A user centric approach for evaluating and enhancing the usability of a complex real-time web user interface

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En användarcentrerad metod för att utvärdera och förbättra användbarheten av ett komplex realtidswebbgränssnitt

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DA225X Degree Project in Computer Science and Communication, Second Cycle, 30 credits
Degree Programme in Computer Science and Engineering, 300 credits
Master’s Programme, Human-Computer Interaction, 120 credits
KTH Royal Institute of Technology year 2015
School of Computer Science and Communication (CSC)
Supervisor at CSC was Helena Tobiasson
Examiner at CSC was Jan Gulliksen
Principal was Challengermode AB
2016-06-16
En användarcentrerad metod för att utvärdera och förbättra användbarheten av ett komplext realtidswebbgränssnitt

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SAMMANFATTNING

Forskningsmetoden bestod av en användar- och systemanalys, användbarhets tester och en kreativ designworkshop. Forskningsresultaten användes sedan i kombination med riktlinjer och principer inom interaktionsdesign för att förbättra och utveckla nya funktioner för det aktuella användargränssnittet.

Resultaten visar att en användarcentrerad designstrategi i kombination med kooperativ design var ett framgångsrikt sätt att utvärdera och förbättra användbarheten av Challengermodes realtidswebbgränssnitt. Dagens forskning inom användbarhet och designritlinjer är applucerbara på modern teknik, men för att utvärdera Challengermodes realtidswebbgränssnitt, och andra liknande applikationer i ett realistiskt scenario, kan traditionella användbarhets tester vara begränsade. De viktigaste slutsatserna från designprocessen är att design för element i tomma tillstånd är lika viktigt som design för element i det optimala tillståndet där data är tillgänglig.

Nyckelord
Realtidswebb; Användarcentrerad design; Kooperativ design; Användbarhets testning; Interaktionsdesign.
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ABSTRACT
As the technologies evolve, more complex products such as real-time web applications are made. These applications introduce new usability challenges and interaction design opportunities. The purpose of this work was to evaluate and enhance the usability of a complex real-time web user interface using a User-centered design approach. Another aim was to investigate how to adapt the current usability research methods, guidelines and principles to today's modern technology, such as real-time web applications. The research was carried out for the Stockholm based start-up Challengermode AB that is currently developing a competitive gaming platform with a focus in automatic tournaments.

The research method consisted of a user and system analysis, usability testing and a creative design workshop. The research results were used in combination with current user interface design guidelines and principles to improve and design new features to the current user interface.

The results show that the User-centered design approach in combination with Participatory design was a successful way of evaluating and improving the usability of the Challengermode real-time web user interface. The current usability research and design guidelines are applicable to modern technology, but in order to evaluate the Challengermode real-time web user interface, and other applications with similar functionality in a realistic scenario, traditional usability testing can be limited. Furthermore, the main takeaways from the user interface improvement process is that designing for empty states and not hiding important elements even though they are not active is as important as designing for the optimal case where data is available.

Author Keywords
Real-time web; User-centered design; Participatory design; Usability testing; Interaction design.

1. INTRODUCTION
There is a large number of products and applications with similar functionality in today's advanced tech industry. Usability and user experience can therefore be of great competitive advantage. The users have more collective influence than ever before (Sanders 2002), and according to early research by Clement and Van den Besselaar (1993) users are becoming more aware of information technology and self-confident dealing with it. Today, the users expect more engaging applications that makes their lives easier. One way to keep up with the user expectations and develop better products is to involve actual end-users in the design process (Rubin and Chrisnell 2008).

As the technologies evolve, more complex applications are made. These applications introduce new usability challenges and interaction design opportunities. Facebook and Twitter are good examples of applications using the newest web technology to take the user experience to the next level (Leggetter 2013). One of the fundamental and most important features of these applications are the ability to update the content in real-time to enable the users to interact with each other and the world in a new way. The dynamic content gives these applications a new interaction purpose by making the user interface responsive to both the user themselves and other user’s actions, creating a new way of communicating via user interface interaction.

1.1 Real-time web
Real-time web (RTW) enables a server to push content to connected clients as soon as there are new data available rather than waiting for the client to make a request (Fletcher 2014). Real-time web applications and user interfaces react to user and server input in milliseconds (Roden 2010), creating a seamless user experience where the user can enjoy the application without waiting for the page to reload. Real-time web technologies are not a new thing, it has been around since 2000 mainly used in dashboards and monitoring systems used by finance companies for example (Fletcher 2014; Leggetter 2013). However, it is not until recently that the technology has been used in mainstream applications and consumed by the everyday person on a daily basis (Leggetter 2013).

There are very limited research and guidelines for real-time user interface evaluation and design with respect to usability. Most usability and interaction design research and principles were developed before the users expected a real-time experience, they therefore apply to more static content user interfaces, such as Nielsen’s 10 Usability Heuristics for User Interface Design (Nielsen 1995).

Making a complex dynamic real-time web user interface usable is a challenge beyond traditional interaction design (Bergel and Chadwick-Dias 2007). Don Norman one of the world's renowned designer and usability expert said the following in a design session (Soon 2013):
“Design principles have not changed over the years. True, time has passed, but design principles don’t change. However, technologies are different, which affects the ways these design principles are applied”.

The challenge today is to adapt and apply the current research methods to evaluate and design cutting edge applications that lives up to the user’s demands and expectations.

1.2 Purpose and goal
Within the context described in the previous section, the purpose and goal of this work was to involve end-users in order to evaluate and enhance the usability of a real-time web user interface using the definition of usability according to ISO-9241-11 (1998):

“The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.”

Where effectiveness, efficiency and satisfaction are defined as:

- **Effectiveness** - Accuracy and completeness with which users achieve specified goals
- **Efficiency** - Resources expended in relation to the accuracy and completeness with which users achieve goals
- **Satisfaction** - Freedom from discomfort, and positive attitudes towards the use of the product

2. BACKGROUND
This section provides information about the principal Challengermode AB, their platform and a short introduction to the term eSports required to fully understand the use case of the platform. This section also contains the problem statement and a description of the delimitations of this work.

2.1 Challengermode AB
Challengermode AB, from here on referred to as Challengermode, is a start-up based in Stockholm, with the vision to make professional eSports available for everyone by making it possible to play competitive computer games, on-demand, with money prizes.

Challengermode was founded in 2014 and is currently run by a team of 10 people with diverse backgrounds in business, management and software development. The current work process consists of agile software development principles with a focus in software engineering. There has been little to none user involvement in the design process and there is no structured or recurring usability testing conducted with the platform. However, there exist user feedback that indicates deficiencies in the platform usability.

2.1.1 The Challengermode platform
The current Challengermode platform is a novel and complex real-time web application that is built to be directly integrated with competitive computer games. The platform is a 3rd party service that is used to organize tournaments, matches and teams. The platform serves as an intermediary between the games and their servers as the actual games are played outside the platform.

The outcome of all games played through Challengermode is based upon the player’s skill, not chance. Skill games are not subject to gambling regulations in Europe and most states in the US. The platform is currently available in Europe and a few other countries where skilled gaming is not labeled as gambling.

The main feature of the current platform is an automatic tournament system. Each tournament consists of a series of games that are visualized in a tree diagram called a bracket, as can be seen in figure 1. The game results are fetched and validated using the integrated game’s servers and presented in the Challengermode user interface as soon as they are available. The users do not need to manually report the results and wait for a judge’s review. The winning team advances to the next round of the tournament automatically.

The largest tournaments are usually streamed by Challengermode on the live streaming platform Twitch with professional commentators. There is also a number of social features on the platform such as teams, friends, and communication via both private and global chats. At Challengermode, the users compete in teams that usually consists of five users, whereof one team captain.

**Usage**
The Challengermode platform is built to be used with any device that supports web browsers. As can be seen in table 1, statistics from Visual Studio Application Insights shows that the majority of the users use Challengermode with a desktop computer.

<table>
<thead>
<tr>
<th>Desktop computer</th>
<th>Tablet/Mobile</th>
</tr>
</thead>
<tbody>
<tr>
<td>95%</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Table 1**: Percentage of usage: Desktop computer vs. Tablet/Mobile.

2.2 eSports
**eSports**, also known as electronic sports and competitive gaming, is a form of sport that is facilitated through 1Visual Studio Application Insights is an analytics tool developed by Microsoft.
computers and mediated by Human-computer interfaces (Hamari and Sjöblom 2015). eSports are coordinated by different leagues, organizations and tournaments where the gamers compete individually or in a team, playing competitive computer games. The most popular games right now are Dota 2, League of Legends and StarCraft 2. Competitions in these games can have 5-digit live audiences, millions of spectators online and prize pools comparable with some of the largest sports in the world, as can be seen in figure 2. (Hval Olsen 2015; Gaudiosi 2015).

Today, the eSports market grows faster than ever. It is expected that the market will grow from today’s value of $748.8 million to over $1.9 billion by 2018 (Gaudiosi 2015). The money comes from both companies and consumers creating a thriving ecosystem (Industry First Report: The Evolution of the eSports Ecosystem 2015).

2.3 Problem statement and research question
Challengermode is currently working on improving the eSports tournament system on their platform. The usability of the current system have never been evaluated and the user involvement have been at a low extent during the design process. Furthermore, user feedback indicate that the usability was at a rudimentary level and in need of various improvements to facilitate the company’s mission. Hence, the research question this study aim to answer is:

How can the current Challengermode real-time web user interface be evaluated and improved to enhance the usability?

2.4 Scope and delimitations
The tournament system in question can be used by both gamers and organizers. However, this work will only focus on the target group gamers (and their teams). Furthermore, the platform is used almost exclusively with desktop computers, as can be seen in table 1. This work is therefore focused on usability concerning desktop computer usage only. This study does not focus on performance issues like loading times caused by the underlying technology even though the overall user experience and usability could possibly be improved by such investigations and improvements.

3. THEORY
This section defines central and important terms through general definitions and within the context of this work.

3.1 Usability and user experience
Researchers view usability and user experience from a number of different perspectives and each company, designer and product may have different goals and definitions (Roto and Rautava 2008). According to Mifsud (2011) user experience is many times confused with usability. This section defines user experience and compares it to usability in order to clarify what the term usability refers to within the context of this work.

According to ISO-9241-210 (2010) user experience (UX) is defined as:

"A person’s perceptions and responses resulting from the use and/or anticipated use of a product, system or service."

The ISO definition further states that “user experience includes the user’s emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments that occur before, during and after use”.

By comparing the ISO definition of UX to the ISO-9241-11 (1998) definition of usability (as can be seen in section 1.2) it is evident that one does not equal the other. Usability concerns the ease of use while UX concerns the feelings a user gets while using a product. Furthermore, one does not guarantee the other, but one may be used to assess aspects of the other. The combination of the two is essential to a products success and should not be overlooked even though the main focus is set on one of them, as in this work.

3.2 User-centered design
User-centered design (UCD) is a framework that emerged from Human-computer interaction research with the aim of helping developers and designers to create products that meet the end-user’s needs (Lowdermilk 2013). According to ISO-9241-210 (2010) UCD is in practise often used synonymously with the term Human-centered design (HCD) even though HCD also addresses impacts on a number of stakeholders, not just the users. ISO defines HCD as:

"An approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques."

The term User-centered design will be used throughout the rest of this study.

Abras, Maloney-Krichmar, and Preece (2004) states that the best way to measure usability criteria and understand how a product is used is to involve and listen to actual end-users. Involving users in the development process often changes the way a product is designed. UCD seeks to adapt the design process and outcome to how the users in question actually work rather than forcing the users to
change (Rubin and Chrisnell 2008). UCD can be seen as a spectrum with a number of methods with different user involvement levels. For example, the users can have a large impact in the design process where they will be involved as co-designers in the design process, or they will be involved to a small extent in requirement gathering processes for example (Abras, Maloney-Krichmar, and Preece 2004).

According to Lowdermilk (2013), users have a tendency to not understand what is required to build certain features of a product and they may not know what they really want until it is given to them. Therefore, it is vital to know when to listen to the users and when not to in UCD. The goal is to learn from the users to create a better product, not the other way around. Furthermore, involving users in a UCD process requires careful user selection to make sure the participants are actual end-users of the product that is evaluated (Gulliksen et al. 2003).

3.3 Participatory design
An approach that has gained strong acceptance in recent years is Participatory design (PD) that aims to involve users in the design process as design partners (Abras, Maloney-Krichmar, and Preece 2004). PD can be seen as a UCD method where the users are involved extensively in the design process. Gulliksen et al. (2003) takes PD in account when defining a set of key principles for UCD and Abras, Maloney-Krichmar, and Preece (2004) describes PD as a method developed to support UCD. Sanders (2002) claims that PD is not simply a set of methods, it is rather a new way of approaching UCD. Instead of designing for the users with UCD, she argues that there is a shift in attitude where designers design with the users by applying PD.

Lowdermilk (2013) states that users and designers can have a hard time understanding each other and users may not know what they actually are asking for. When this cultural differences occur, PD is useful because it involves end-users and designers working together with sketches, prototypes and testing of the actual product (Abras, Maloney-Krichmar, and Preece 2004).

In a UCD study by Gulliksen et al. (2003), one of the most successful activities were a collaborative prototyping workshop conducted with end-users inspired by PD. The participating users could develop their own vision of how the end result of the system developed could look like together with the designers. The study shows how effective extensive user involvement can be, and how a design can be improved based on user research and involvement.

3.4 Usability evaluation
There are a lot of different usability evaluation methods that can be used, however, this study focuses on usability evaluation methods that involve end-users within the scope of UCD.

3.4.1 Usability testing
Usability testing provides information of how the end-users use the product interface and what their difficulties are (Nielsen 1993). The goal of usability testing is to collect empirical data while observing real users perform realistic tasks to identify usability issues in an existing product (Rubin and Chrisnell 2008). Nielsen (1993) states that reliability and validity are two issues all kinds of usability tests have to pay attention to. Reliability concerns the question if the usability test would generate the same results if it were to be repeated and validity is the question if the usability test really reflects real and relevant usability issues of the product in question.

In a study to identify challenges of usability evaluation of complex systems, Gossen, Haun, and Nürnberg (2011) states that one challenge is to create an appropriate scenario and tasks for usability evaluation of such systems. The tasks must be complex enough to represent a realistic situation. These tasks can in some cases require a lot of time, meaning that several usability tests with individual users is not a good option because of time and cost limitations. Instead the authors propose to conduct a controlled experiment with 5-10 participants to collect qualitative data using observations, recordings and interviews. The aim is to let the participants discover the system and collect data about learnability and satisfaction by having them conduct tasks or explore the product freely.

Frøkjær and Hornbæk (2005) describes a different approach to usability testing called Cooperative Usability Testing (CUT). In CUT, the test users and evaluators join expertise to understand the usability problems of the product evaluated. CUT consists of an interaction session where the participant has the initiative. Thereafter a cooperative interpretation session between participant and test moderator is conducted to identify and understand usability problems from the interaction session. An exploratory study conducted by the authors suggests that CUT contribute to more important usability information compared to think-aloud evaluations and that both participants and test moderators were positive to the evaluation approach.

3.4.2 System Usability

The System Usability Scale (SUS) is a quick and reliable UCD tool for measuring the perceived usability of a computer system developed by John Brooke in 1986. Brooke based SUS on the ISO standard definition of usability described in section 1.2. According to Brooke (2013) SUS has been cited in more than 1,200 publications and is incorporated into commercial usability tool kits such as Morare. Furthermore, SUS has been referred to as an “industry standard” in several publications although it has never been through any formal standardization process.

Figure 3: Grade rankings of the SUS score from “Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale” by Bangor, Kortum, and Miller (2009).
In a SUS survey, the users answers ten questions with five response options ranging from "strongly agree" to "strongly disagree". SUS provides a score from 0 to 100 that describes the perceived usability of the system evaluated. Bangor, Kortum, and Miller (2009) provide a guide of how to interpret individual SUS scores and how the score describe a product’s usability as can be seen in figure 3.

Since SUS was published, there has been a number of researchers questioning the validity of SUS for modern technology (Brooke 2013). Research by Bangor, Kortum, and Miller (2008) and Sauro (2011) have shown that SUS can be applied to a wide range of modern technology that had not been invented when SUS first was developed.

3.5 User interface design
On the web, usability is of great importance because of the large number of applications available with similar functionality. If a user does not understand or like the web application, they simply leave and look for another. A good user interface is therefore necessary for survival on the web (Nielsen 2012).

3.5.1 User interface design guidelines
Two of the most common user interface design guidelines are Nielsen’s 10 Usability Heuristics for User Interface Design (Nielsen 1995) and Shneiderman’s Eight Golden Rules of Interface Design (Shneiderman and Plaisant 2010). These two design guidelines are quite similar and highlights the importance of consistency, error prevention and user control to mention a few similarities. The guidelines also state that a user interface should be designed to support both novice and expert users.

3.5.2 Rapid prototyping
Designers are today able to test and reiterate faster than ever thanks to the technological advancement. Rapid prototyping is therefore an effective method to improve usability by iteratively improving the user interface design of a product (Cao et al. 2015).

4. METHOD
This section describes the research method used in this study. The method is divided in four main phases; (1) user and system analysis, (2) usability testing, (3) creative design workshop and (4) user interface improvements.

4.1 User and system analysis
A user and system analysis was conducted with two user centric approaches consisting of a questionnaire and a survey. The questionnaire and survey was made with Google forms and sent out via an in-app message using Intercom2 in order to only reach end-users that have been using the the Challengermode platform. The user and system analysis was conducted in English as a large number of end-users living in different countries was targeted.

4.1.1 User analysis
A user analysis questionnaire was sent out to all users participating in a tournament hosted with the Challengermode platform. The goal of the questionnaire was to get to know the end-users better, gather usability criteria and learn about general usability issues. The full questionnaire can be seen in Appendix A.

4.1.2 System analysis
As a compliment to the user analysis questionnaire, a SUS survey was sent out to all participating users during another tournament. The goal of the survey was to get an overview of how the users perceived the usability of the Challengermode platform and to gather quantitative data for future reference. See Appendix B for the full SUS survey.

4.2 Usability testing
In order to evaluate the Challengermode user interface in an as realistic scenario as possible a new experimental usability evaluation technique designed for complex real-time web user interfaces such as the Challengermode platform is proposed. The proposed technique is partly inspired by the usability evaluation research by Frøkjær and Hornbæk (2005) and by Gossen, Haun, and Nürnberg (2011) described in section 3.4.1. Instead of traditional individual usability testing such as think-aloud evaluations, the participants are supposed to cooperate in teams. Furthermore, the technique is designed to be conducted with a functional system that supports real interaction rather than interaction with a low fidelity prototype.

4.2.1 Data and measurements
The main objective was to collect qualitative data regarding satisfaction and learnability from observations, recordings and user interviews. Quantitative data such as task completion times and error rates was not considered as relevant in this scenario because of the asynchronous interaction and communication between team members during tasks, making it hard to both measure such data accurately and also analyze and understand in a way that would improve the usability.

4.2.2 Participants
Ten users that had not previously competed in any tournaments using the Challengermode platform were invited to the usability testing via in-app communication using the Intercom integration via Challengermode. However, due to last minute cancellations, seven participants participated on location and three remotely. The participants were between 16 to 24 years old, all male, either working within IT, sales, electronic production or are students. All participants reported good computer skills. The usability testing was conducted in Swedish as all participants were from Sweden.

4.2.3 Setup
The usability testing was conducted at the Challengermode office in Stockholm during a 43 team tournament facilitated by the Challengermode platform.

The team members of the two teams that participated in the usability testing were placed next to each other with one

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2Intercom is a platform that makes it easier to communicate with customers (https://www.intercom.io/ 2015).
computer each. The setup allowed for a good overview of the participants in each team as they worked on the same tasks together. Each participant was encouraged to take notes of usability issues during the session with the help of a usability testing form that can be found in Appendix C.

Figure 4: The usability testing setup for each team. The blue circles represent the participating users.

4.2.4 Tasks
The usability testing tasks were designed based on conclusions from the user and system analysis to ensure that the most important parts of the tournament system were used and to involve all team members in each task.

1. Create/Join a team
   The participants were instructed to create a new team and invite each other. The participants had to decide a team captain themselves. The task was considered complete when all participants were members of the newly created team.

2. Join a tournament
   The second task was to find and join an existing tournament. The task was successfully complete when all team members confirmed their participation in the tournament.

3. Look up the enemy team of the next game
   The next task was to find out who the next games enemies were. The task was completed when one of the team members could communicate the information to the other team mates.

4. Play the tournament
   The last task was to explore the platform freely by playing the tournament until elimination.

4.2.5 Interpretation session
After the usability testing tasks each participant was interviewed individually in an interpretation session, inspired by the usability research by Frøkjær and Hornbæk (2005). Each task was discussed in detail during the session that was recorded and documented.

4.3 Creative design workshop
In order to involve end-users even further in the design process in line with User-centered design and Participatory design principles as described in section 3.2, a creative design workshop was conducted. The workshop was held as a follow-up activity to the usability testing with the same seven participants. As the participants were all native Swedish speakers, the workshop was held in Swedish to make the participants feel as confident as possible. The workshop lasted for two hours and the entire session was recorded.

4.3.1 Material
The workshop was conducted in a conference room at the Challengermode office. The material available during the workshop were pens, paper, post-it notes, a large whiteboard and a laptop connected to a projector showing the Challengermode platform. The participants were encouraged to use the material in any way as they pleased.

4.3.2 Workshop process
The workshop was divided into four main phases. These phases are described in detail below.

Phase 1 - Brainstorming
The workshop started with a 15-minute brainstorming session where the participants individually wrote down as many usability issues, problems or thoughts on post-it notes as they could. Each participant later presented their issues in front of the group and attached the post-it notes to the whiteboard.

Phase 2 - Voting
Duplicates and related issues were categorized and grouped together on the whiteboard in order to make it possible to vote for each issue after the brainstorming phase. Each participant had three votes that could be spent all on one issue or distributed to several issues. The goal was to highlight the three most important usability issues according to the participants.

Phase 3 - Design
During the design phase of the workshop, the participants were divided in three groups. The purpose was to let the participants sketch and design solutions though participatory prototyping to each of the three most important usability issues. At the end of the design phase, each group got 10 minutes to present their sketches and solutions.

Figure 5: One of the three groups working on their design solutions to the usability issues attached to the whiteboard in the background during the workshop.

Phase 4 - Open discussion and summary
The workshop session ended with a summary of the results and an open discussion where the participants were encouraged to discuss and build upon each others design solutions.

4.4 User interface improvements
The final stage of this work was to improve the user interface according to the findings from the usability research
described in the previous sections. Before starting the design phase, a short workshop with two software engineers and the product manager of Challengermode was conducted in order to present the research findings and decide how the user interface would be improved.

The user interface improvements were done through rapid prototyping where each improvement was first sketched and then implemented/improved in an iterative design process. All improvements made to the user interface were implemented using modern web technologies such as HTML5 (W3C 2014), LESS (Sellier 2015) and Angular.js (Google 2015).

5. RESULTS
This section presents the usability research results from the user and system analysis followed by the results from the usability testing and the creative design workshop. The user interface improvements are presented separately in section 6.

5.1 User analysis questionnaire
89 responses were received from a total of 215 users participating in a tournament at Challengermode which corresponds to a response frequency of 41%.

5.1.1 Summary of user related questions
How old are you?
95.5% of all respondents stated that they are in the age of 15-25, and within that span 69%, stated that they are within the age of 15-20. Only a fraction (4.5%) stated that they are older than 25 years as can be seen in figure 6.

In what country do you live?
The responses were from users located in Sweden, United Kingdom, Portugal, Germany, Estonia, Lithuania, Denmark, Finland, Netherlands, Spain, Croatia, Latvia, France, Slovakia, Czech Republic and Greece.

How would you rate your computer skills?
About 80% of the respondents rated their computer skills as good or above average as figure 7 shows.

What is your current occupation?
The most common occupations of the respondents ranged from software engineers to part time workers and students.

Why did you sign up for Challengermode?
34 respondents stated that they signed up for Challengermode to either play organized tournaments, earn money while playing computer games or to play more serious matches that matters. For example, one respondent wrote the following:

"I signed up because I am somewhat tired of what I’m matched up against and with. There is not nearly as much time for me to spend on gaming as it was a couple of years ago when I was in my prime. It would be nice to make these few matches I play count for something else and leave less things to chance."

There were also a number of respondents that referred to the term "pro-gaming experience" while describing why they signed up for Challengermode.

How do you communicate with teammates while playing?
As can be seen in figure 8, 94.4% stated that VoIP (Voice over IP) like Skype is the preferred way of communicating with team mates while playing. No respondent answered that they didn’t use any kind of communication channel.

5.1.2 User profile
Based on the user related questions in the user analysis questionnaire analyzed above, a Challengermode user profile is described below:

The typical Challengermode user is between 15-25 years old, living in Europe and either works within a IT related area or is a student. The typical user is knows how to use a computer in an above average way. The user signed up for Challengermode to play serious competitive computer games and tournaments that counts for something more than just artificial rewards. Communication with team members is important and is preferably done via VoIP.

5.1.3 Compilation of usability Issues
The user analysis questionnaire featured three free text questions concerning usability. The most interesting and important results from these questions will be presented as a compilation in table 2 and in a summary below.
The most frequently mentioned issue was regarding unfair games and skill level requirements, as can be seen in table 2. This issue does however concern user experience rather than usability.

Several users stated that they had a hard time understanding when a tournament would start. The problem does not appear to be missing start time information, the problem is rather how the start time is visualized. One respondent said that:

"I see the tournament start time but I do not know what time zone it is based on. I would like to know exactly how many hours it is left until it starts."

It appeared that the users wanted to have the opportunity to change their team setup during a tournament and also register a team larger than the tournament team size in order to have substitutes. A few users also stated that tournament information like what region (server) the tournaments would be played in was hard to find.

Furthermore, one common issue that appeared in several responses was that it is hard to find a team to play with in the first place. Other comments and statements were about better notifications, issues with tournament check-in, other team roles, long waiting times and bracket improvements.

### 5.2 System analysis

The System Usability Scale (SUS) survey received 57 answers. A summary of all individual responses can be seen in table 3 and the calculated SUS score is presented in table 4.

#### 5.2.1 Summary of responses

It appeared that most users found Challengermode relatively easy to use and they thought that most people would learn to use it very quickly. However, it appears that they also thought that the platform was a bit complex and that there were some inconsistencies in the user interface.

#### 5.2.2 SUS score

**Formula**

The SUS score is calculated with the following formula:

\[
V_i = \begin{cases} 
5 - S_i & \text{if } i \text{ is even} \\
S_i - 1 & \text{if } i \text{ is odd} 
\end{cases} 
\]

where \(S_i\) represents the answer for question \(i\). The SUS score becomes:

\[
2.5 \cdot \sum_{i=1}^{10} V_i 
\]

**Calculated score**

| SUS Score | 71.32 |

Table 3: Average of all individual responses of the SUS survey. 1 equals "strongly disagree" and 5 equals "strongly agree". The word Challengermode is replaced with "CM" in the table.

According to Abras, Maloney-Krichmar, and Preece (2004), a SUS score of 71.32 is just above the acceptance criteria of system usability as can be seen in figure 3. The SUS score indicates that there is a need to improve the usability of the Challengermode platform.

### 5.3 Usability testing

The results from the usability testing is presented in the following two sections below.

#### 5.3.1 Observations

The observed user behavior during the usability testing is summarized in the list below.

- When the team captain invited the other users to the newly created team he had to ask some of the users to accept the invitation. It appeared as they did not notice the notification.
- Just as the tournament started the users became somewhat anxious when they did not find their first game right away. A few users found it eventually and they had to point out how to enter the game lobby to the other team members.
- Most participants had a hard time finding other users and teams when trying to find out how good their opponents
were. Almost everyone asked if there was a search function somewhere. The task was completed by finding the team in the teams list, but it appeared as they expected the same information by interacting with the bracket.

- The relatively large size of the tournament (43 teams) made the bracket really large, both vertically and horizontally. The participating users had a hard time navigating by scrolling in the bracket.

- When the teams had played the first round of the tournament it appeared as they had learned how the system worked and they could complete the tournament without any major problems.

5.3.2 Interpretation session
The usability test tasks were reviewed in detail during the individual interpretation session with each participant. Interesting thoughts and issues were discussed further. The conclusions from the interpretation sessions are summarised below.

Task 1 - Create/Join a team
Several participants stated that they wanted a clearer notification when they got invited to a team and two participants mentioned that a sound would have made them more aware of the notification.

The two team captains suggested that it would be nice if the other users could request to become members of a team in addition to the existing invite functionality that only team captains could use.

Task 2 - Join a tournament
One participant mentioned that a way to filter available tournaments would have made the process of finding a tournament easier. The team captains did not understand why they had to first join, and then confirm their participation in a tournament. The two-click interaction was confusing because they did not notice that a second click was needed to confirm their participation. One of the two team captains said that:

“At first, I did not understand that I needed to press the join button two times. I thought that I was ready the first time I pressed it.”

Six out of seven participants stated that they had a hard time noticing the tournament activity that appeared in the left bottom corner when they had been invited/joined the tournament. According to the participants a notification would have made the join process easier.

Task 3 - Look up the enemy team of the next game
All but one mentioned that they tried to interact with the bracket in order to find information about other teams, especially team members. In addition to be able to find team members, the participants mentioned that they expected to find the game lobby, game status and game time by interacting with the bracket. Two participants stated that they had a hard time navigating using the scroll in the bracket.

Four participants asked how to search for another user and stated that they did not find any search functionality at all.

Task 4 - Play the tournament
All participants stated that it was not clear enough when the next game would start and what to expect. It was hard to see when the dynamic activity widget appeared and changed. The addition (A box with a link to the next game) to the already hard to find tournament activity in the bottom left corner was not easy to find according to the participants. However, several participants stated that when they had played one round of the tournament they knew what to expect and could use the platform quite easy.

Additional conclusions
Additional conclusions from the interpretation session that was not related to a specific task is listed here.

- Three participants got frustrated when a new message forced the chat container to scroll to the bottom while reading an old message. “The chat scroll should be locked if you are not at the bottom of the chat” said one participant.

- Two participants mentioned that the difference between the global chat and the tournament chat was not clear enough.

- One participants mentioned that there was too little contrast in the user interface colors.

- Two participants stated that more information about how the platform worked could be useful for first time users.

5.4 Creative design workshop
The most interesting aspects and results from the creative design workshop is presented in this section.

5.4.1 Brainstorming and voting
37 different usability issues surfaced during the 15 minutes of brainstorming. The issues ranged from smaller bugs to large usability problems. The issues were grouped to nine larger issues to make it easier for each participant to vote for what they thought was the most important issues based on their experience using the Challenger mode platform.

<table>
<thead>
<tr>
<th>Usability issue</th>
<th>Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better notification when a game is starting</td>
<td>5</td>
</tr>
<tr>
<td>Details on demand in the bracket</td>
<td>4</td>
</tr>
<tr>
<td>Global search function</td>
<td>3</td>
</tr>
<tr>
<td>Toast notifications</td>
<td>2</td>
</tr>
<tr>
<td>Tournament layout</td>
<td>2</td>
</tr>
<tr>
<td>Profile stats</td>
<td>2</td>
</tr>
<tr>
<td>Team finding and drafting</td>
<td>2</td>
</tr>
<tr>
<td>Main platform navigation</td>
<td>1</td>
</tr>
<tr>
<td>Communication improvements</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 5: The nine usability issues raised during the workshop and the vote distribution.

5.4.2 Design phase
The three highest rated usability issues were described as questions in order to make it easier for the participants to come up with and sketch solutions. The design solutions from
the design phase is showed in figure 9 and described in detail below.

1. Better notification when a game is starting
In what way would it be easier to find the next game?

All three groups came up with an identical design solution: A pop-up at the center of the screen with game information inside. Buttons with the text "Join game" and "Go to game" were used by all groups. Two groups stated that some kind of notification sound would improve the usability even further. During the presentation of the design solutions it became clear that the users expected a more distinct change of content. One group said the following while presenting their solution:

"A pop-up covering the entire screen may in some cases be a frustrating thing, especially if I am doing something else on the site, but in this case I did not first notice the small change in the user interface even though I was waiting for the game to begin. I actually expected to be interrupted by some kind of pop-up but I was not."

The other groups agreed to the above statement and it appeared that getting information about the upcoming game was at the highest priority as soon as a tournament had started.

2. Details on demand in the bracket
How would you like the bracket interaction to be designed?

It became clear that the bracket should be used both as a visualization but also as a navigation tool. All three groups wanted an easy way of navigating to team and user profiles by clicking a match in the bracket. According to the participants the bracket was the element that they expected to interact with the most during a tournament and they felt very limited when they could not. The lack of information made it hard to navigate and know what to expect while playing a tournament.

In summary, the information that should be available by interacting with the bracket was following:

- Link to teams
- Link to team members
- Match status
- Game time
- Match streaming status

Two out of the three groups mentioned that an option to toggle the extra information on and off could be useful in order to reduce the cognitive load in large tournament brackets.

3. Global search function
What should be possible to search for and how should that be designed in a global search?

All three groups came up with a minimalistic design for the search input field: A simple input field should be placed in the header or in a sidebar in order to be accessible at all times. Two sketches contained a magnifying glass icon. All groups agreed that the following three things should be searchable:

- Users
- Teams
- Tournaments

During the presentation of the solutions it was clear that search suggestions and results should appear and change while typing a search query. Two groups described this feature with the use of the term "real-time search". It also became clear that the search result elements should have the same type of layout, but it has to be easy to see the difference between a user, team and tournament while searching.

5.4.3 Open discussion
All participants stated that they were satisfied with the results of the workshop and that they liked the idea of being involved in the design process of a product that they use.

6. USER INTERFACE IMPROVEMENTS
This section presents the user interface improvements and new features that were designed and implemented based on the results and conclusions from the usability research conducted in this study.

6.1 Improvements to the current user interface
The improvements made to the current user interface is presented in this section.

6.1.1 Tournament layout improvements
A tournament on the Challengermode platform has its own page with several sub-pages. The most central part of a tournament page is the layout that consists of a header with the most relevant information and navigation tabs.
The usability research showed that the users had a hard time finding tournament information because of the unorganized placement of content. The tournament layout, as can be seen in figure 11, has been improved by organizing the content in a more compact way.

The game settings (related to the game played only) have been grouped together below the tournament title instead of spread out as before. Furthermore, in order to make it easier for users that do not know what time zone the tournament start time show, a timer has been added as an addition to the actual start time. The timer show how many hours, minutes and seconds is remaining until the scheduled start time.

To participate in a tournament a team has to register and then become ready. This means that there are two different states a team can be placed in. Before the improvements the only information available in the header was total team slots. The users had to navigate to the "Teams" tab to find out how many teams were signed up and ready for the tournament. The improved tournament layout header now features a "team stats" section showing number of registered, confirmed and total slots.

6.1.2 Bracket improvements
The Challenger mode tournament bracket can be divided into three main components: rounds, matches and teams. Each round consists of a number of matches and each match consists of two teams. The usability research results clearly show that the users expect to be able to interact with the tournament bracket in order to find more information. As the bracket is a tree diagram visualization of a series of matches, the Visual Information Seeking Mantra by Shneiderman (1996) could be applied. The mantra is a visual design guideline that is defined as:

"Overview first, zoom and filter, then details-on-demand".

Overview
Round start time has been added to each round header in order to make it easier to see when each round is scheduled to start. The match component has been improved with a badge showing the current match status (not started, ongoing, finished), the current game time, an icon showing if the match will be streamed or not and a description of how many games a match consists of (figure 12).

Zoom and filter
During the creative design workshop, the participants stated that the information added to the bracket could possibly make the user interface feel crowded, therefore a way of hiding/showing the new information was introduced as a toggle button with an eye icon as can be seen in the top right corner of figure 12. Furthermore, the usability testing showed that a large tournament forced the users to scroll horizontally to view the entire bracket. This issue has been solved by a "View bracket in full screen" toggle button that show the bracket in full screen.

Details on demand
In addition to more detailed match components, the bracket now features a way of getting an overview of each match and the two teams. By hovering a match in the bracket the text "View match details" is showed, and by clicking the match, the modal in figure 13 is shown. The modal show a detailed view of each team including team members, online status and game status. The modal also features a detailed view of all matches as well as a tab that opens the match chat.

6.1.3 Activity widget and upcoming game notification
Most participants had a hard time finding their current activities widget placed in the lower left corner within the left sidebar. Furthermore, it was only visible as soon as the user had at least one activity which means that the user had no idea that the widget even existed before getting an activity. The widget was moved to the top of the right sidebar and a placeholder with the text "Your games will appear here" was added in order to inform the users that the widget actually exists before it became active. Figure 14 show the old and new placement of the widget.
The usability research indicate that the placement of the activity widget was not the only problem. The majority of the users had a hard time navigating to the game lobby when a new game was available. The activity widget expanded with an element that redirected to the game lobby but the users had difficulties noticing the subtle change in the user interface. During the creative design workshop, it became clear that the users would prefer a more prominent change in the user interface and an "upcoming game" modal was proposed by all groups. Their sketches were used as a base to design a modal that is pushed to all users involved in the game as soon as it is available, see figure 15.

The new upcoming game modal show what tournament the game relates to and explains what the user is supposed to do. The modal also show a timer that counts down to the start time of the game to reduce waiting times for users already in the game lobby.

6.1.4 Own team widget
The research, especially the usability questions in the user analysis questionnaire showed that the users had problems with the team setup and numbers of team members. Due to technical limitations, a team member substitute feature could not be implemented within the time frame of this work, however the widget that showed the users tournament team were improved to clarify exactly what team the users are competing with.

To clarify even further, an orange status bar was added at the top of the widget. The status bar displays feedback messages to each individual team member. For example, figure 16 gives the user feedback that the game lobby is available.

6.2 New user interface features
The findings from the research conducted in this study indicated that the usability of the Challengermode platform could be enhanced further by implementing new features that would help the users complete their goals.

6.2.1 Global search
Firstly, the usability testing showed that it was very hard to find other users on the platform. Secondly, the results from the creative design workshop strongly indicates that the users expected an easy way of searching for users, teams and tournaments. The lack of a search functionality made certain tasks very hard to complete. Based on the usability testing results, and the design sketches from the workshop, a global search feature was implemented. The design consists of a search input located in the header of the platform (Figure 17) with a corresponding search result panel that covers the entire screen with three columns, one for each category: users, teams and tournaments (Figure 18). The result panel slides down from the top as a user clicks on the search input.
The user analysis showed that one problem while using the Challengermode platform was to find a team to play with. Without a team, the Challengermode platform is not usable. The problem was solved by a new feature called "Looking for team". The feature consists of a list that users can sign up to if they are looking for a team. Other users can thereafter go through the list to find suitable players for their teams. The rows in the list expands and show vital information when they are clicked on as can be seen in figure 19.

![Figure 19: The new "looking for a team" feature that makes it easier to find a team to play tournaments with.](image)

7. DISCUSSION
The research, purpose and goal of this work are discussed from six different perspectives in this section: the research method, the user interface improvements, ethics, the impact of eSports and future work.

The purpose and goal of this work was to evaluate and enhance the usability of a real-time web user interface using a User-centered design approach. As described in section 1.1, there are limited research concerning real-time web user interfaces with respect to usability. Therefore, another aim of this study was to investigate how to adapt the current usability research methods, guidelines and principles to today’s modern technology, such as real-time web applications.

7.1 Research method
The usability research that consisted of the user and system analysis, usability testing and the creative design workshop complemented each other well. Each method had different levels of user involvement and generated similar results from different perspectives. The creative design workshop was dependent on the usability testing conducted in this study as it was a follow-up activity with the same participants. Both methods were conducted with the participants on location in the Challengermode office with predefined tasks. This made the participants somewhat constrained to what they could do and experience, while the user and system analysis were conducted with a larger number of users online, allowing for a broader perspective. As the methods built upon each other and resulted in usability insights from different perspectives, each method contributed with valuable data that makes it hard to judge if one contributed to more than any other.

The research showed that the Challengermode real-time web user interface requires more than traditional usability testing in order to be evaluated in an as realistic scenario as possible in the specified context of use. The users had to cooperate and interact with both the system and other users in order to complete tasks. After an extensive literature review, the only similar usability research found was the research by Frøkjær and Hornbæk (2005) where the participants and the experts cooperated. In the study conducted in this paper, a new exploratory usability testing technique was proposed where the participants cooperated with each other and conducted tasks in teams. The new usability testing technique was an a successful usability evaluation methods and is discussed further in section 7.1.2.

During the research conducted in this study, the participants in the usability testing and the creative design workshop consisted of men only. Furthermore, the gender aspect were overlooked in the design of the user analysis questionnaire. The questionnaire was tested with pilot users from Challengermode before it was distributed to the end-users, and even though several questions were changed, no one commented or brought up the missing gender aspect. One assumption is that gamers are expected to be male or that the majority of gamers actually are male. However, no such data was generated but it would have been useful information in the design process and further work withing the area.

7.1.1 User and system analysis
I had little to none prior experience of competitive gaming and knowledge about the eSports community and as stated in section 2.1 the user involvement in the current Challengermode design process was at a low extent before this study was carried out. The user and system analysis was therefore of great help to plan and develop the usability research in this study. The user profile derived from the findings of the user analysis contributed to valuable guidelines in the user interface improvement process. The system analysis was used to get an overview of the perceived usability of the platform in an quick and easy way.

User analysis
The user analysis questionnaire and the system usability survey were the methods that had the least user involvement but generated the most data. The user analysis provided valuable knowledge about the end-users and current usability issues. What was interesting is that the three free text usability questions generated issues related to both usability and user experience. The user experience related responses highlighted how usability and user experience can correlate. For example, one issue regarding user experience were long waiting times caused by other users having problems navigating through the user interface.

The user analysis resulted in a user profile that helped develop the usability testing and the format of the design workshop. The user profile was also helpful in the user interface design process and will be valuable for future work as well, for
example, to create personas. What is interesting is that there are only about 9% of the responding end-users of the user analysis questionnaire that rated themselves as beginners or new computer users. The majority rated their computer skills as good or above average, as can be seen in figure 7, which was also reflected in the design workshop.

System analysis
The system analysis conducted with the SUS survey resulted in a quick overview of how the users perceived the usability of the Challengermode platform and what aspects of the user interface needed improvements the most. The SUS survey was used to gather quantitative data that was supposed to be used to compare the usability of the current user interface with the improvements made in this study. As the research by Bangor, Kortum, and Miller (2008) and Sauro (2011) shows, SUS is applicable to modern technology. However, the SUS score is hard to interpret as it covers a number of different aspects of system usability. The SUS score was therefore used in combination with the other usability research in the study and showed to be of value as a requirements gathering method. Due to the time frame of this work, a second SUS survey was not conducted because the design improvements were not live for enough time to change the user’s perception of the usability.

7.1.2 Usability testing
The experimental usability testing conducted in teams made it possible to find usability issues that traditional individual think-aloud evaluations would not have in the context of a real-time web application, such as the Challengermode platform. For example, by testing in teams, issues related to other user’s interaction could be found. The interaction and communication within the Challengermode platform, and other social real-time web applications, is asynchronous and makes it hard to measure efficiency by time it takes to complete tasks because if one user does not understand what to do, the other users will be slowed down as well. Therefore the usability testing focused on qualitative data from observations and interviews regarding satisfaction, learnability and effectiveness rather than quantitative data. For the purpose of this study the generated data were more than enough to improve the user interface. However, the subjective qualitative data generated will be harder to compare with results from future usability testing of the same system. Therefore, screen recording and other tools that would allow to measure quantitative data regarding effectiveness for example, both during and after the usability testing would have been a good addition to the observations and interviews.

Due to last minute cancellations there were seven participants instead of 10 as planned. Two teams (one with three participants) participated in the study. The cancellation did however not affect the results as it was clear that the number of participants were enough, especially during the individual interpretation session because after four to five interviews the participants reported the same usability issues already addressed by the previous participants.

7.1.3 Creative design workshop
The creative design workshop was a follow-up activity to the usability testing with the same participants. The results were therefore similar and limited to the tasks conducted in the usability testing. It could have been better to invite new users that would not be biased by the tasks from the usability testing session and instead let them explore the Challengermode platform freely before the workshop in order to give them the opportunity to find other usability issues. However, the workshop contributed to more detailed descriptions of the usability issues and the participatory prototyping made the participants reflect on their experience and provide more useful data for the purpose of this study.

The brainstorming were conducted without any communication between the participants in order to ensure that the participants did not affect each other. The voting on the other hand was done by letting all participants vote at the same time which could affect how the votes were distributed due to peer pressure for example. Even though the voting had flaws, the highest rated usability issues were in fact also mentioned in the user analysis and the individual interpretation sessions during the usability testing, they can therefore be seen as credible enough for the purpose of this study. A more credible approach would have been to give each participant a list of the usability issues from the brainstorming phase and let them vote individually.

The participants of the workshop had a good understanding of technological solutions and did in fact contribute to a lot of valuable design solutions that was technologically possible to implement. This is in line with the research by Sanders (2002) and Clement and Van den Besselaar (1993) who states that users are becoming more aware of information technology and self-confident dealing with it. However, the research show that the Challengermode users rate their computer skills higher than the average user which is understandable as they play competitive computer games on a daily basis that usually takes some skills to master. Other target groups may not be as skilled and design workshops for such systems with such end-users would probably not result in the same quality discussions and solutions, but could still be of great value for the design process.

7.2 User interface improvements
The initial plan was to only improve features of the current user interface, but the usability research showed that there were user needs that the current platform could not provide. Rubin and Chrisnell (2008) states that the design process in UCD should be adapted instead of forcing the users to change. The plan was therefore slightly changed and new features were designed and developed as well.

The user interface design process was based on the results from the usability research and current user interface design guidelines and principles. The research showed that due to the real-time aspect of dynamic elements that only appear when they are active can be problematic for the users to understand. By showing a placeholder or cues of what may happen makes the users more aware of “hidden” functionality in the user interface and they will feel more in control. Designing for empty states is as important as designing for
states where data is available. The research also showed that the system needed to communicate important changes and notify when the user was expected to take action. It became clear that important events and change of states needed to be easy to detect and have highest priority in the user interface to make the users feel like they were in control.

The user profile derived from the user analysis was used throughout the design process as one major aspect of UCD is to understand who the end-users are and design solutions based on their needs (Lowdermilk 2013). The user analysis showed that the users use ChallengerMode to play serious competitive gaming and that they wanted to experience "pro gaming" while using the platform. Furthermore, the research showed that the end-users are between 15-25 years old. The improvements was therefore designed to have a serious and professional feeling to them as opposed to a playful feeling that could have been more appropriate to a younger target group for example.

There were some system related usability issues that could not be implemented due to technical limitations. For example, an easier tournament check-in process and the ability to change team lineup during a tournament. These issues were instead addressed by making the user interface more intuitive by presenting relevant data in dynamic widgets. Furthermore, the real-time technology made it challenging to develop and improve features due to the number of different states a user could experience. The rapid prototyping were therefore not as successful as I initially hoped for. A better approach would have been to work more with low-fidelity prototypes instead of implementing the improvements with the web technology used by ChallengerMode right away.

### 7.3 Ethics
All material generated through the user centric research in this study were handled anonymously. That includes questionnaire answers from the user analysis as well as notes and recordings from the usability testing and the creative design workshop.

The participants had to fill in a consent form, that can be found in Appendix D, before the usability testing and the creative design workshop. The purpose of the consent form was to inform the participants that their participation was voluntary and that the material would be used in research purpose only, meaning that it would not be published in any form outside this study. The participants were also informed that the usability testing and creative design workshop would be recorded and that photographs from the sessions would be published in the report. Furthermore, the user consent was especially important in this case because their real data was used during the usability testing.

### 7.4 The impact of eSports
As stated in section 2.2, eSports is a growing sport with a large world wide community. One interesting thing is that eSports are available for almost anyone. For example, male and female users can compete against each other on the same terms which is not possible in most common sports because of the physical differences. Within eSports it is even possible to compete without specifying ones gender or compete with users from other countries that does not have the same conditions. In addition to that, it is evident that the eSports ecosystem is growing. More money is involved and with that, new jobs emerge and eSports have a greater impact on the society every year. The majority of the events and communication are hosted online which enables a large number of people to join the accessible community. This introduces interesting economic and social aspects of sustainability within the society that should be considered while designing within this problem area. ChallengerMode is one of many stakeholders within this growing ecosystem with the opportunity to make a large impact in an area where I believe usability and design are two important factors.

### 7.5 Future work and research
A UCD process should be iterative. This work can be seen as one larger iteration in such a process. Due to the time frame of this study, it was not possible to make shorter additional iterations that could have increased the quality of the outcome because the user interface improvements took longer time than expected to implement and deploy to the production environment of ChallengerMode. The improvements made to the platform need to be evaluated more thorough in additional usability testing and other activities involving users to verify that they actually improved the usability of the ChallengerMode platform. Preferably with the same user centric approach proposed and used in this study. Furthermore, as the research carried on, it became clear that the ChallengerMode platform relies heavily on the social aspects such as communication between users. This could have been more in focus during the research and in the proposed methods, but were due to the time constrains left for future work.

The eSports scene is a large growing ecosystem with a number of stakeholders that should be studied further in order to fully understand its impact on the society and sustainability.

### 8. CONCLUSION
The research question this study set out to answer was:

> How can the current ChallengerMode real-time web user interface be evaluated and improved to enhance the usability?

The user-centered design process that was used to approach the research question in this study showed to be a successful way of evaluating the ChallengerMode real-time web user interface. The different levels of user involvement in the methods generated data from different perspectives, making the research results more credible. Requirement gathering processes such as questionnaires worked really well, however, in order to evaluate the ChallengerMode real-time web user interface in a realistic scenario, traditional usability testing was not enough. A new usability testing technique was proposed that successfully generated qualitative data that could be used to improve the user interface. Furthermore, as the ChallengerMode users are
confident dealing with computers and showed to have a good ability to discuss the technology and aspects behind the user interface, participatory design activities were very effective and contributed to valuable usability and design details that was successfully used in the user interface improvement process.

The usability research showed that the Challengers mode tournament user interface could be improved in various ways. There are many similar aspects of static and dynamic content user interfaces, therefore the current research is still applicable. The main takeaways, that is not included in the user interface design guidelines used in this study, is that designing for empty states and not hiding important elements even though they are not active is as important as designing for the optimal case where data is available. Another finding was that good usability of a real-time web user interface can result in improved user experience by eliminating long waiting times caused by other users having problems navigating through the user interface. Furthermore, a search function is needed as a second way of navigating and finding key elements in a complex user interface.

9. ACKNOWLEDGMENTS

I would like to thank all participants in this study as well as the Challengers mode team for the help and the opportunity to conduct this project with them. I would also like to thank my supervisor Helena Tobiasson and my examiner Jan Gulliksen at KTH for the valuable feedback.

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usability - and - user - experience/ (visited on 05/10/2016).


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Appendix A - User Analysis Questionnaire

How old are you?
- 15-20
- 21-25
- 26-30
- 31-35
- 36+

In what country do you live? ________________

How would you rate your computer skills?

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<tr>
<th>Beginner or new computer user</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Computer expert / IT professional</th>
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</table>

What is your current occupation? ________________

Why did you sign up for Challengermode? ________________

How do you communicate with teammates while playing?
- Voip (Skype, Discord, Teamspeak, etc)
- Direct communication (IRL)
- Text chat (In game chat, etc)
- No communication

What are you having problems with when participating in a tournament at Challengermode?

Is there anything you would like to change about the Challengermode tournament user interface?

Do you find all information that you need while playing a tournament?
Appendix B - System Usability Scale (SUS) survey

I think that I would like to use Challenger mode frequently

<table>
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<td>〇</td>
<td>〇</td>
<td>〇</td>
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</tr>
<tr>
<td>Strongly agree</td>
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<td>〇</td>
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I found Challenger mode unnecessarily complex

<table>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
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<td>Strongly disagree</td>
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I thought Challenger mode was easy to use

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I think that I would need support to be able to use Challenger mode

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I found the various functions in Challenger mode well integrated

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I thought there was too much inconsistency in Challenger mode

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I would imagine that most people would learn to use Challenger mode very quickly

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I found Challenger mode very difficult to use

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I felt very confident using Challenger mode

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I needed to learn a lot of things before I could get going with Challenger mode

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Appendix C - Usability test instructions

Usability test instructions
In this usability test you will cooperate with four other participants in a team of five while completing tasks using the eSports tournament platform Challengermode - [https://www.challengermode.com/](https://www.challengermode.com/).

During the usability testing we would like you to be extra observant and take notes of usability issues you encounter while using the platform. All instructions and tasks will be presented during the usability test session.

On this page: [link] you will find three questionnaires that you will need to fill in during the session. One before the usability testing, and two afterwards.

Thank you for your participation!

Notes:
Appendix D - Consent form

Consent Form

I agree to participate in the study conducted and recorded by Challengermode.

I understand that participation in this usability study is voluntary and I agree to immediately raise any concerns or areas of discomfort during the session with the study administrator.

I agree to the recording of the study session, and I understand that the recorded material and information is for research purposes only and that it will not be published in any form outside the study.

Please sign below to indicate that you have read and you understand the information on this form and that any questions you might have about the session have been answered.

Date: __________________

Please print your name: ____________________________

Please sign your name: ____________________________

Thank you!
We appreciate your participation.