out there". • Great to avoid the risk of bullying by singling out the weakest team member. • Anonymity is perhaps mostly interesting when you're at home or in a distributed setting, or if you don't know who your teammates are. • It may be easier to disagree with the "loudest" voices in the room if you can react to other players opinions anonymously. • For younger players i.e., between the ages of 10 and 20 years, the concept of anonymity can be especially valuable. Imagine you're in a classroom or lecture hall, and no one knows who's on what team. You help each other anonymously. When you finish, there is a big reveal of who was on the winning teams.

Live games	• Try to twist the solution to something that could work for live game settings as well. • Create a shared screen with a podium or some other method of seeing the progress and standings in the game. Display something to maintain engagement and competitiveness.
Starting the game	• One issue to consider is how the game itself is launched. If the players are all in a video conference together it is no problem, but assigning challenges for student teams to complete at their own time requires some sort of scheduling.
Ties	• Reevaluate the current tie-situation, avoid the players ending up in a restricting situation where they cannot move on. • Players disagreeing could be a part of the game, agreeing to disagree also giving the possibility of scoring points. • One option is that the players' votes count as "bets" on each answer, and the scores are divided accordingly. The team get more points the more votes they have on the correct answer.

Table 9: Summaries of the different concepts discussed in the focus group.

5.2 User testing

To complete the second iteration of the feature design, a round of user testing was preformed. The prototype for this iteration was made using the high fidelity design tool Figma. The prototype was designed to emulate the social and collaborative environment of Kahoot Team Mode, with dynamic animations and events. The interaction of the test person was limited to a series of actions, meant to demonstrate the functionality of the system.

Participants and setup

Due to the current situation, the recruitment of test subjects from different demographics was challenging. The user testing therefore only includes tests performed with subjects in the age group 25-28, of which all were students, or recently graduated students, of different fields of study. As the solution is meant to be used primarily for educational purposes, this demographic was deemed sufficiently relevant to the project. However, testing on students of different ages and levels of schooling would have been preferred to get a broader verification or rejection of usability.

Before the prototype was presented to the participants, they were asked about their familiarity with Kahoot! and technology in general. Two of them were very familiar with the platform and had used it frequently in lectures and other presentations they had attended. Both had only used it for live games however, and only one of them was aware of the possibility to play individual challenges. Three of the participants described themselves as very technologically capable, whereas the last person said their skill level was more basic, mainly limited to social media and elemental use.

All user tests were held using the video conferencing tool Zoom. The possible observation of body language and detailed signals from the test person was therefore limited, and the verbal testaments were largely weighted. The test person was sent a link to the interactive prototype, and asked to open it. They then shared their screen with the interviewer, so that any interaction with the prototype could be monitored.

No personal data was collected, and the participants were informed of this initially. A brief of how the user test would be conducted was given. They were informed of the limitations of the prototype, and given simple instructions on how to open and interact with it. The participants were asked to explain their thoughts and actions throughout the session, to the best of their abilities. They were also ensured that they could not make any mistakes, as the prototype was the subject of the test, not themselves.

Prototype user test

After the preliminary introductions and questions, the main part of the prototype test begun. The interactive prototype had been designed and created as a game of three questions, all about water. The topic was selected to be realistic, familiar and at an appropriate difficulty level. However, the test participants were asked not to get hung up on the questions and answers themselves. The execution of the test is outlined below. Many of the supporting figures can be found in the previous Section 4.3 Kahoot Team Mode. The remaining screens from the prototype can be viewed in this section, or in Appendix C.

The prototype first takes the player to the lobby, where they are given an animal character, and a username is generated, as seen in Figure 14. The rest of the team appear in the lobby, and the game can start, see Figure 28 below.

The first question is presented in the familiar Kahoot! way, see Figure 15, before the player arrive at the main question screen. This is where the first round of voting takes place, by the player either clicking an answer, or dragging their vote button to the desired answer, see Figure 16.

When the player selects an answer option to vote for, the emoji keyboard is displayed above the answer button, with a message asking the player to add a reaction to their vote. See Figure 29 below.

When all players have cast their first votes, or the time runs out, the players are taken to the info screen illustrated previously in Figure 17. After a delay, the

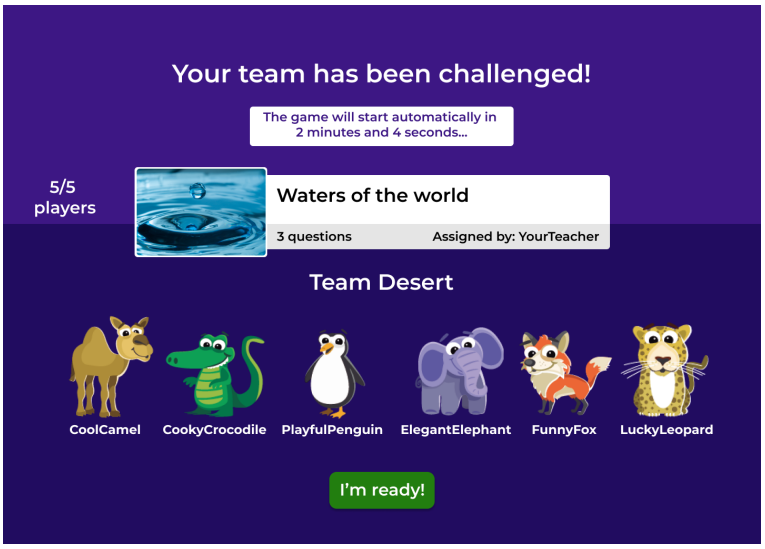

Figure 28: All players present in the lobby before the game starts.

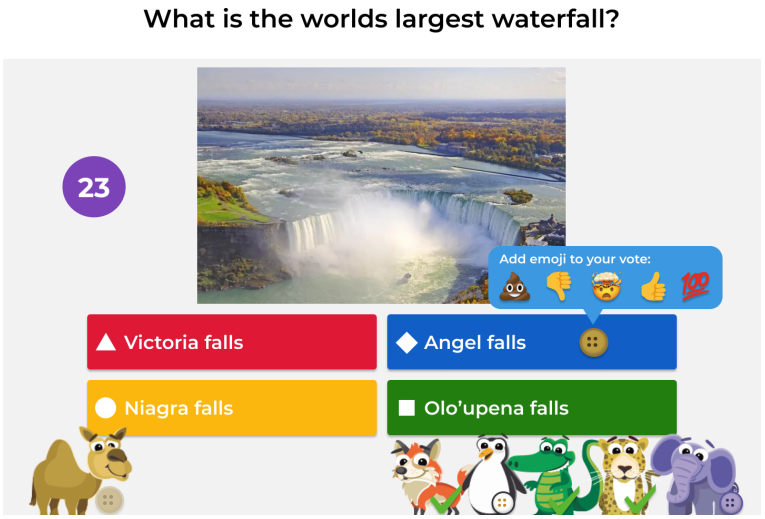

Figure 29: Emoji selection above vote button.

players proceed to the discussion part of the voting process. Initially, a modal giving instructions about the votes and the discussion process is displayed, see Figure 30. The modal lifts after some moments. The votes are revealed, and the players can start reacting and communicating with the emojis available, or change or submit their own vote, as seen in Figure 18.

When all players had submitted their final votes, or the time runs out, the correct answer is revealed, as displayed in Figure 19. The correct answer(s) turns green, while the wrong turns red. The color indications are supported by check marks for correct, and X for wrong.

In the prototype, the test player is awarded the Speed helmet after the first question, for getting the answer right the quickest, as seen in Figure 20. This is awarded before the scoreboard is displayed, which can be seen in Figure 21.

Figure 30: Modal displayed with information about the discussion and voting process.

The game continues, and the players answer two more questions in the same manner. After the last question, the final scores, and the podium is revealed, as displayed in Figure 22. From here, the modal shown in Figure 31 below appears. The players on the winning teams can choose between finishing and exiting the game, or revealing what team they were on to their teammates. If they select the latter, the screen in Figure 23 is shown, and the players can look for other players with a matching color. Who played as what character is not revealed.

Figure 31: A modal gives the winning team the option of revealing themselves to their teammates

When the game is finished, either by clicking the "Finish game" button, or after a delay, the screen in Figure 32 appears, and the game is over.

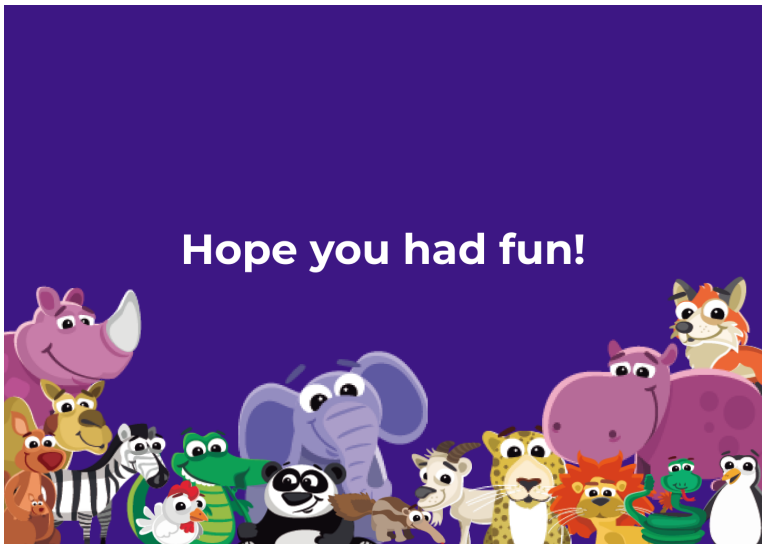

Figure 32: Final screen displayed when game is finished.

Feedback and discussion

After the prototype-testing part of the sessions was completed, the test persons were asked a series of questions, in a semi-structured manner. These questions were prepared beforehand, with the aim to not only get feedback on the feature design and functionality of the product, but also to answer the research questions posed for the project. An outtake of these are listed below. The complete list of questions can be found in Appendix D.

1. Did the system work as you would have expected?
2. Did you encounter any navigation issues or other pain points?
3. How did you experience the interaction with your teammates?
4. How was you engagement affected by the collaboration with your teammates?
5. What did you think of the instructions given throughout the game?

The answers to these questions, as well as other feedback and observations were summarized and organized by concepts, and are presented in Table 10. Some comments considered particularly interesting were highlighted and discussed further during the sessions. Some of these are elaborated on below. All answers and discussions have been translated from Norwegian to English, and are therefore not verbatim renditions.

One remark made by a participant during the run-through of the game was the following;

> *"Oh, so everyone got the question right!"*

This comment was made at the point during the game illustrated in Figure 33 below, when all the players had green check marks instead of vote buttons displayed by their animal character.

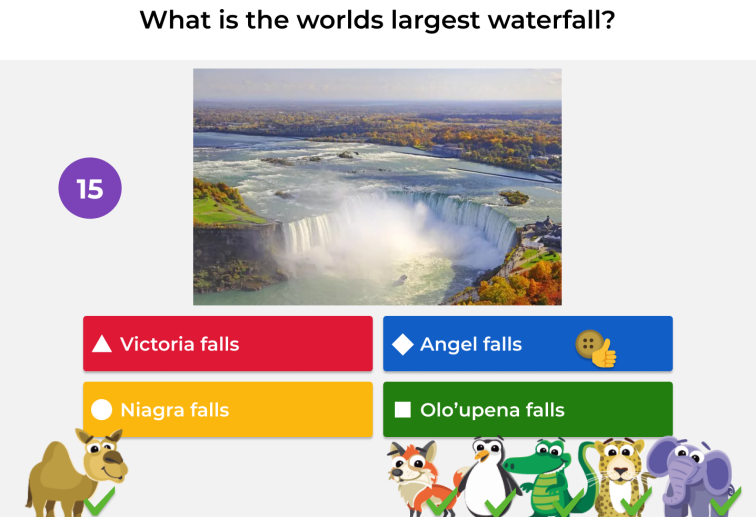

Figure 33: First part of the voting process in the game. Green check marks meant to indicate that all players have cast their votes.

After the test game was finished, the participant was asked to elaborate on the comment. They explained that they understood the meaning of the check marks after they got to the discussion stage of the game, but that there was a moment of confusion from the initial assumption that everyone got the question right, to processing that this was not the case. Green check marks are often associated with something being correct or right. The same green color is also used for highlighting the correct choice upon the answer reveal, which further substantiates this claim. The test person said that check marks were a good option for indicating that players were finished with something, as this is also often an intrinsic meaning that they hold. The color however could be changed to avoid this initial confusion.

Another issue brought up by one of the test participants was the identification of relationship between vote buttons and animals or characters. The vote buttons being related to animals by color in the discussion part of the game can be seen in Figure 34 below.

The value of awareness within the game should be evaluated compared to the possible negative effects if players find out who played as what animal. As the mentioned test person pointed out;

> *"Being able to see who voted what gives more incentive for asking and trying to figure out who was who after the game. It is easier to ask "Who was the penguin?" than "Who answered blue on question four?", which can make it uncomfortable for those who answered questions wrong. Children can be very good at using the elimination method to single out each other in these cases, which can be a negative outcome of this."*

With similar concerns as the above mentioned identifiable voting buttons, was the check marks being adjacent to each animal who had answered a question. The scoring in kahoots, both traditionally and intended for this solution, is partly based on timing and quickness. With the current solution, players are able to see what

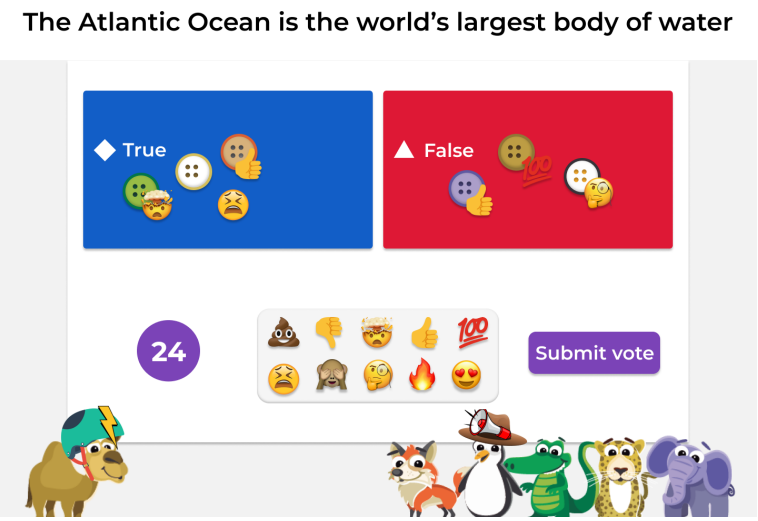

Figure 34: Discussion part of the game. Vote button colors correspond to animal colors. Emoji keyboard in the center of the frame.

animal answered a question quickly, and who took longer, and thereby potentially lost the team points. With the described reasoning, the slower players may be exposed and mocked. One idea mentioned was therefore to move the check marks away from the players themselves. In the lobby of the game, there is a counter to signal how many of the team members are present before starting the game. This same functionality was proposed as a solution to anonymize the voting process completely.

All of the test participants were excited by the Speed helmet, revealed in the screenshot in Figure 20 in the above section. However, questions were asked about what the other hat meant, as this was introduced to another player, but without explanation to the rest of the team. In a real situation, this would be the case for those players who didn't receive either of the hats. This could cause confusion, as they would perhaps not understand what was going on with the hats, and only be distracted by these.

A suggested solution was to display the distribution of the hats to all players on the team. This could both clear up confusion, and also add a motivational factor. When the players know they can also be competing internally for the hat badges, they may be inclined to try and perform even better, with regards to speed and communication.

The question of whether the helmet came with any additional benefits was also asked. The question was returned back to the participant, whether they would think that it was. They were unsure what such a benefit could be, and said that it was a fun addition also without getting any advantage. One mentioned risk with the hats not granting any points or other benefits was that they would have an impact initially, but that the effect could wear off quickly.

The concept of conveying meaning and having a discussion only using emojis was new to all the test participants. Their initial reactions varied from not understanding

the drag and drop action available with the emoji keyboard, to wanting to use the emojis more than the prototype allowed for. Two of the participants immediately asked the question of "What do I do here" when they arrived at the discussion part, illustrated in Figure 34 above. However, without their questions being answered, they were able to resonate relatively quickly, and figured out how to interact. Several of the test participants took some time to discover the drag and drop functionality in the first question round. However in the subsequent rounds they had learned and understood the feature. One participant said the initial perception of the discussion screen was somewhat confusing, as there was "a lot going on".

The test persons were asked to give their opinion and thoughts on the communication method. One test person said that they think they would struggle with saying everything they wanted through only using emojis. When asked to elaborate on what types of things they thought would be hard to communicate however, they did not have any concrete examples. After thinking about it for a little longer, they inclined that perhaps the emojis could be sufficient. The scope of the discussion is limited to the votes and reactions of the team, and the conversation needed is therefore also reduced. Another participant also pointed out that communicating with emojis forces the discussion to be quite quick, both as no writing is necessary, but also because it does limit the things you can say.

A comment made about the emojis as a communication method was that it could be experienced as somewhat childish or frivolous. The participant explained that in a lower grade setting, they would think the emojis would be perceived as fun and engaging, while in university or work situations, they may make the game seem unserious. The participant said that they thought the emojis would work fine in many cases, but perhaps not in all.

The meaning of the emojis was also discussed with the participants. Only within the group of four test persons, the meaning of some of the emojis was interpreted differently. The "thinking" emoji circled in Figure 35 below, was by one participant understood as meaning something along the lines of "should we consider this option more", while another read it as meaning "I think you're foolish for thinking this".

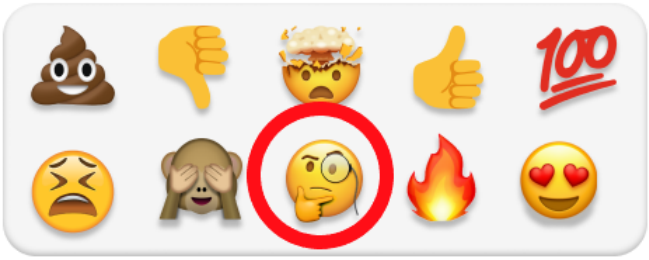

Figure 35: Emoji keyboard, with above mentioned "thinking" emoji circled in red.

This issue was commented on specifically by one of the test persons. This participant said they have a lot of experience with pre-teens and teenagers, particularly in social media and online. They said that the following about the meaning of emojis for this demographic;

"Emojis can change meaning over the course of a few hours for an entire age group, and what emojis are "popular" and not changes continuously. For instance if a celebrity uses them for something specific, if a song mentioning one is released and becomes popular or by any sort of online or "viral" trend."

Although this participant said that they were not aware of any particular trends or meanings related to the emojis used in the prototype, they would recommend being cautious using the standard iOS or Android emojis.

Table 10 below provides a more complete summary of the concepts brought up and discussed in the user testing sessions. The table is sorted after what concept each comment related to, and similar comments made by the different participants are merged where suitable.

Concept	**User feedback**
Navigation and flexibility	• Prior familiarity with Kahoot! made navigation easy, and simplified the learning curve for the system. Most of the functionality was easily recognized. • The possibility to move your own emojis after placing them was requested. • The emoji attached to your vote remained with the original answer if the vote was moved. This caused some confusion.
Team interaction	• In the discussion part of the voting process, it was easy to see who answered what, and thereby who got the answer wrong. • The animals contributed to a positive team feeling, along with the naming. One test person said it felt as if everyone was given a character to play, which was a fun observation. • Two of the participants specifically pointed to the team interaction as contributing to increased learning. It was useful to see what the other teammates had answered, both to evaluate your own response, but also as a form of repetition. It helped to remember the questions and answers after the game was finished.

Voting and communication	• The majority of perceptions of the emoji reaction and communication solution was positive. Two of the participants pointed out that they enjoyed being able to react to their own votes, which was an unexpected feature. • One participant experienced the discussion session as somewhat chaotic, and said that it took a couple of question rounds to understand and get used to. • Due to the colors of the voting buttons, it is easy to see who voted what. This can be positive because you know more of what is going on, but also have negative consequences. It might make it more interesting for children especially to try and figure out who was who in the game. This again may lead to bullying if someone did poorly in their team. • Also related to the identification of each button vote, a player may feel bad if they get a lot of negative reactions to their vote. This could also be mitigated by the votes being completely anonymous. • The available emojis were perceived as sufficient to get a point across to the other players. Although the communication is somewhat restrained by only being through emojis, you do have everything you need to say in the game. • One thing to consider is that emojis may mean very different thing to different people. They also can change meaning with trends, and so using custom emojis or symbols could be safer.

Design and layout	• The animal characters were very popular with test persons. The bright colors and friendly faces gave the game an overall fun and positive atmosphere. The initial display of teammates in the lobby gave the expectation of something fun coming. • The emojis also added to the "fun" design of the game, with bright colors and a playful expression. Emojis give association to humor. • The color of the initial emoji panel that appears when the players add an emoji to their vote was mentioned. The panel is a lightened version of the color of the answer, which was experienced as cohesive. • The bright green color of the check marks was by one of the test persons understood as indicating that everyone got the answers correct. • Music and audio effects were missed from the prototype, and suggested as a tool to support or clarify some of the events in the game.
Instructions	• It was unclear for several of the test persons that the emojis in the discussion part of the game needed to be dragged and dropped. • One of the participants did not register the mention of being able to change your own vote in the instructions screen. This caused them some confusion in the first discussion session. • Several of the participants answered that they liked the way the instructions were formulated in a positive and informal tone. It made them feel more like tips and help than instructions. • A comment about the instruction screens was that they contained quite a lot of information to read. A suggestion was also made to only display the whole instructions for the discussion once, and then shorten the text for the following questions.

Motivation and engagement	• All participants said their motivation was increased by the presence of teammates. You feel more motivated to complete the task and score points, because you don't want to disappoint or bring down your team. • Engagement specifically was mentioned as affected by the collaborative nature of the game, because the desire to win is amplified when the competition and winning is done collectively. • The check marks of the other teammates in the initial voting part also contributed to the participants feeling motivated to answer quickly. • The two hat badges were mentioned as being motivational. Both because it was fun to see your character wear them, but also because initially not knowing what they represented sparked curiosity. • The team reveal at the end of the game was mentioned by all four participants as a fun addition to the game experience. It was described as contributing to the players' desire to win, and thereby both motivation and engagement.

Table 10: Summaries of feedback from the user test sessions.

6 Discussion

The discussion section of the thesis will start off presenting a taxonomy of different concepts and ideas encountered throughout the project work. Each concept is explained, and its implementation or discarding is justified. Further, the first iteration of the design and development process is discussed. Findings and decisions are elaborated on, and changes going into the next iteration are explained. The second iteration and the discoveries and decisions made in this phase are then reviewed. Where applicable, opportunities for further exploration and adaptations to a possible third iteration are proposed.

6.1 Taxonomy of concepts

Throughout the process of design and creation, a number of concepts relevant to the product were brought to light and evaluated. Some of these were implemented into the final suggestions, whilst others were considered unfitting or out of scope. During the formation of the product, weigh offs were made to answer to the discoveries made in the focus group and user tests, while also having support in former research and literature. In order to clearly justify the decisions made, a taxonomy of the concepts is presented in Table 11 below, discussing the reasoning for each suggested concept, and the assessment of its feasibility.

Concept	Reason for suggestion	Evaluated feasibility
Anonymity	The idea of keeping teammates anonymous was sparked from the initial plan of keeping the first round of votes anonymous. However, allowing the players to be anonymous throughout the entire game phase could facilitate the learners to be more unafraid and dare to voice their opinions, without the risk of being blamed for potential errors.	The anonymity of workers or learners in a collaborative setting is a tried and tested concept. Wikipedia is an example of a platform that utilizes this [Jeong and Hmelo-Silver, 2016]. There are both benefits and weaknesses to this approach. Some of the benefits are, as suggested, the potential increase in confidence when learners can operate without the fear of retribution from classmates if they make mistakes. Often, as in the case of Wikipedia, the identity of those an individual collaborates with are irrelevant to the learning outcome. In these cases anonymity may help reduce the complexity of the collaboration, removing one variable from the learners' cognitive load.

Communication with emojis	As Kahoot! is a platform much used by children, some rules and guidelines must be followed when it comes to user input. Bullying or otherwise profanities should be avoided, in order for the game to be an inclusive and fun experience for everyone. Additionally, smaller children or those with writing disabilities should be considered. A suggestion to address these concerns was to use emojis or pre-defined phrases as a form of communication. Younger learners particularly are often used to conveying meaning through the use of emojis, GIFs and symbols, which may therefore simplify the communication for them. Another benefit of replacing textual communication with symbols or emojis is that it can make the product feel more like a game, rather than a gamified experience.	For a platform like Kahoot!, maintaining the fun and engaging atmosphere around the learning is key. The idea of using emojis or symbols as a method of communication was therefore welcomed in the focus group. A goal of the new game feature is to encourage collaborative learning, while keeping the game fun, fast-moving and competitive. Removing the hurdle that some players may experience by having to type comments and messages was therefore viewed as a positive change. Although emojis may not be sufficient to communicate any and all messages, the informal and fun nature of the game may not require more than they can provide. The added benefit of making the game available to all learners regardless of age and typing skills was also considered significant. Using emojis for communication takes away some of the "risk" students may experience of mistyping, typing too slow, or merely writing the wrong thing.

Reveal of teammates after game	Following the suggested concept of keeping team players anonymous to each other throughout the game, the idea of revealing the winning team members to each other at the end of the game was proposed. By only revealing the top team or teams, any learners who did not perform their best would be allowed to remain anonymous, while those teams that were able to collaborate and perform well could be applauded.	The revelation of the top teams at the end of the game was discovered to have more benefits than those brought up in the initial discussion. The excitement of finding out who was on your team if you won the game is a valuable motivator to preform well. During the game, the learners are communicating and collaborating, and the reward of getting to know your teammates at the end is an enticing prize. In physical classroom settings, this announcement of the winning teams can also be a form of community building within the class. Having learners who may not usually collaborate work together anonymously, and then be revealed as each other's teammate may even establish new friendships, which again facilitates a social learning environment. Also in larger lecture hall settings, this could be an exciting aspect, collaborating with strangers and then being introduced by having won a game together.

Team mode during live games	Kahoot! is traditionally a platform most used for live games in classrooms and other physical gatherings, especially before the pandemic. The question was therefore raised about how the suggested KTM solution could be implemented to work in live game situations as well. Although these types of games have decreased in frequency due to the current situation, learners are now returning to classroom and live audience situations. Designing a solution only for use in remote settings could therefore be considered short-sighted.	In order to keep the scope of the project manageable, a live game solution for team mode would have to be integrated in the final solution, rather than developed as a separate concept. The final product suggestion is not dependent on the players working remotely and can already be used directly in a classroom setting as well. The team reveal feature is best suited for live, co-located games, as the players need to be able to see each other's screen to find their teammates. The technical requirements may however be an issue for playing KTM in a classroom. The current solution is adapted to larger screen resolutions, meaning that students would need to bring their own laptop or tablet to class if not provided by the school. Regular Kahoot! live games only requires the students to have their own mobile devices. For the anonymity to play its role in the game, the students should also preferably be able to position themselves in a way so that classmates are not able to view each other's screens.

Team mode during video conferences	Another way to play a kahoot "live", while in a distributed setting is during video conferences or meetings. Playing kahoots has been a popular way of connecting with friends, family or coworkers during the pandemic, and the current live solution works well for this purpose. A lot of teachers and lecturers also uses video conferencing as a replacement for classroom settings, and the team mode solution should be adapted to work for this as well.	The suggested KTM is designed to work well in a live distributed setting, also during a video lecture or class. Initiating the game live and simultaneously for all teams, the competitive aspect would be even more engaging, as scoreboards and the podium would be updated in real time. As the players have all the information to play the game available on their own devices, they are not dependent on viewing a shared screen by their teachers, which could complicate the game experience. The team reveal would also work in this setting, as the winning team members could either share their own screens for the reveal, or otherwise signal to the rest of the class.

Two-step voting process	The two-step voting process was one of the original suggestions, aiming to let the players make an individual assessment before entering the team space. This modular method, as described by Swanson et al. [2019] has been found to both support an individual sense of control and contribution, while also allowing the players a second chance to evaluate their work. Additionally, the two-step voting could work as a repetition for the players, aiming to increase the learning outcome of the game.	Implementing the voting process modularly, with different activities in each module, is a tactic very much supported by literature. The individual first vote eliminates the risk of confirmation bias and allows all players an equal say in the discussion. The additional reaction added to this first vote also provides the players with a better starting point for the discussion. There is more information available, in addition to the initial votes, which expands the teams shared mental space, and gives a better context for discussion. The players are free to change their own votes during the second stage of the voting process but may also chose not to. The input and shared knowledge by their teammates will be what influences their decision, and the weight that the players place on their teammates input versus their own knowledge, will be up to themselves.

Reactions to teammates' activity	During the focus group, based on the suggestion of moving away from written communication, the concept of reactions was proposed. Reactions are common in a lot of major communication tools today, and therefore familiar to many of the players. The idea was that the players could "fight" for their opinions by reacting to the votes of their teammates, and the image of "throwing poop emojis at things you knew to be wrong" was used as an illustration.	The emoji reactions ended up being one of the biggest changes between the first and second iteration. A valid argument was made that the need for extensive communication was not relevant, and that it could potentially even make the game less fun. The main things needed to be said in the discussion module of the game may just as well be communicated through emojis or symbols, as reactions to votes, answer options or to other reactions. The dismissal of written communication could also solve the issues of bullying, bad language and students struggling with typing.

Table 11: Taxonomy of evaluated concepts and reasoning for their implementation or discarding.

6.2 First Iteration

The first design iteration was as mentioned based wholly on the literature review performed for the background theory, as well as some informal conversations with members of the Kahoot! staff. As the game to be designed was meant to fit in with the existing Kahoot! platform, preferably with little technology overhead, the solution was designed within relatively strict confinements. The main focus during this design process was to find an efficient way for players to collaborate on a kahoot, while playing remotely.

As the evaluation performed in the first iteration was a focus group, rather than interactive user test, the results to be discussed come with some uncertainties. The results consist of the opinions of adults with a lot of experience with the Kahoot! platform. They therefore cannot be viewed as impartial user data, and must be seen rather as reflections based on experience. Hence, any certain claims or conclusions based on these results cannot be made. However, their contribution to the development of the final solution will be discussed.

Aiming to form a foundation for answering the first research question of the thesis, concepts and mechanisms to increase the players' learning outcomes should be investigated. During the focus group, the introduction of a two-step voting mechanism

was applauded. It's potential for peer to peer knowledge exchange was pointed out, which is an important aspect to increase learning outcomes in team based learning. In the discussion part of the voting process, the stage is set for the stronger students to help the weaker, through co-construction and a shared knowledge space. This provides support both for the weaker learners to be able to perform better and gain confidence, while also allowing the stronger learners to use their knowledge to contribute to the success of their team. Additionally, the two-step modular approach forces the players to actively think about the question to be answered for longer, while simultaneously performing different tasks. This elongated exposure to the topic, with active interaction in two stages may make the information easier to absorb and retain.

The concept of anonymity was also mentioned in the context of learning outcome. Playing anonymously could give the players the confidence to participate more actively than they normally would, which again could lead to increased learning outcomes. Eliminating the risk of bullying or being "run over" by stronger students, may give a voice to those who may normally keep in the background.

The feedback on the collaborative and social aspects of the solution was predominantly on the communication form, that is, written versus symbolic communication. Initially, this was brought to light after a focus group participant voiced a concern about GDPR for children or young students typing freely to each other. KTM should be a safe space for all learners or players, free of bullying and profanities, and the avoidance of textual communication may ensure this. Another reasoning for using emojis or symbols was that it could make the solution more fun, hopefully making it a collaborative game that people would actually want to play. A pitfall of using gamification in education is creating learning tools with some gamification concepts, rather than an entire cohesive game. This was brought up in the focus group and indicated to be an important consideration for the solution.

The focus group participants seemed unanimous in that the social aspect of communication could well be maintained without textual interactions. They also suggested that using emojis may make it easier to defend your position in the discussion, as the players don't have to worry about formulating arguments, or that their negotiations are affected by their ability to type. This puts all the focus on the topic and votes, rather than on who is the better negotiator.

One addressed problem with Kahoot!'s current team mode solution is the issue of one or more students overriding the rest of the team, and the weaker students feeling left out or demotivated by this. The suggested two-step voting process also has the benefit of allowing all players to contribute equally. Not only is each vote counted and valued the same, classroom biases are also removed. As expressed in the focus group, this is seen as an effective way of "giving everyone a voice", and could contribute to an important confidence boost for students who lack the courage to speak up.

Gamification concepts were less focused on during the first design iteration. The initially proposed solution mainly utilized the already implemented game concepts by Kahoot!. Still, a number of interesting suggestions and ideas to advance the game experience were brought to light by the focus group. Following the suggestion

of anonymity throughout the game, the idea of having a team reveal at the end of the game was posed. Rewarding the winning teams with the ability to reveal their team could be a fun way to even further motivate the players to win. This new functionality could be very interesting to try and test both in classroom or lecture settings, but also in live remote online settings. For asynchronous games, that is, the teams playing asynchronously, the team reveal would be less suited, as there would be no shared, live display for the players.

The timing and scoring are important parts of the game's progress and dynamics. The focus group participants argued that the timing aspect would be just as important in the collaborative version of the game. Keeping the excitement and engagement up is a challenging task in a distributed environment especially, and timing could help with this.

The question of individual points was brought up in relation to this. There should be some reward or points for getting the question right quickly, similarly to in the traditional Kahoot! gameplay. If not, the players may end up answering the question at random individually, and then merely correcting their votes to the opinion of the team in the second part of voting. This undermines the first individual assessment, which is an important part of supporting the learning outcome. This concern was addressed moving into the second iteration, both in the scoring system, and by introducing the "hat badges" in the game.

6.3 Second Iteration

After processing and systematizing the feedback from the focus group, several changes were made to the solution, as presented in Section 4 Implementation. The second design iteration took form in an interactive prototype, which was used for more in-depth user tests. Although these tests were done with the participants being able to interact with the prototype, and thereby get a more realistic experience of the game, the results from these tests also lack some validity. Only four tests were carried out, which is not a sufficient number to make any final conclusions. The main focus was therefore on the exploration process. Additionally, due to external factors, only university level students were recruited for the test. Ideally the solution should have been tested on students of multiple grade levels, preferably in real collaborative settings. The scope of time for this project did not allow for this however, and any assumptions or claims made about impact on learning outcome, motivation and engagement are made with the limited user testing in mind. The validity of the results should therefore be regarded with care.

As for the learning outcome, the user test participants understandably struggled to make certain claims. More extensive testing would be needed to sufficiently answer RQ1, and the feedback from the test sessions will consequently only be evaluated as subjective experiences. The team interaction was said to have an increasing effect on the learning outcome, by the players being able to see what their teammates had answered, and to reassess their own vote in context of the available information. This claim emphasize the effect of supporting shared knowledge awareness and co-construction in the collaborative process.

Viewing the question and answering twice, but in different situations was also thought to have a positive effect, by making it easier to remember the questions. This indicates that the two-step voting process in itself may also have a positive effect on learning outcome, and substantiates the idea of TBL facilitating better learning. Although these results cannot be used to make any definite conclusions, they do speak in favor of this modular structuring of the game being an interesting area to explore further.

One of the main discoveries made in the first design iteration was the possible misconception of the need for written or verbal communication. As was suggested in the focus group, to make the game both accessible and safe to use for children, the chat functionality may be considered ill-advised. Communication with emojis, as implemented in the second iteration was therefore a much-discussed topic during the user tests. Although mostly positive, the test participants did have varying opinions of them. Consequently, a general assumption of their suitability cannot be made, but the results again form a compelling argument to explore and test the feature more elaborately.

The emojis were not only perceived as contributing to the collaborative and teamwork aspects of the game. The user tests also revealed that they were experienced more as a game concept than regular written communication. As the test participants were all university students, and presumably among the older groups of learners, this may be seen as a good indication that younger students might also experience the emojis as fun. Regardless, this assumption should be tested explicitly to make any certain arguments. Particularly the comments made about the different meanings that emojis may hold should be investigated more in depth. A possible solution to this issue could be to design Kahoot!-specific emoji-like symbols to use instead.

The comment about the emojis' "seriousness" should also be taken into consideration. The intended target group for the solution are students and learners, primarily focusing on university level and below. The purpose of designing for this group is to make a fun and engaging game, and maintain learning without making the experience too serious. The above mentioned concern could therefore holds less relevance, but should be investigated for the sake of business users and workplace training situations. These use cases may call for a more complete communication system within the platform, and this prospect may be a case for further research.

With respect to RQ2 and the social dynamics in the game, the choice of animal avatars seemed to be a positive addition. Especially in a game context, playing as avatars or characters is to many a familiar concept. The use of animals, with already associated human-like characteristics was intended to allow the players to experience their presence as a social environment. The user testing revealed that they did give a sense of a "team feeling", with the initial naming of the characters also contributing to this. This feedback points to the mechanism of personifying anonymous players through avatars having the intended effects of increasing the players' sense of community and mitigating the removal of the players' identity. Designing Kahoot!-specific animal characters to use in KTM should be considered.

As another attempt at easing this reduction in immediacy between the players, the

color correlation between the characters and their votes was introduced in the second iteration. During the user testing sessions however, the participants made several interesting points about the risk of being able to identify the votes to the characters. Part of the intention of keeping the players anonymous in the game was to allow them to participate without the fear of being bullied or picked on if they don't do well. Similar worries were voiced for the check marks adjacent to the players' avatars when they completed a stage in the game. If the positive contribution to the players' mutual awareness is outweighed by this concern, the design features should be changed. This will need to be investigated further, with the results from the user tests pointing to less identification between animal avatar and in-game behavior.

Gamification concepts were more in the spotlight during the second design iteration. In the focus group it was pointed out that there should be some incentive to perform well in the individual round of voting. The Speed helmet badge was introduced for this purpose. In the user testing, all participants were excited by this, although they had somewhat varying reactions to it not contributing to their points or rankings. Seeing their animal character wearing the hats was reported to add a fun element to the game, and when they lost it, there was a desire to win it back. This is an indication that the badges could have a positive effect on engagement in the game. The Speaker hat was introduced at a later stage in the user test sessions and was also received with excitement from the test participants. However, as the prototype was made with limited opportunities for action, the test persons were not able to realistically compete for the badges. These results must therefore also be researched further in order to make more certain claims. As the badges are only awarded for positive contributions, the identification of what animal characters won them was not considered a problem, as was the case with the above mentioned voting and progress indicators.

The scoreboards in the prototype were more or less exact replicas of the scoreboards in an original game of kahoot. They were therefore not focused on specifically during the user tests. Previous research mainly points to them having a positive impact on motivation and engagement, and they were therefore implemented into both iterations of the prototype. Additionally, the scoreboards are an essential part of the known and loved Kahoot! experience and contributes to the new solution integrating well with the existing platform.

The team reveal at the end of the prototype game was also positively received. Although this specific mechanism was not explored as an element of gamification in the background theory, it was experienced as a fun contribution to the gameplay by the test participants. It facilitated motivation and desire to win, which are important aspects when designing games for education. As this concept was introduced based on discoveries made in the focus group, and not purely based on literature or user testing, it is not adapted or optimized to distributed learning. In an online classroom setting where the students and teacher are present through video transmission, the current solution would work. However, the game is also intended for use in situations where students are assigned collaborative kahoots to play at their own time or when video is not available. For these cases, other solutions to achieve the same motivational reward as the team reveal poses should be explored.

7 Conclusion and Future Work

This section will present any conclusions or discoveries made through the course of the project work. The research questions introduced in Section 1.3 Research Questions and Objective will be answered to the best possible extent, and concluding remarks about the project will be made. Finally, suggestions are made for future work, and the project's implications and contribution to knowledge will be discussed. Limitations and validity of the results are also evaluated.

7.1 Conclusion

As explained in Sections 6.2 First Iteration and 6.3 Second Iteration, no definite conclusions will be made based on the results of this research, due to the limited extend of testing. The goal of the thesis was to explore mechanisms of team based learning and gamification, and their impact on learning outcome and engagement. Therefore, reasonable assumptions or relevant observations will be made where possible, in order to provide some insight into the research questions asked.

The first research question asked **what mechanisms should be in place to facilitate learning in a gamified, distributed collaborative setting.** A considerable contribution to learning outcome, as presented in the evaluation phase of the research, was the two-step voting mechanism. Being able to re-assess a vote, evaluating individual effort in context of their teammates contributions was reported to have a positive effect on learning. This modular process also functioned as a form of repetition of the question and answers, making it easier to remember the content for later. However, it is difficult to make any statements about what effects the gamified elements of the solution may have on learning specifically.

Research question two addressed the concern of **how social dynamics [can] be maintained and supported through gamification of distributed collaborative learning.** The results from the evaluation pointed to the presence of teammates in the form of animal avatars having a positive impact on the players' sense of immediacy to their peers. The communication with emojis was met with a somewhat mixed reception and should be further tested on a wider audience. However, the evaluation did in summary suggest that the team interaction strengthened the learners' motivation to participate. The players' engagement was increased by the sense of working collectively towards a common goal, substantiated by the communication and interactions. Based on the results from the user testing, the social dynamics in the game were reported to be sufficiently maintained to make the players' want to perform better and win for the sake of their team.

The final research question was focused on **what mechanisms from gamification [may] effectively promote engagement in a distributed, collaborative setting**. The badges in the game, i.e. the two hats, were evaluated to be engaging additions to the game experience. Although their value with regards to points or other benefits could be reconsidered, their effect was present for the test participants also without points. The design process further explored the mechanisms of anonymity and a final team reveal. Following the two-step voting and emoji discussion, these features were perhaps the most novel, and therefore interesting to analyze. The team reveal was positively received by the test participants. It was described to contribute additionally to motivation and engagement in the game, making the players even more eager to win, to get to unveil their teammates.

The anonymity in itself was assessed to potentially have beneficial effects on student confidence and willingness to participate. With regards to gamification however, the impact was mainly explained by the choice of the animal characters as personifying avatars. Their colorful look gave the players an expectation of fun, and contributed to the solution feeling like a game, rather than a learning tool.

7.2 Contribution to Knowledge

The fields of team based learning, computer supported collaborative learning, and gamification are already much researched areas within the field of education. The contribution of this thesis will therefore be bridging these topics and aiming to make new discoveries of how the combined theory can form a basis for novel design suggestions. These suggestions are made with the objective of being implemented with the Kahoot! platform but should also have potential for application in other situations. Similar or equal implementations of the combination of concepts and mechanisms applied in the suggested Kahoot Team Mode have not been found. The discoveries made from testing these mechanisms may therefore be claimed as novel, and thereby contribute to existing knowledge within the fields.

As previously described, the testing performed in this research is not sufficient to make any certain claims of new knowledge. Hence, the discoveries made should be viewed as indicators and suggestions to base future research on, rather than foregone conclusions.

For Kahoot! as a company, the Master's thesis may contribute by making suggestions of several new mechanisms that may be integrated with the platform. As one goal for the learning platform has been to better support collaborative learning, the project work may serve as an entry way into the fields mentioned above, supplemented by the suggested and evaluated features.

7.3 Future Work

As formerly discussed, the main limitation to the validity of the results discovered in this project has been the test capacity. A much more extensive testing phase would have provided a better foundation for making conclusions and novel discoveries. Both due to the restrictions caused by the Covid-19 pandemic, and the limited time

scope, wider testing was difficult. If granted more time and flexibility, user testing of the solution with entire school classes or university courses would be optimal. The testing should be performed both in co-located settings, to test the solutions functionality in live game situations, as well as in distributed settings, with and without video transmission.

To be able to carry out the above mentioned tests, a higher fidelity prototype would be needed. The current prototype is limited in functionality, and only mimics the presence and interaction of teammates. A functional prototype should therefore be created in order to get feedback on how the collaboration would be experienced in a realistic setting.

Some of the feedback brought to light during the user testing sessions were on specific design solutions and details that should also be modified moving forward. The identification issue discussed previously with regards to the votes and the check marks should be addressed and improved. Instructions given to the players could be clarified and tested further, ensuring that all players will be able to play under equal conditions and with the same information.

7.4 Project Evaluation

The goal of the project was initially to develop a fully functioning prototype of a Kahoot Team Mode solution, and to be able to test it on a class of students in realistic settings. However, as the project work unfolded, it became clear that the development of a functioning and testable prototype would require far too much time. A significant amount of work and time was spent setting up a code base and data base for the solution. However, this work was discarded after the above mention realization. The main problem with this approach was that the development of the suggested features, i.e. the new features that would in fact be interesting to test, were not feasible within the time scope of the project.

Additionally, the test plan was affected by the social distancing regulations due to the pandemic. Testing with a group of children or students in real time would not be possible, and an alternate testing solution was developed. As social distancing rules made sharing a laptop and testing with sufficient space difficult, the user tests would have to be done via a video conferencing tool. Recruitment for this also proved to be more challenging than expected, resulting in the test group being relatively uniform. This severely affected the usability of the results from the tests. It was not considered reasonable to draw conclusions on behalf of all learners, based only on feedback from university students.

The overall scope of the project was from early on concentrated to the design and development of a limited interactive prototype. The presence of teammates was emulated through the dynamic prototype, reducing the complexity of simultaneously monitoring multiple users via video link.

Ultimately, despite all obstacles and changes of course throughout the project, working with this master thesis has been a positive learning experience. I have gained a much greater insight into the process of design and creation, particularly the value

a focus group may have in early stages when developing for an existing company or solution. Having access to the knowledge of people who are highly experienced within the fields of gamification, education technology and the Kahoot! platform in general was very valuable. I believe I was able to get the most out of the session both in terms of feedback on my current suggestion, as well as discussing ideas for progression and improvement. The feedback from this session was largely deciding for the changes and design suggestions made moving into the second iteration.

The user testing sessions were also worthwhile, but as suggested by Oates [2006], it was more difficult to get feedback on the mechanisms and general concepts of the game with the more finished design prototype. A lesson learned for the future was the importance of being more specific about what aspects I am seeking feedback on, and work better to steer test participants away from getting hung up on lay-out, color choices and design details. Additionally, note taking proved to be more challenging in a one-to-one setting, and other methods of documentation of the user testing should have been considered. Nevertheless, the results that did come from these sessions were undoubtedly valuable, and some important suggestions for future improvement were made.

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Appendix

A Wireframes

The complete set of wireframes shown in the focus group are displayed in the presented order in figures 36 to 42 below. Figure 43 is an image meant to illustrate a higher fidelity prototype, using Bitmojis as avatars.

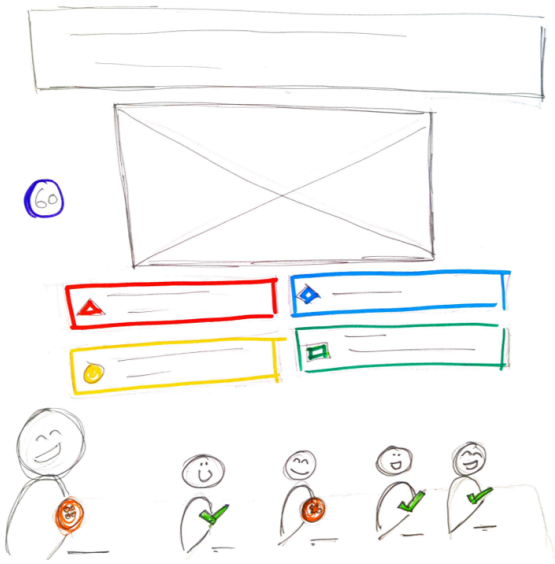

Figure 36: Initial voting session, where some of the players have finished answering.

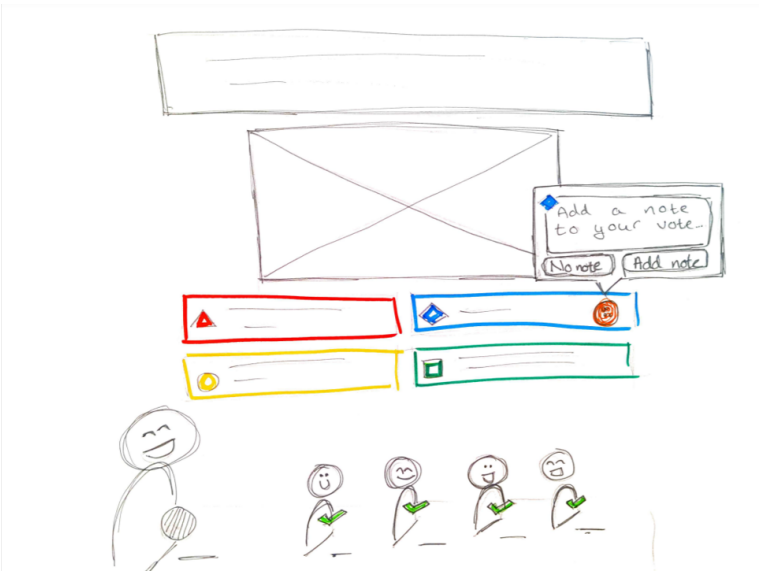

Figure 37: Player have selected an answer option and is prompted to add a note to their vote.

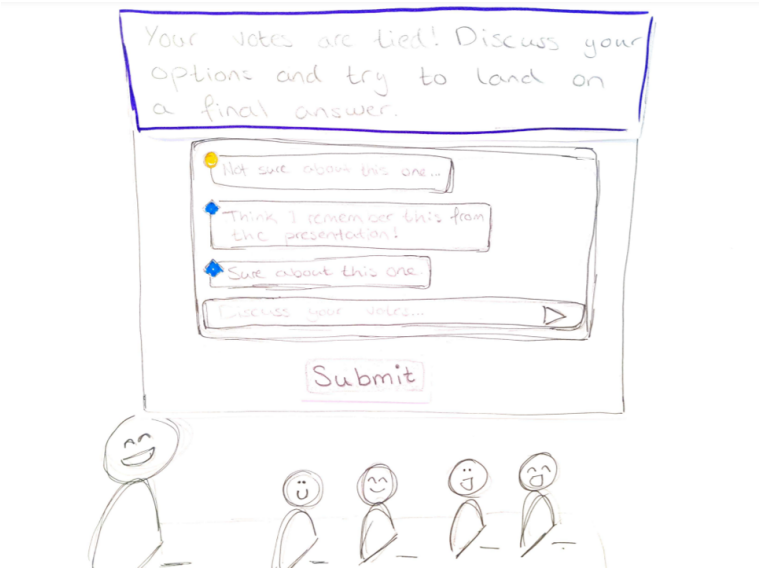

Figure 38: Initial discussion screen, with modal for tied votes.

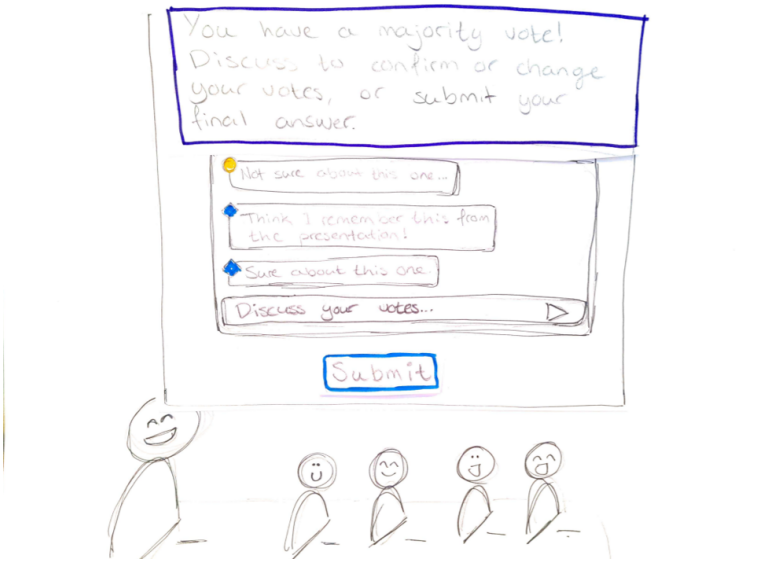

Figure 39: Initial discussion screen, with modal for a majority vote.

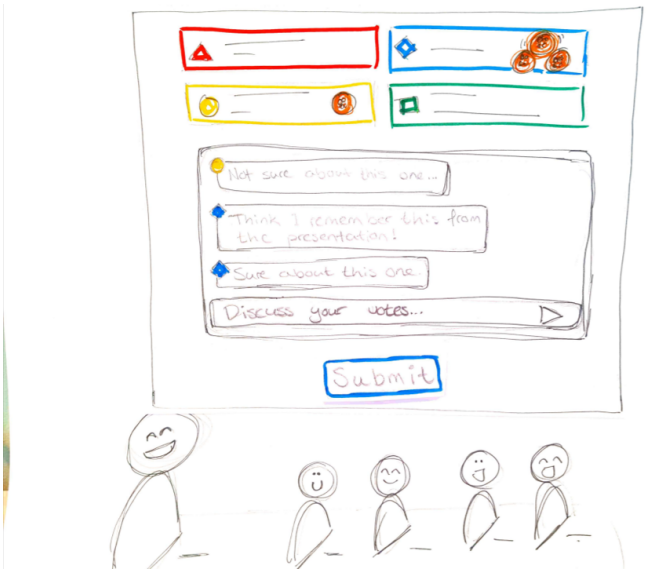

Figure 40: Discussion screen where votes are displayed and chat function is available.

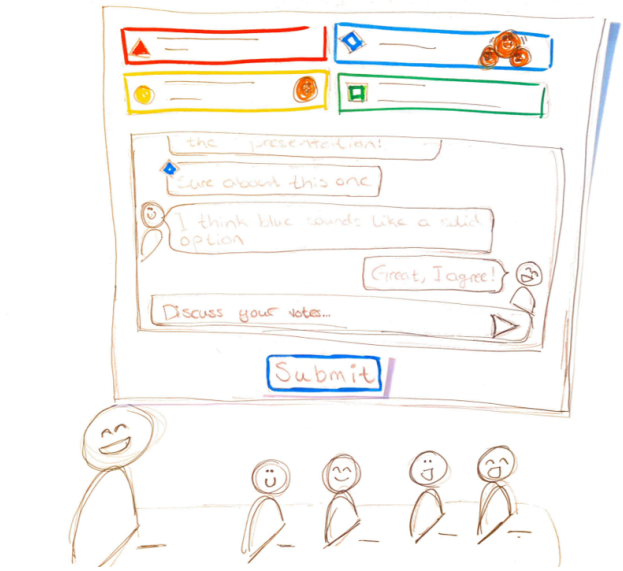

Figure 41: Discussion screen where players are negotiating their answers.

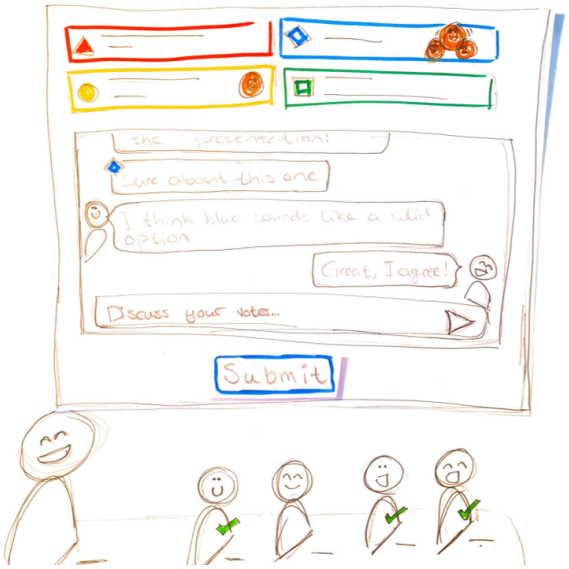

Figure 42: Discussion screen where some players have submitted their final votes.

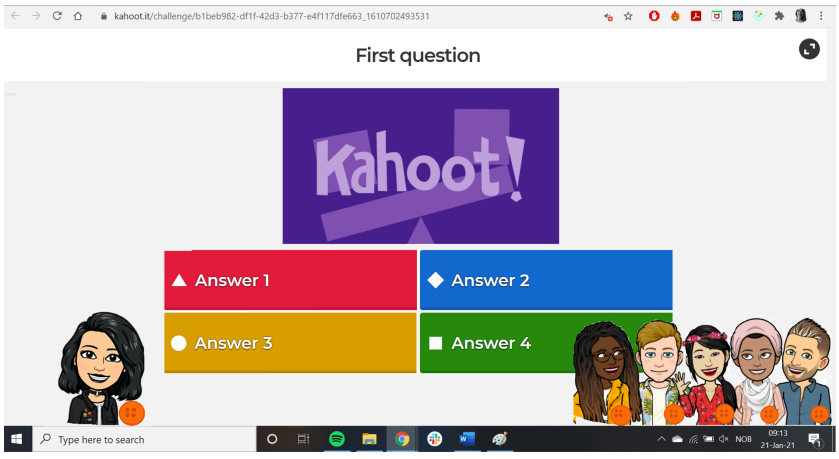

Figure 43: Higher fidelity example illustration of the wireframe.

B Animal avatars

Figure 44 below is the complete set of animal characters used for the Figma prototype in the second iteration of the design process.

Figure 44: Animal characters downloaded from www.pngfree.io. Licensed for non-commercial use.

C Prototype

A selection of screenshots from the prototype not previously displayed in the paper are presented in Figure 48 to 62 below, with explanatory captions.

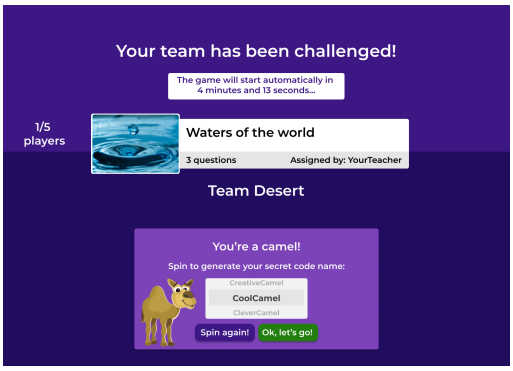

Figure 45: Lobby where players may spin to generate a different code name, or join the game.

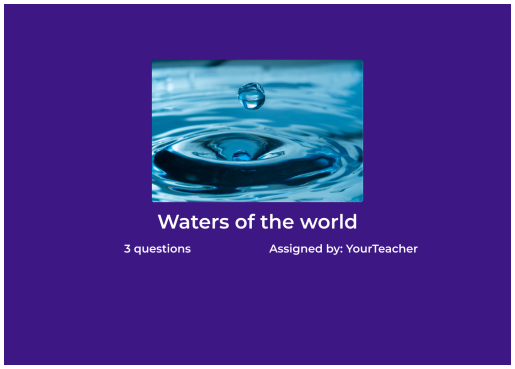

Figure 46: Information screen shown after lobby, before the first question.

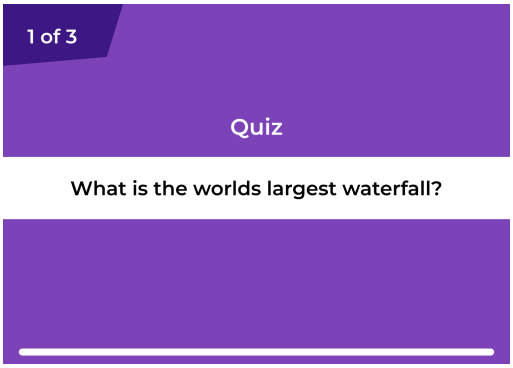

Figure 47: Intro to the first question.

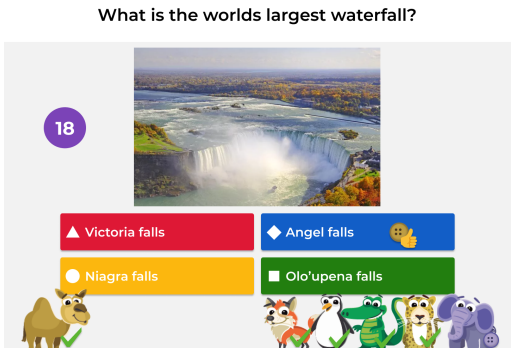

Figure 48: Initial round of voting for the first question. All but one player have finished casting their votes.

Figure 49: Discussion round after first question. All players but one have submitted their vote.

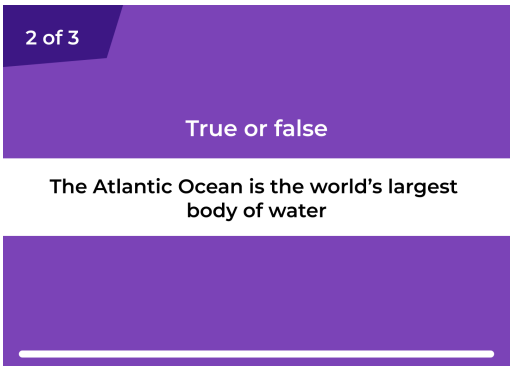

Figure 50: Intro screen to the second question.

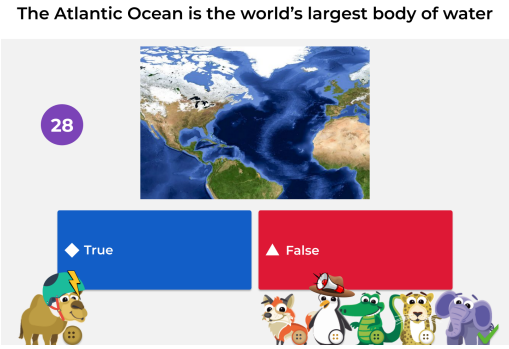

Figure 51: Initial voting round of the second question.

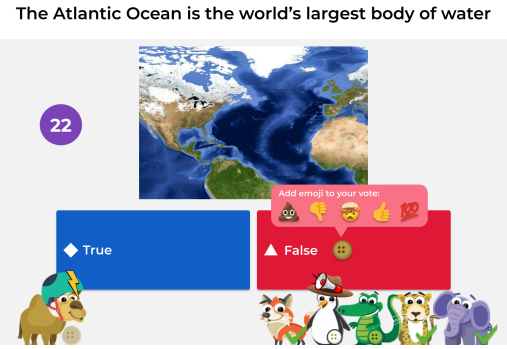

Figure 52: Initial voting round of the second question. Player is in the process of casting their vote.

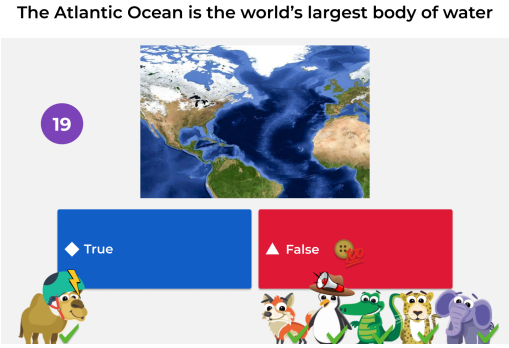

Figure 53: Initial voting round of the second question. All players have cast their votes.

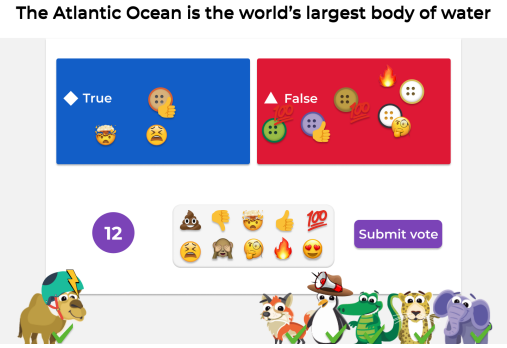

Figure 54: Discussion round after second question. All players have submitted their votes.

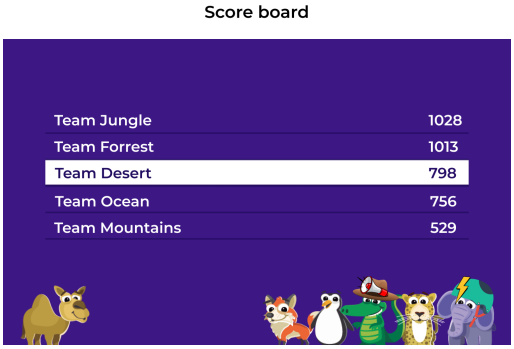

Figure 55: Scoreboard after second question.

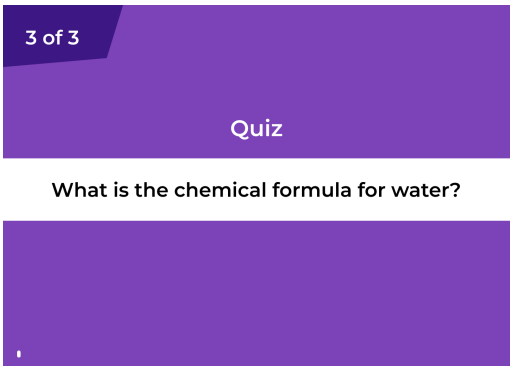

Figure 56: Intro to the third question.

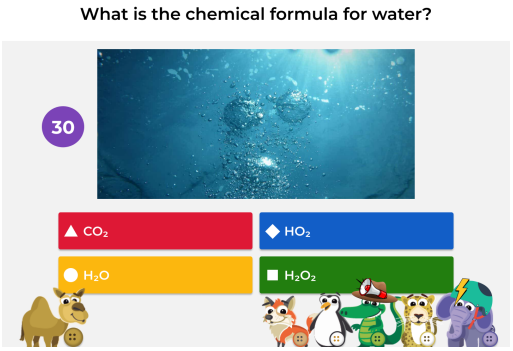

Figure 57: Initial voting round of the third question. No players have cast their votes yet.

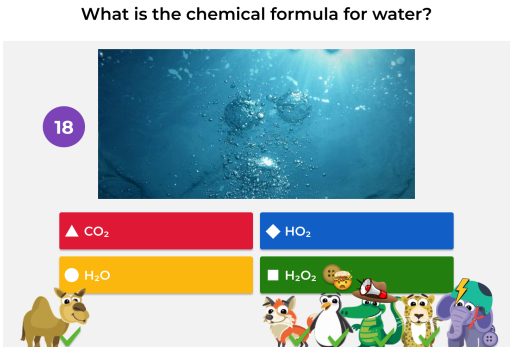

Figure 58: Initial voting round of the third question. All but one player have cast their votes.

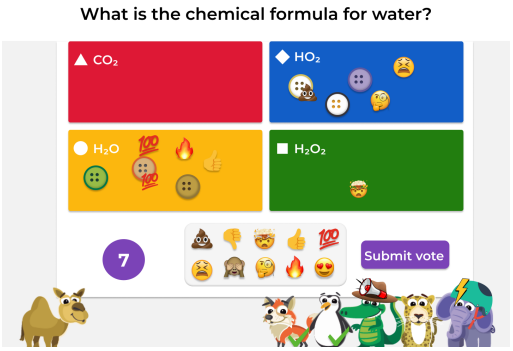

Figure 59: Discussion round after the third question. Two players have submitted their answers.

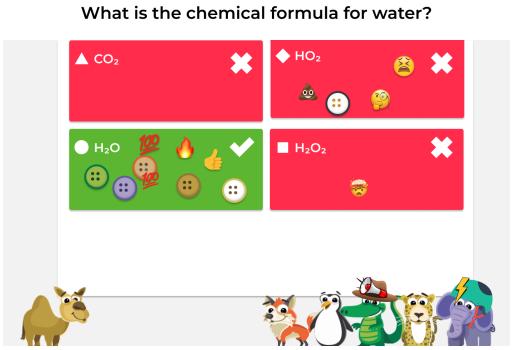

Figure 60: Answer reveal after the third question.

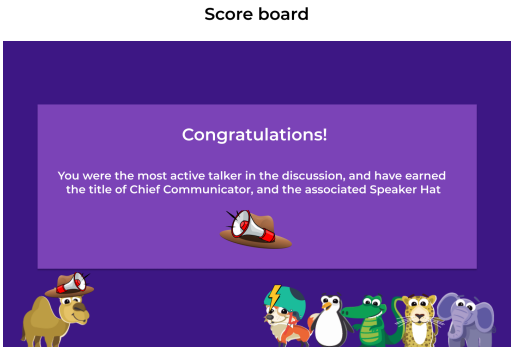

Figure 61: The Speaker hat is awarded to the player for top participation during the discussion session of question three.

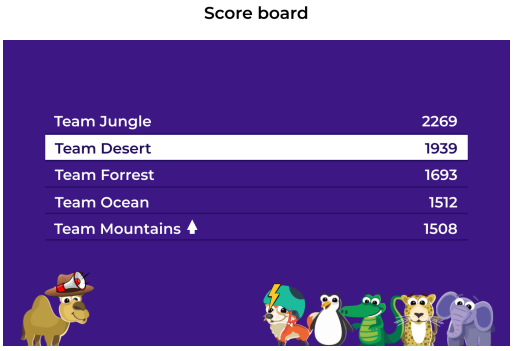

Figure 62: Scoreboard after the third question.

D User Test Questions

This is the complete list of questions prepared for the participants during the user testing sessions in the second design iteration. As the interview part of the user test was planned as a semi-structured interview, the order and inclusion or exclusion of some of the questions varied. The questions were asked in Norwegian, but have been translated to English for consistency.

1. How familiar are you with Kahoot! and the way it is used in education today?
2. How would you describe you experience level with technology and online solutions such as Kahoot!?
3. Did the system work as you would have expected?
4. Did you encounter any navigation issues or other pain points?
5. How did you experience the interaction with your teammates?
6. What did you think of the way of communicating with emojis only?
7. How was you engagement affected by the collaboration with your teammates?
8. How do you think the collaboration could affect the learning outcome when using this solution?
9. What did you think of the instructions given throughout the game?
10. Do you have any thoughts about the layout or design of the game?
11. Was there anything you particularly liked about the solution?
12. Was there anything you particularly disliked about the solution?