Navigating the Blackboard: A Qualitative Study of Findability on the Utrecht University Blackboard Learn Smartphone App

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Abstract

This study aimed to understand the problems that students of the Utrecht University face when using the Blackboard Learn mobile application, a widely-used tool for accessing course materials, submitting assignments, and checking grades. The research question was "What problems are students facing regarding findability on the Blackboard Learn mobile application?" To answer this question, a Diary Study and User Study were conducted. Participants were recruited through personal interactions and were given detailed information about the study. The data collected was analyzed using Straussian Grounded Theory, involving open, axial, and selective coding. The goal was to identify a taxonomy of problems and goals that students have when navigating the app. The findings of this study revealed that although students are able to find what they are looking for, the app could still be improved by reducing the amount of interactions required, making actions more intuitive, reducing additional confusion and resolving bugs. The results of this study can provide valuable insights into the usability of the Blackboard Learn mobile app, and can be used to improve the overall user experience for students.

CCS Concepts: • **Human-centered computing** → **Usability testing**; **User Studies**; **Accessibility design and evaluation methods**.

Keywords: Mobile learning, Usability, User experience, Navigation, Mobile applications, Educational technology, Learning management systems, Qualitative research.

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1 Introduction

As technology continues to advance at an increasingly rapid pace, more and more educational institutions are turning to digital platforms for teaching and learning [1]. This trend has made it increasingly important to ensure that these platforms are user-friendly and accessible to all students, regardless of their level of technological proficiency. This is particularly important for smartphone applications, which many students now use as their primary means of accessing course materials and participating in online discussions.

Utrecht University is one of the institutions embracing digital learning management systems and uses a service named Blackboard Learn to digitally deliver course materials, facilitate communication, and manage assignments and assessments for its students. This allows the university to provide a flexible and accessible learning experience for its students, whether they are studying on campus or remotely. Blackboard Learn also offers a range of tools and features that make it easy for instructors to create and manage their courses, assess student progress, and provide feedback.

Conducting a qualitative study into the findability of items within the mobile application of Blackboard Learn at Utrecht University would be an important and valuable undertaking. Such a study would provide valuable insights into the user experience of the app, and help identify any areas where the app may be difficult to navigate or use. This information could then be used to make improvements to the app, making it more user-friendly and accessible for all students at Utrecht University.

In addition to benefiting students at Utrecht University, a study like this could also help identify best practices for designing and implementing smartphone apps for educational purposes. This information could be useful for other institutions looking to develop similar apps and could help them to avoid common pitfalls and improve the user experience for their students.

In conclusion, researching findability on the Utrecht University Blackboard Learn smartphone application is important because it has the potential to improve the user experience for students at Utrecht University and provide valuable insights for the design and implementation of educational smartphone apps more generally. This brings us to the research question of this paper: What problems are students facing regarding findability on the Blackboard Learn mobile application?

This study on the findability of the Blackboard app has been conducted using two qualitative research methods, Diary Studies, and User Studies. These two methods were selected based on the results of three piloted studies. Diary Studies include asking participants to use the app on their own and to record their experiences and thoughts in a 'diary', or in the case of this study, a questionnaire. User Studies involve recruiting participants to perform specific tasks using the app and observing and recording their actions and behaviors. Both of these methods have provided valuable insights into the findability of the app and helped us identify users' problems and issues.

2 Study Design

2.1 Pilot Studies

To investigate which methods could best aid in answering the research question, three methods were selected and a pilot study was conducted on them. These pilot studies were then evaluated to select and design the final study.

2.1.1 Focus Group. Prior experience revealed that Blackboard is a topic that many students hold strong opinions on and highly interactive discussions about the topic have been observed. Therefore, a focus group was hypothesized to be a fitting method to investigate the research question. In contrast to interviews, focus groups offer the opportunity to build on the contributions of others and are also more efficient. A pilot focus group was conducted with 6 participants for a session of 30 minutes.

2.1.2 Protocol. The focus groups were prepared and structured as follows.

1. **Introducing the research:** Participants were recruited by introducing the study aim, which requires participants to have used the Blackboard Learn mobile application at least once. At the start of the focus group, participants were welcomed, provided with refreshments, and introduced to the moderator and notetaker. The study aim was also explained in more detail.
2. **Asking for informed consent:** Participants were informed that their participation is voluntary and that they can withdraw at any time without providing a reason. They were asked to verbally consent to their participation and audio recording, which would be transcribed and anonymized before being deleted. Participants were given the opportunity to ask any questions.
3. **Content**: As focus groups are unstructured group discussions, a set of questions was created beforehand to serve as a guide for the moderator during the focus group. The questions aimed to cover the following topics: what participants usually look for in the app, what they would like to find using the app, their success rate in finding what they wanted, and their suggestions for improvements. The moderator aimed to ask little themselves and let participants finish their sentences to prevent one person from dominating the discussion.
4. **Closing**: Participants were thanked for their participation and invited to ask any questions or provide comments to the moderator and notetaker individually after the session.

2.1.3 Reflection. The focus group pilot was generally successful in gathering information about problems students encounter with the Blackboard Learn mobile application. Participants were comfortable and able to voice their opinions and, as expected, the topic seemed to be one that the target group is passionate about, allowing for easy building upon each other's contributions.

However, many contributions from participants were about generic usability issues, making it difficult to focus on findability issues specifically. Participants also often mentioned the Blackboard website without relating their statements to the mobile application being researched. The moderator attempted to steer the discussion towards findability and the mobile application, but the group often veered away from those topics towards general usability issues and technical flaws. Additionally, it was interesting to note that multiple participants visually demonstrated issues with the Blackboard app on their phone. Lastly, notetaking was not performed, which would have reduced the need for transcription and could have provided additional information not captured by the audio recording, including nonverbal cues such as nodding and other movements indicating agreement.

2.2 Diary Study

Collecting data about findability issues with Blackboard Learn in a naturalistic setting would be beneficial. However, as the application is often used multiple times a day for short periods of time, contextual inquiry methods are infeasible. A Diary Study would be a fitting option, however, as it does not require constant observation and relies on participants self-reporting. A pilot Diary Study was conducted with two participants who were asked to fill in a survey on at least two different days within a period of 4 days.

2.2.1 Protocol. The Diary Studies were prepared and structured as follows.

1. **Introducing the research**: Participants were recruited by introducing the study aim and were then sent a message that contained the study aim, an explanation of the actions required, and a link to the survey. They were asked to fill in the survey as many times as they wanted, especially when they experienced problems looking something up.
2. **Content**: The survey was created using Microsoft Forms and consisted of a minimum of 1 and a maximum of 5 questions depending on the user's answers. The questions, including their dependencies, are represented in figure 1. The exact questions and example answers can be found in Appendix H.1.
3. **Contact**: Participants were thanked after their first response and reminded on the second to last day to ensure that they would be able to submit their responses on two different days.

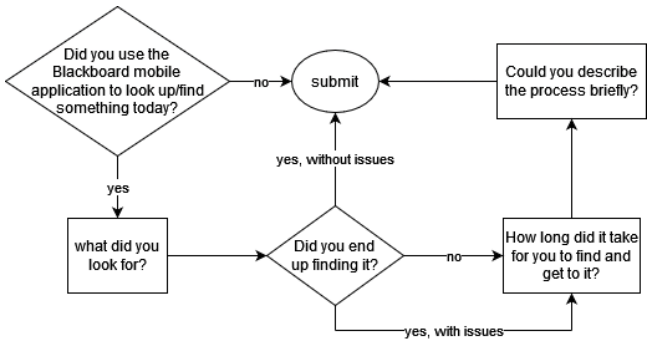


Figure 1. A flowchart illustrating the Diary Study questionnaire.

4. **Review**: After the pilot study, it was discussed with both participants simultaneously. They were given the chance to elaborate on their answers and the quality and usefulness of the Diary Study was assessed.

2.2.2 Reflection. Two responses were received from both participants, one of which submitted responses on two separate days as intended, while the other participant submitted their responses on a single day. The latter also installed the app for the first time after responding to the information message by asking if it was also fine to use the browser.

The responses received were clear and unambiguous. The review session did not reveal any additional information regarding findability, but participants were eager to discuss general usability issues with Blackboard. The participants deemed the goal and questions to be clear and easy to fill in, and thought that a Diary Study would be an effective method. Suggestions for improvement included having participants fill in the survey only when they experience problems with finding something and adding an optional field for reporting technical issues encountered. Both agreed that finding a balance between length and depth is hard, and that the pilot struck this balance well.

2.3 User Study (using Think-Aloud)

The fact that Blackboard Learn is an existing mobile application makes it easy to perform User Studies. Carefully selected tasks may reveal many problems students encounter with respect to findability. Unlike self-report methods, it allows studying the actual actions that participants take using the application. Think-aloud was chosen as a method to gain additional information about the reasoning of a participant without requiring much more time from them. A pilot think-aloud User Study was conducted with a single participant. The following sections will present the initial protocol and reflect on the outcomes.

2.3.1 Protocol. The User Studies were prepared and structured as follows.

1. **Introducing the research**: The participant was asked to participate in a quick User Study in which they were required to perform a couple of tasks using the Blackboard Learn mobile application.
2. **Content**: The participant was asked to perform four different tasks sequentially and think out loud while doing so. The tasks were provided verbally by the moderator and were repeated upon request. The tasks were: Find exam grade for a specific course, find slides for a specific lecture, find topics of next colloquium talks, and find hand-in date for a specific assignment. The specific tasks can be found in Appendix A. The moderator logged if the task was performed successfully and which steps were taken. They also made additional noteworthy observations.
3. **Closing**: The participant was thanked for their participation.

2.3.2 Reflection. The participant recruited for this pilot had never used the app before, but was able to perform all tasks successfully. Their thoughts and actions provided useful insights about findability. However, taking notes in real time was difficult and not all steps could be logged. Additionally, the moderator did not encourage the participant to think out loud, leading to extended drops in verbalization. The participant also had to ask the moderator to repeat several questions several times as they couldn't access them themselves. Recording audio and the screen could have nullified the note-taking issue but would make the method more labor-intensive when analyzing. Also, the findability problems discovered rely heavily on the tasks defined.

2.4 Other Methods

Focus groups, Diary Studies and think-aloud User Studies were not the only qualitative methods considered for this research. Other methods such as surveys, interviews, creative problem solving, contextual inquiry, case studies, co-discovery, guerilla testing, heuristic evaluation and cognitive walkthrough were also considered.

- Surveys were not chosen as they were expected to have a low response rate and the potential difficulty for students to recall findability issues without additional prompts.
- Interviews were also not chosen as they were deemed less efficient and less suitable for the topic of the research. As students are very opinionated on Blackboard they could more easily add onto what others are saying in a focus group setting.
- Creative problem solving was seen as a potential method for later stages of the research. Once findability problems have been uncovered by previous methods, creative problem solving could be used to come up with innovative solutions.
- Contextual inquiry was not chosen as it was deemed time-inefficient. Though students use Blackboard quite often, it is unpredictable when exactly they will use it. Furthermore, they often use it with quite some time in-between which makes contextual inquiry very time inefficient.
- Case studies were not chosen as the goal was to generalize results to all students and therefore studying a single or a few case(s) does not seem interesting. Furthermore, when trying to find out which problems students encounter regarding findability on Blackboard, spending a lot of time with one user would not gain sufficient extra depth to be worth the effort.
- Co-discovery was almost chosen, however, as navigating Blackboard is not a natural cooperative task, and because co-discovery effectively requires twice the amount of participants, thinking-aloud was selected for the User Study instead.
- Guerilla testing was not chosen as students could be easily recruited for more controlled experiments.
- Heuristic evaluation was not chosen as involving users was deemed to be more beneficial.
- Cognitive walkthrough was not chosen, but may be considered in future research if more resources were available. As the focus of this research was specifically on findability and on the issues that users encounter, other options which involve users were chosen instead. Given more resources, it might be interesting however to perform cognitive walkthroughs on all the thinking-aloud User Study tasks. The outcomes of both methods can then be compared to provide interesting additional insights.

3 Main Studies

The focus group pilot on Blackboard Learn's mobile application gathered information on the problems students encounter with the app. However, many contributions from participants were about generic usability issues, and it was difficult to focus on findability issues specifically. Additionally, participants often mentioned the Blackboard website without relating their statements to the mobile application being studied. Despite the moderator's attempts to steer the discussion, the group often veered away from these topics, making focus groups less effective in gathering the desired information. As a result, this method was dropped and User- and Diary Studies were chosen to be the focus going forward. The following sections discuss the procedures for carrying out these studies.

3.1 Diary Study

In the pilot study of a Diary Study on Blackboard Learn's mobile application, it was found that the questionnaire structure and questions were effective in providing valuable answers.

Participants also deemed the goal and questions to be clear and easy to fill in. However, the pilot study had limitations in terms of sample size and duration. For the main study, a larger sample size was recruited to gather more representative and reliable data. The study was also extended to a longer period of time in order to track participants' experiences over time and to increase engagement and participation. The main study began on December 12th, 2022 and continued up until December 23rd, 2022. Participants were asked to complete the questionnaire once every day and received daily reminders to do so. Additionally, the main study was conducted using the Qualtrics Survey Service for enhanced privacy. The questionaire which was used can be found in Appendix H.2.

3.2 User Study

The pilot User Study on Blackboard Learn's mobile application was conducted with a single participant, which resulted in limited data and unreliable results. To improve the reliability and generalizability of the study, it was necessary to increase the number of participants. At the same time, it was important to balance the number of participants with the resources required to conduct and analyze the results. A right balance was found at four participants. A representative sample of participants was selected to provide valuable insights without excessive resource use.

The pilot User Study had shortcomings in documenting the user's actions and verbalizations. To improve this, in the main study, screen recording was used in addition to recording audio. This allowed for capturing both the user's actions as well as their thought-verbalizations. Additionally, notes were taken during the tasks to document observations. The method of thinking aloud was used again to gain insight into the user's thought process and decision-making.

The four tasks in the pilot study can be found in Appendix A. They covered different areas of the Blackboard application and were found to provide sufficient coverage. Therefore, the main study also used these same four tasks. Adding more tasks was considered but ultimately rejected as it would have required a significant amount of extra time for both conducting the study and analyzing the results. For these tasks, potential navigational flows were established. These are:

1. Course → 2022-2023 JAAR Colloquium HI (INFOCHCI) → ...
   a. ...Announcements → [multiple announcements here have information regarding the next two talks]
   b. ...Course content →Agenda → Agenda HCI Colloquium
2. Course → Current courses → 2022-2023 Advanced HCI qualitative research methods (INFOMQLM) → Course content → Course content → Course material → Week 51: Writing academic papers; Data analysis plan presentations (20, 22 Dec)
3. Course → Current courses → 2022-2023 Advanced HCI qualitative research methods (INFOMQLM) → Course content → ...
   a. ... Course content → Course schedule
   b. ... Assignments → Qualitative Study Design
4. Course → Current courses → 2022-2023 1-GS Advanced Cognitive and Social Psychology for HCI (INFOMCSP) → Current grade

Despite these documented trajectories, it was speculated that participants might find alternative routes, which was ultimately the case. To account for this, the path each student took was documented. One thing that was changing with regard to the tasks (from the pilot study to the main one) is that, as opposed to verbally expressing the task, participants now received a card for each task (with the task written on it) to reduce unnecessary cognitive load of having to remember the (details of the) task that was given.

User Studies were conducted between the 12th of December 2022 and the 13th of January 2023.

3.3 Privacy

Ensuring the privacy and consent of participants was of the utmost importance in conducting the research study. Several steps were taken to ensure that participant data was kept confidential and that informed consent was obtained from all participants.

Firstly, all participants were fully informed about the nature of the study and the data that would be collected from them. They were given detailed information about how their data would be used, as well as any potential risks or benefits associated with participating in the study. Participants were then asked to provide their explicit consent to participate in the study and to have their data collected. The information forms can be found in Appendix I and K and the consent forms can be found in Appendix J and L.

Secondly, all participant data was securely stored and handled carefully. Measures were taken to ensure that all participant data was anonymized and that no personal identifying information was shared or published without the explicit consent of the participant.

Additionally, participants were provided with the option to withdraw from the study at any time, without providing any reason or explanation. If a participant chose to withdraw, their data was immediately removed from the study and no further action was taken with their data.

Overall, maintaining the privacy and consent of participants was a key priority in conducting this study, and all necessary steps were taken to ensure that participant data was handled in a responsible and ethical manner.

Table 1. Diary Studies Sample

Participant	Familiarity with Blackboard (website)	Familiarity with Blackboard app
D01	Four months of experience	Four months of experience
D02	Four years of experience	Three years of experience
D03	Sixteen months of experience	Sixteen months of experience
D04	Sixteen months of experience	Sixteen months of experience
D05	Three and a half years of experience	Three and a half years of experience
D06	Six years of experience	Six years of experience
D07	Four months of experience	Three months of experience
D08	Four years and a bit	No prior experience

Table 2. User Studies Sample

Participant	Familiarity with Blackboard (website)	Familiarity with Blackboard app
U1	Three months of experience	No prior experience
U2	One year of experience, although at a different University	No prior experience
U3	Four to five years of experience	Two years of experience
U4	Nine to twelve months of experience	No prior experience

3.4 Sampling

Convenience sampling was used for both the User and Diary Studies. The goal was to gather a representative and reliable dataset on the user experience of the Blackboard app. In an ideal world, a diverse sample would have been collected, including students from various years, courses, faculties, departments, graduate schools, etc. and students with a diverse range of familiarity with Blackboard and its app. However, it was found that convenience sampling the class came close to achieving this goal. The class used for sampling had students that had been students at Utrecht University for a diverse number of years, following a diverse list of courses, and students with a diverse range of familiarity with the app. This ensured that the sample was representative of students at Utrecht University who use the Blackboard app.

As for the sample size, more participants leads to more data from more perspectives, which is beneficial for the study as it leads to a more diverse, representative, generalizable, reliable, and less bias-prone dataset, which ultimately results in a more comprehensive understanding. However, more participants also comes at the cost of more resources. For the Diary Studies a balance was found at six participants, although ultimately eight participants were recruited to allow for flexibility in case of withdrawals. For the User Studies, a balance was found at four participants, which was considered a suitable number for the resources available and for the desired level of insight. This number allowed for a good balance between the amount of data collected and the resources required to conduct and analyze the study.

The resulting samples are shown in Tables 1 and 2.

3.5 Recruitment

The recruitment of participants for both studies was conducted through personal interactions, either face-to-face or via personal messaging. Potential participants were provided with a brief overview of the study and given an informational sheet that detailed the purpose, procedures, risks, and benefits of participating.

This method of recruitment was chosen for its convenience and to minimize required planning. User Studies could be conducted on an ad-hoc basis, by approaching individuals and immediately conducting the study if they expressed interest in participating. The same applied for the recruitment of participants for the Diary Study. Afterwards, except for sending daily reminders, only the appropriate form would have to be send to interested participants.

Efforts were made to avoid overlap between participants of the two studies, but it was not a strict rule as the main priority was put on obtaining a desired sample size. In the end this effort paid off and no participants participated both in the Diary and User Study.

3.6 Analysis

The data collected from the User Study and Diary Study was analyzed using Strausian Grounded Theory [2], which is a method of qualitative data analysis that emphasizes the constant comparison of data and the development of categories, properties and dimensions of these categories.

The first step of the analysis was open coding, where the data was broken down into smaller chunks and patterns and themes were identified. This included identifying specific

problems that students encountered when trying to find something on the Blackboard app and the goals they had when using the app.

In the next step, axial coding, the identified patterns and themes were organized into larger categories and related to the research question. This involved grouping similar problems and goals together and identifying relationships between them.

Finally, selective coding was performed, focusing on the most important themes and patterns that emerged from the data. These themes were then related back to the research question, "What problems are students facing regarding findability on the Blackboard Learn mobile application?".

The analysis initially aimed to relate the data back to the quantitative measures of familiarity with Blackboard. This would have provided insight into any potential relationship between familiarity with the app and the findability issues experienced by students. However, it was determined that the use of familiarity as a measure was not valid due to the presence of confounding factors. This limitation is further discussed in the limitations section of the study.

Overall, the analysis aimed to produce a comprehensive understanding of the findability issues that students experience with the Blackboard app, including both a taxonomy of the problems and a taxonomy of the goals that students have when using the app.

4 Study Results

In total, the participants of the Diary Study provided 58 responses. Of these 58 responses, 26 responses reported the use of the Blackboard mobile application and thus contained a navigation goal. Out of these 26 responses, 10 responses encountered one or more issues while navigating.

During the User Study, which contained a predefined goal for every of the four tasks, 25 instantiations of problems were identified. Using Straussian Grounded Theory, all reported goals and problems were coded. The codes of each reported problem and their goal can be found in Table 3. All codes and their desciption can be found in Appendix D.

4.1 Taxonomies

A goal and problem taxonomy was derived directly from the created codes. These taxonomies can be found in Figure 2 and Figure 3 respectively. Both Figures can also be found in larger formats in Appendix E.

The goal and problem taxonomies include numbers, written between parentheses, which are related to the findings of the Diary Study and the User Study respectively. The numbers in the goal taxonomy represent the success rate of the goals from the reported attempts in the Diary Study. Here the second number represents the number of times the goal was attempted and the first number represents the number of times the goal was achieved without encountering any

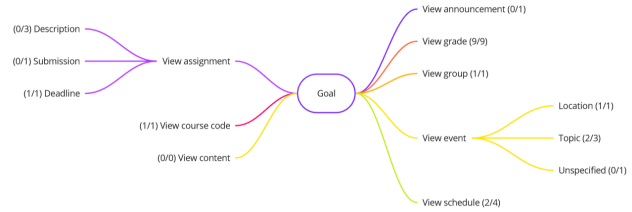


Figure 2. A taxonomy derived directly from the codes of all the reported goals in the Diary and User Study combined.

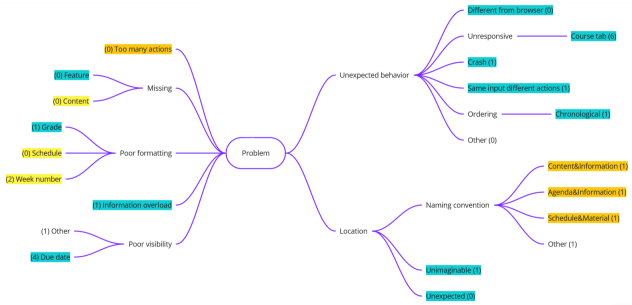


Figure 3. A taxonomy derived directly from the codes of all the reported problems in the Diary and User Study combined.

issues. For example "View grade (9/9)" means that nine attempts to view a grade have been reported of which none encountered any issues. It is good to note that these success rates are prone to bias. Participants have been instructed to fill in at least one diary entry every day and especially report cases in which they encountered problems. Therefore, success rates may be deceivingly low and based on limited data.

The numbers in the problem taxonomy allow for more interpretation. These represent the number of times each problem was observed during the User Study. With a controlled environment, and careful observation aided by out-loud thinking of the participant, these are less prone to error. However, as the User Study included only four tasks with one goal each, they do not represent a natural distribution.

The problems in the taxonomy are also categorized as indicated by the highlighting color. Problems highlighted in cyan are marked as the responsibility of Blackboard, yellow ones as the responsibility of the course organizer and orange as ambiguous (to the limited knowledge of the researchers).

4.2 Hierarchy Charts

The prominence of the goals and problems in both studies have been visualized in hierarchy charts in Appendix F. Figures 6a and 6b show the relative prominence of the goals and problems in the Diary Study respectively. Note that the figure visualizing the goals includes all 26 responses which reported the use of the Blackboard mobile application,

whereas the figure visualizing the problems only includes the 10 of those which reported problems.

For the User Study, the goals were fixed for all four tasks for all participants. Therefore, Figure 6c shows the relative number of problems which were encountered for each goal. Figure 6d shows the relative prominence of all problems encountered during the User Study. The tables with the numerical values on which these hierarchy charts are based can be found in Appendix G.

4.3 Navigational flows

As explained in section 3.2, prior to the execution of the User Study, at least one navigational flow had been defined for every task. The defined navigational flows were followed for all tasks by all participants, with only a single exception. A navigational flow is considered to be followed if all steps included in it were used to reach the goal. Performing different actions before or during this sequence does not violate the following of a navigational flow as long as the user starts or resumes the sequence at some point. Furthermore, as participants were told that they did not have to go back to the start screen between each task, skipping course selection actions was also not considered as a violation of the navigational flow.

For the first task, all participants followed trajectory (b). Interestingly, as the content was missing for U3 and U4, these two participants performed trajectory (a) directly afterwards. For the third task, three out of four participants followed trajectory (b) and U4 followed trajectory (a) instead. For the fourth task, U1 followed a yet unidentified trajectory: More → Grades → Current → 2022 - Periode 1-GS → 2022-2023 1-GS Advanced Cognitive and Social Psychology for HCI (INFOMCSP)

5 Conclusions

First of all, it is good to note that overall students seem to be able to find what they look for. Out of the 26 reported Blackboard uses in the Diary Study, only two indicate that the item could not be found. Out of these two, one was caused by a missing feature and in the other one the content was missing. Also, the User Study had two instances where an item could not be found, which were both because the content was missing.

Hence, potential improvements should aim to reduce the amount of interactions required, make actions intuitive, reduce additional confusion and resolve bugs. Reducing the amount of interactions should resolve having to do too many interactions to find something and could make locations imaginable. Additionally, making actions intuitive should resolve unexpected behavior issues with functionality working different from the browser, having the same input generate different actions and with (chronological) ordering. Furthermore, additional confusion could be resolved by tackling unexpected locations or locations that suffer from problematic naming conventions. Also reducing information overload, improving formatting and consistently adding content and features could help to resolve additional confusion. Lastly, bugs could be fixed to prevent crashes and fix unresponsive functionality which hinder navigation.

As can be seen from the text highlighting in the problem taxonomy in Figure 3, the identified problems are the responsibility of different stakeholders. In this research, two stakeholders have been identified: Blackboard and course organizers. Therefore, the potential improvements identified above should also be implemented by these stakeholders respectively.

As can be seen from the hierarchy charts in Figure 6b and 6d in Appendix F, the problems identified by the Diary Study and the User Study overlap partly, but interestingly also differ quite substantially. This seems to support our assumption that a Diary Study and User Study would work complementary to research findability problems. This could be explained by the fact that a Diary Study relies heavily on self-report and User Studies allow the observation of (unconscious) problems in the moment. Comparing Figures 6a and 6c in Appendix F provides evidence for the representativeness of the tasks of the User Study. Viewing content does not appear in self-reports in the Diary Study, but the other three tasks are well presented in there.

Apart from these additional findings, the main contributions of this study are the goal and problem taxonomies which can be found in Figure 2 and 3. The problem taxonomy directly answers the research question by showing a hierarchical organization of problems that students are facing regarding findability on the Blackboard Learn mobile application. The goal taxonomy additionally shows during the pursuing of which goals these problems are encountered.

Furthermore, from Table 3, four relations between certain goals and problems can be derived: (1) Unexpected behavior is encountered during various goals. It is only absent in our results when aiming to view an assignment submission, a group or the topic of an event. The omnipresence of unexpected behavior is sensible as unexpected behavior hinders generic usability of the Blackboard mobile application. (2) Apart from unexpected behavior, viewing content suffers specifically from poor formatting issues and problematic naming conventions. (3) Apart from unexpected behavior, viewing an assignment leads to missing feature and location issues. (4) Viewing an assignment deadline specifically reveals the poor visibility of the due date feature. Though this problem was recorded when viewing an event topic too, it is inherently specific to assignment deadlines.

6 Discussion and Limitations

The limitations of this study should be acknowledged in order to understand the potential biases and inaccuracies of the findings. The following limitations were identified:

The method used for identification in the Diary Studies included manual entering of an assigned numerical ID. This ID was however not validated in Qualtrics, this created a security risk as users could potentially sabotage other participants' results by either accidentally or purposefully entering an ID that was not theirs. Additionally, the researchers were aware of which user received which ID, which despite anonymizing the data, did not result in a double-blind experiment which could have been used.

The sampling method used in this study was convenience sampling, which may not have produced a representative sample of the population. This limits the generalizability of the results, as it only included students from a single course, and an ideal sampling would have included participants from other departments, faculties, and classes. Additionally, a larger sample size would have provided more data and a better representation of the population.

The duration of the Diary Studies was limited to a single week, which may not have been sufficient to capture all of the problems that students face with the Blackboard app. A longer duration of the Diary Studies would have provided more data and a more comprehensive understanding of the findability issues that students face.

Another limitation of this study is that it does not relate the problems that participants encountered to their familiarity with the Blackboard app. While it was intended, it was not possible to do so due to the nature of the User Study. The amount of problems observed in a participant during the User Study was likely influenced by their thinking aloud skills. Participants who were more vocal and able to effectively communicate their thoughts and struggles were more likely to have more problems identified, leading to an overestimation of the number of problems they encountered. Additionally, the frequency of problems encountered in the Diary Study may not be representative, as a user may encounter many more problems than they reported on a given day and reporting frequencies may differ between participants. This highlights the limitations of self-reported data and the importance of considering alternative methods in future studies.

The study was conducted in English, and it could be argued that a multilingual study would have been more beneficial, as the app is also used by students who do not speak English as their first language.

The scope of this study is limited to students only, despite there being a lot of other users of the app at the Utrecht University such as staff and faculty members. The study was also conducted only at Utrecht University, and it would be beneficial to conduct similar studies at other universities to see if the findings generalize to other institutions. Future research could expand on different perspectives and include other user groups.

Finally, it is worth noting that while the study aimed to identify problems related to findability within the Blackboard app, it did not aim to evaluate the effectiveness of any potential solutions or proposed changes. Further research would be required to evaluate the impact of any changes made to the app on user experience.

Overall, this study has several limitations that should be acknowledged when interpreting the results. Despite these limitations, the findings provide valuable insights into the findability issues that students face with the Blackboard Learn mobile application and can be used to improve the usability of the app and enhance the overall user experience for students.

References

[1] Imed Bouchrika. 2022. 51 LMS Statistics: 2023 data, Trends & Predictions. https://research.com/education/lms-statistics#TOC2

[2] Juliet M. Corbin and Anselm Strauss. 1990. Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology* 13, 1 (1990), 3–21. https://doi.org/10.1007/bf00988593

A User Studies Tasks

1. Find the topics of the next two colloquium talks.
2. Find the slides for the lecture on Tuesday 20 December for the course Advanced HCI Qualitative Research methods 2022-2023.
3. Find the hand-in date for the 'Qualitative Study Design' for the course Advanced HCI Qualitative Research Methods 2022-2023
4. Find your Exam Grade for the Advanced Cognitive and Social Psychology 2022-2023 course

B Diary Study Information message

Thanks for piloting our Diary Study about findability on the Blackboard mobile application. We like to find out which problems students experience when trying to find things on Blackboard via the mobile application. For this reason, we ask you to fill in a very quick survey on two workdays.

You can report as many search attempts per day as you like. If you didn't look up anything using the Blackboard mobile app you can still fill in the survey. It would be great if you could fill it in on days when you tried to look up something, especially if you experienced problems when doing so.

You can find the survey link below, feel free to contact us if you have any questions and thanks again for your help!
https://forms.office.com/e/a7PaSrvujw

C Reported problems

ID	Goal	Problem
	View assignment	
D04	Description	Location Unexpected
D06		Unexpected behavior Unresponsive Course tab
D07		Unexpected behavior
D05	Submission	Missing Feature
U02	Deadline	Unexpected behavior Unresponsive Course tab
U02		Poor visibility Due date
U02		Location unimaginable
U03		Unexpected behavior Unresponsive Course tab
U03		Poor visibility Due date
	View event	
D01	Topic	Content&Information
U01		Poor visibility Due date
U02		Poor visibility Due date
U03		Location Naming convention Agenda&Information
U03		Missing Content
U04		Missing Content
U01	View grade	Information Overload
U01		Unexpected behaviour Ordering Chronological
U01		Poor visibility
U01		Naming convention
U02		Unexpected behavior Unresponsive Course tab
U02		Unexpected behavior Same input different actions
U02		Poor formatting Grade
U03		Unexpected behavior Unresponsive Course tab
D08	View announcement	Unexpected behavior
D06	View group	Location Unexpected
D08	View schedule	Missing Content
D06		Too many actions
		Unexpected behavior Different from browser
D06		Too many actions
		Poor formatting Schedule
U01	View content	Poor formatting Week number
U02		Poor formatting Week number
U02		Location Naming convention Schedule&Material
U02		Unexpected behavior Unresponsive Course tab
U03		Unexpected behavior Unresponsive Course tab
U04		Location Naming convention Content&Information
U04		Unexpected behavior Crash

Table 3. All reported problems ordered based on their accompanying goal and including participant identifier. The identifier of participants start with the capital letter 'D' or 'U' for those of the Diary Study and User Study respectively.

D Code Descriptions

D.1 Goals

Goal Code	Description
View assignment	User wants to see an aspect of an assignment
Description	User wants to see description of an assignment
Submission	User wants to view the submission of an assignment
Deadline	User wants to see the when an assignment is due.
View course code	User wants to see the course code of a course
View content	User wants to view miscellaneous content
View announcement	User wants to view an announcement
View grade	User wants to see a specific grade for a specific course
View group	User wants to view a specific group which they are part of for a specific course
View event	User wants to seen an aspect of an event
Location	User wants to see the location of an event
Topic	User wants to see the topic of an event
Unspecified	User wants to see an unspecified aspect of an event
View schedule	User wants to see their schedule

Table 4. Goal codes and their description

D.2 Problems

Problem Code	Description
Poor visibility	An element goes unnoticed by a user
Other	A miscellaneous element went unnoticed
Due date	The 'due date' section on the page of a course went unnoticed
Information overload	Too much information or too many options were presented
Poor formatting	An element is poorly formatted
Grade	The grade is not standardized (1-10), in this case it was 22.84 / 30
Schedule	The presented schedule is formatted poorly
Week number	Week numbers are used instead of dates
Missing	An item is missing
Feature	A feature within the app does not exist
Content	Content within the app was not added by a course organizer
Too many actions	It takes too many actions to navigate to a place within the app
Unexpected behavior	The behavior is different than what the user expected
Different from browser	The app shows different behavior than the web client
Unresponsive	The app is unresponsive
Course tab	Clicking the 'course' tab does not do anything
Other	A miscellaneous feature within the application is unresponsive
Crash	The app crashed
Same input different actions	the same input/gesture leads to a different result
Ordering	The ordering of a list within the app leads to confusion
Chronological	A chronological order was used instead of sorting based on recency
Other	An aspect behaved in a miscellaneous unexpected manner
Location	An item is found in an unexpected location
Naming convention	The way items are named leads to confusion where something can be found
Content&Information	It is unclear to the user if the item they are looking for can be found under Course content or Course information
Agenda&Information	It is unclear to the user if the item they are looking for can be found under Agenda or Course information
Schedule&Material	It is unclear to the user if the item they are looking for can be found under Course Schedule or Course Material
Unimaginable	The user could not imagine where the item they are looking for would be located
Unexpected	There was a discrepancy between the actual location of an item and were it was expected to be

Table 5. Problem codes and their description

E Taxonomies

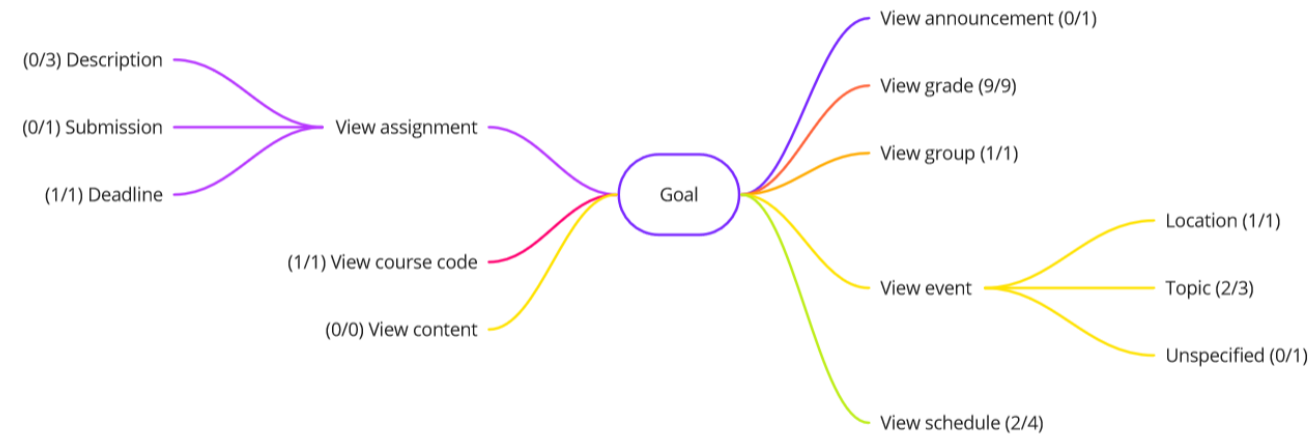


Figure 4. A taxonomy derived directly from the codes of all the reported goals in the Diary and User Study combined.

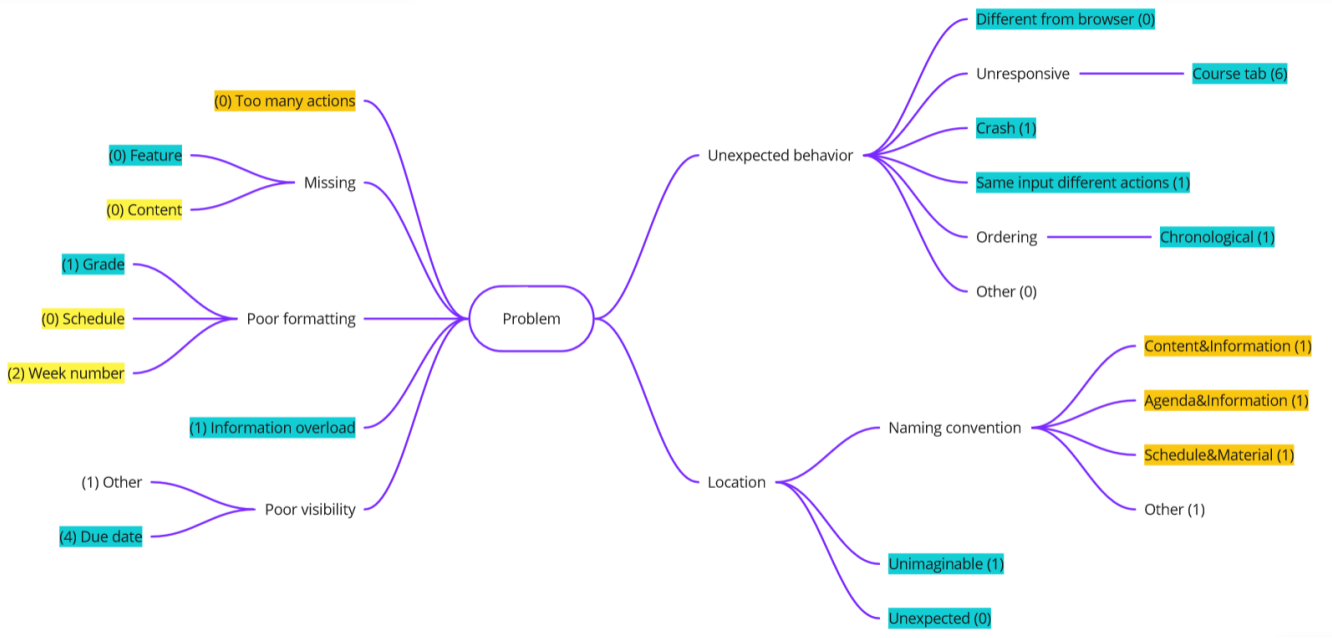
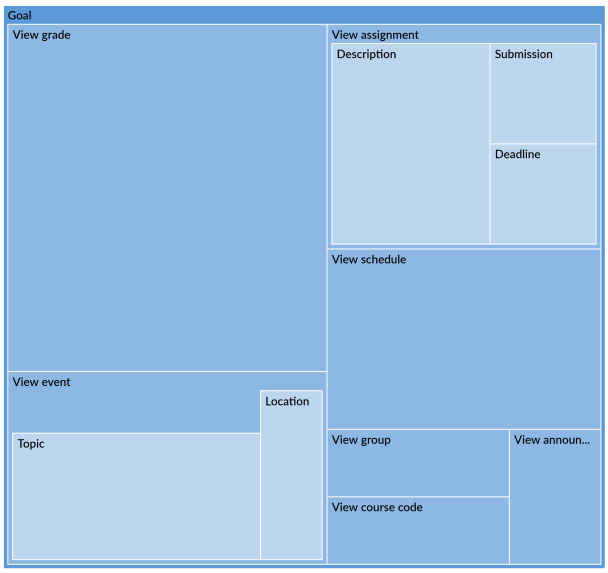
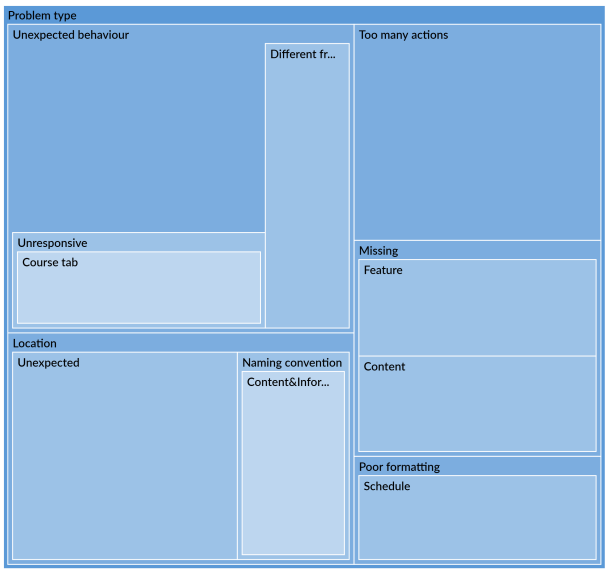


Figure 5. A taxonomy derived directly from the codes of all the reported problems in the Diary and User Study combined.

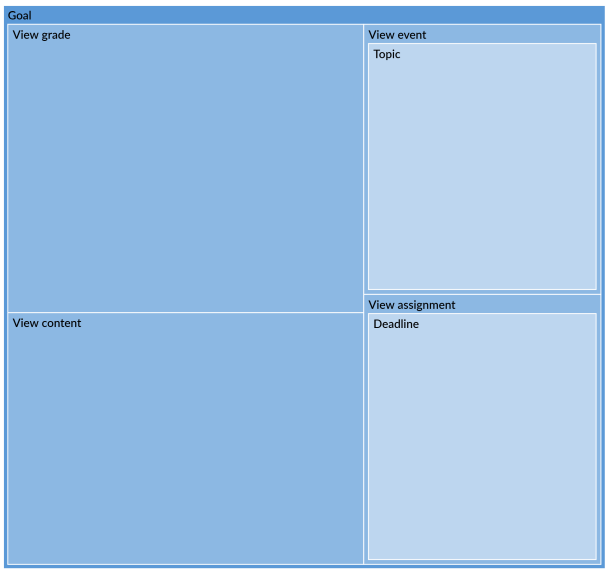
F Hierarchy Charts



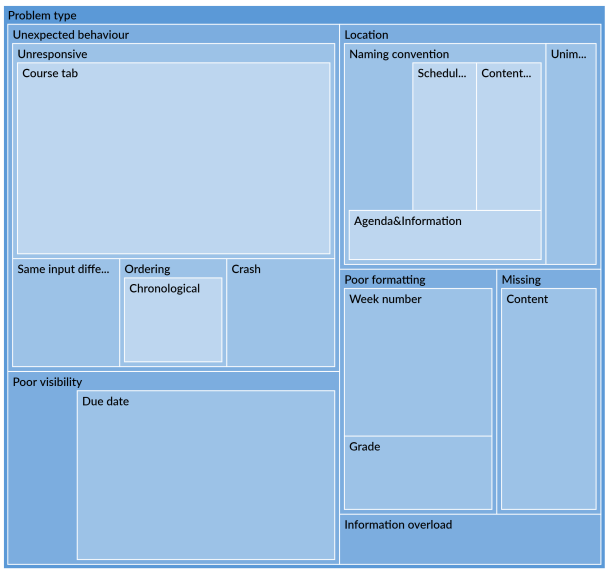
(a) Goals of the Diary Study



(b) Problems of the Diary Study



(c) Number of problems for each goal in the User Study



(d) Problems of the User Study

Figure 6. Hierarchy charts of the relative prominence of the goals and problems from the Diary and User Study.

G Frequency tables

Goal	#
View announcement	1
View assignment	
Deadline	1
Description	3
Submission	1
View course code	1
View event	1
Location	1
Topic	3
View grade	9
View group	1
View schedule	4

(a) Number of times each goal was reported in the Diary Study

Problem	#
Location	
Naming convention	
Content&Information	1
Unexpected	2
Missing	
Content	1
Feature	1
Poor formatting	
Schedule	1
Too many actions	2
Unexpected behavior	2
Different from browser	1
Unresponsive	
Course tab	1

(b) Number of times each problem was reported in the Diary Study

Goal	#
View assignment	
Deadline	5
View content	7
View event	
Topic	5
View grade	8

(c) Number of problems observed for each goal in the User Study

Problem	#
Information overload	1
Location	
Naming convention	
Agenda&Information	1
Content&Information	1
Schedule&Material	1
Unimaginable	1
Missing	
Content	2
Poor formatting	
Grade	1
Week number	2
Poor visibility	1
Due date	4
Unexpected behavior	2
Crash	1
Ordering	
Chronological	1
Same input different actions	1
Unresponsive	
Course tab	1

(d) Number of times each problem was observed in the User Study

Table 6. Frequency of the goals and problems from the Diary and User Study.

H Diary Study Survey

H.1 Pilot survey

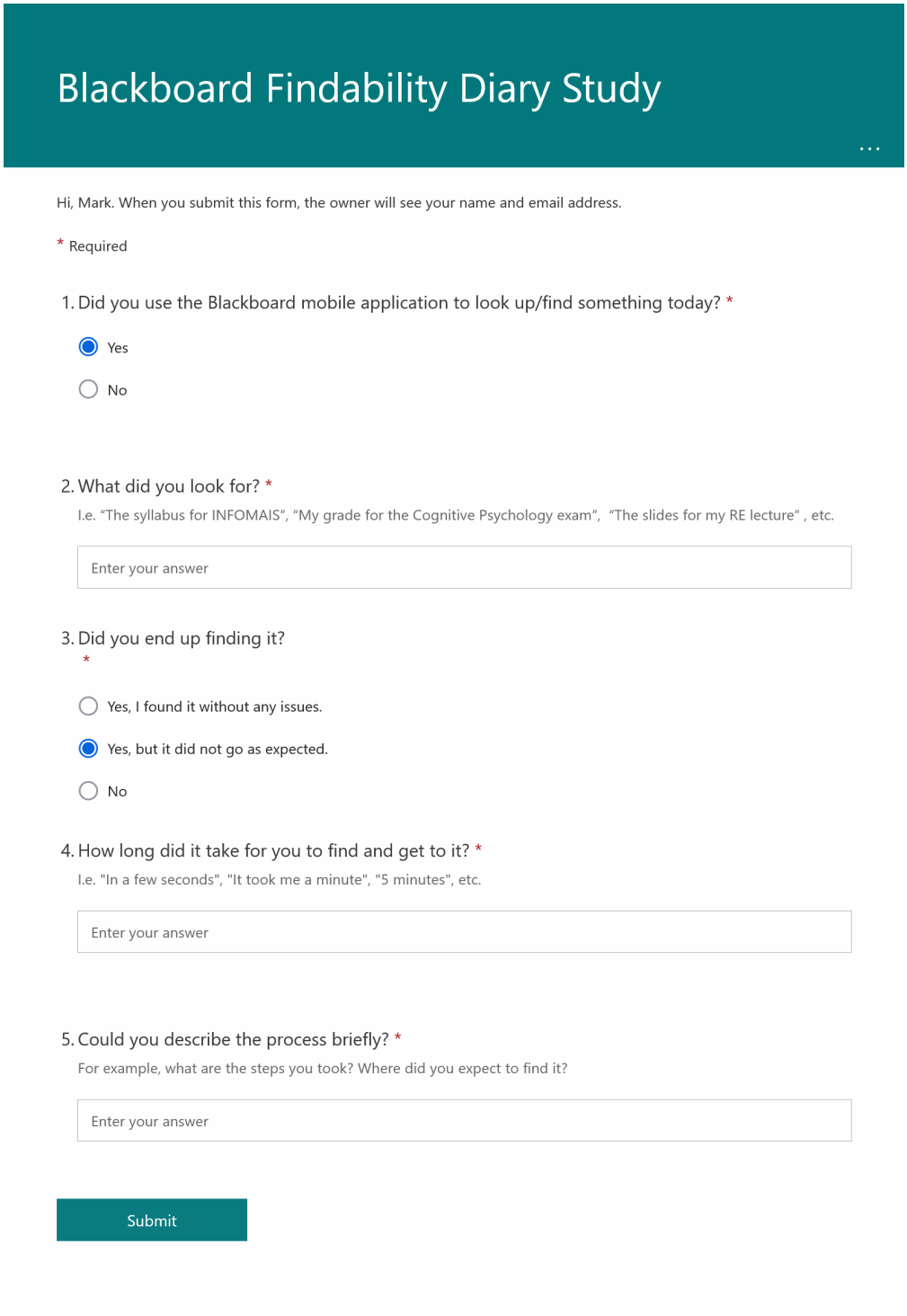


Figure 7. The pilot Diary Study survey made with Microsoft Forms as seen on a desktop device.

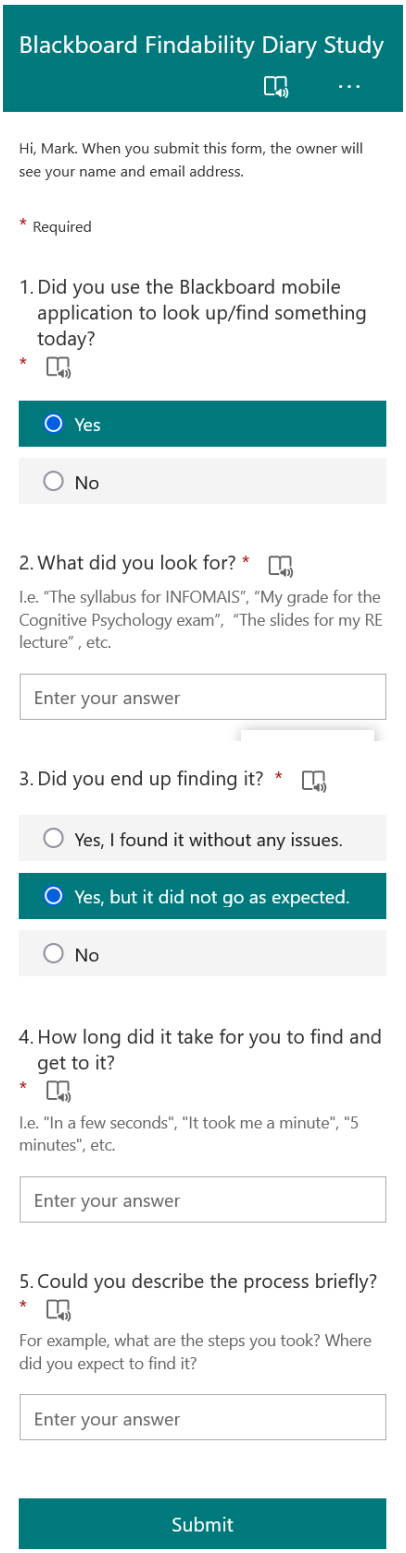


Figure 8. The pilot Diary Study survey made with Microsoft Forms as seen on a mobile device.

H.2 Final survey

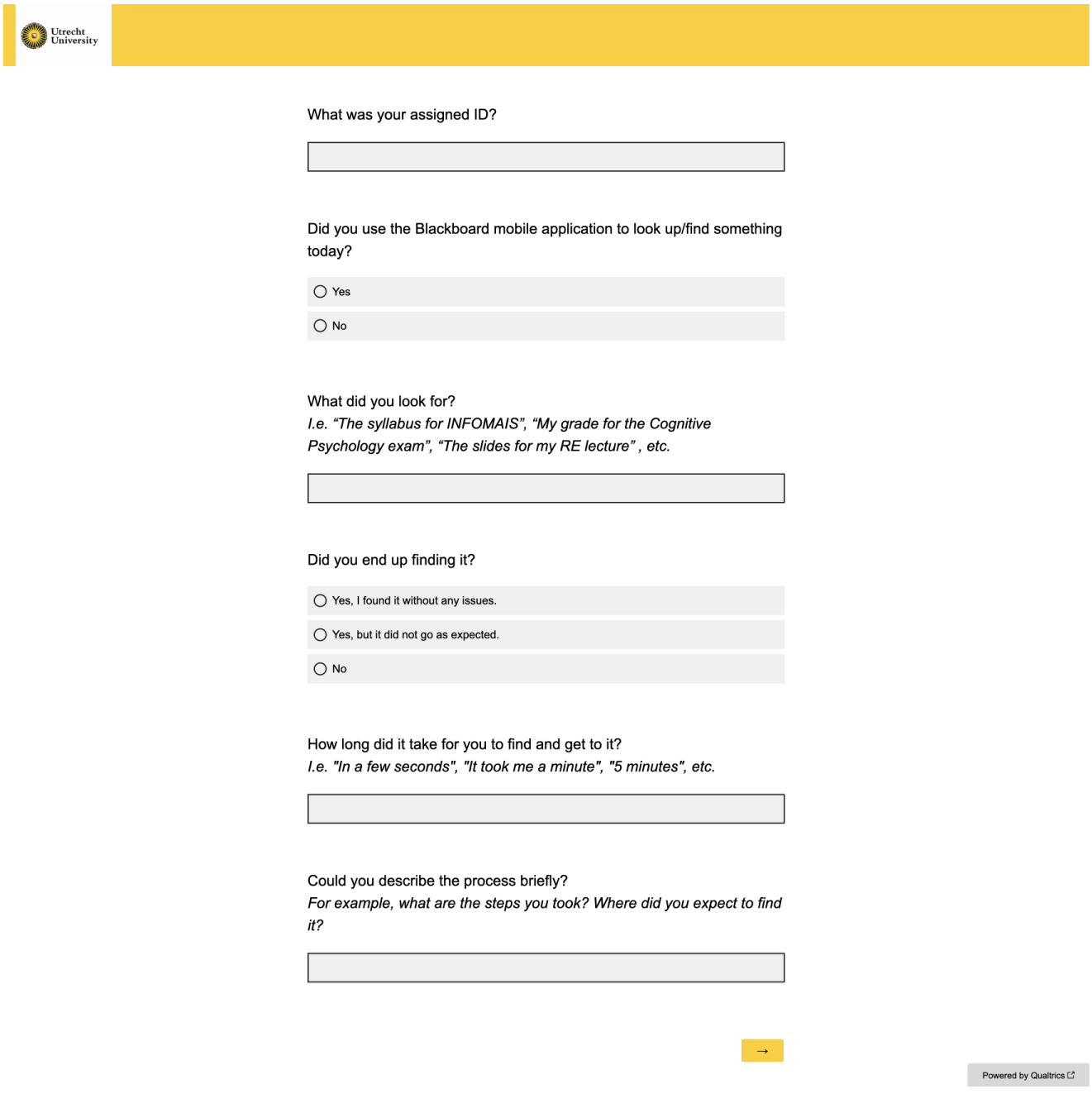


Figure 9. The full Diary Study survey made with Qualtrics as can be found at https://survey.uu.nl/jfe/form/SV_1BQXh6R3d6A4Dem

I Diary Study Information Form

Diary Study Information Sheet
You have been invited to participate in a diary study for the course Advanced Qualitative Research Methods at Utrecht University. The study aims to investigate what problems students encounter regarding findability using the Blackboard mobile app. You will be asked to fill in at least one diary entry every day for 7 days in a row about your search attempts on Blackboard for that day. Your responses will be kept completely confidential.

The study is conducted by Samuel Spithorst and Mark Rietvelt. The completion of this intake form will take approximately 3 minutes. The completion of a diary entry will take about 1 minute.

Participation
Your participation in this study is completely voluntary. You have the right to withdraw from the study at any time by closing this survey, stop filling in the daily surveys or contacting one of the researchers. You are not obliged to give any reason for withdrawal.

Benefits & Risks
You will receive no direct benefit from participating in this study. However, you do help us to learn more about the problems students encounter regarding findability using the Blackboard mobile app. We foresee no risks associated with participating in this study.

Confidentiality
Your responses will be gathered via Qualtrics. This data will not be linked to you personally, only to an identification number. The data will be used exclusively for the assignment within this course.

If you have any questions or comments regarding this survey or the study as a whole, please contact us at m.r.j.p.rietvelt@students.uu.nl or s.f.spithorst@students.uu.nl

Figure 10. Information form to accompany the Diary Study

J Diary Study Consent Form

Universiteit Utrecht

Consent form for participation in the research project

"What problems students encounter regarding findability on the Blackboard mobile application"

Please read the statements below and tick the final box to confirm you have read and understood the statements and upon doing so agree to participate in the project.

I confirm that I am 18 years of age or over.

I confirm that the research project ***"What problems students encounter regarding findability on the Blackboard mobile application"*** has been explained to me. I have had the opportunity to ask questions about the project and have had these answered satisfactorily. I had enough time to consider whether to participate.

I consent to the material I contribute being used to generate insights for the research project "**What problems students encounter regarding findability on the Blackboard mobile application*".***

I understand that personal data will be collected from me and that this information will be held confidentially so that only Samuel Spithorst and Mark Rietvelt have access to this data and are able to trace the information back to me personally. The information will be held in a password protected secure place for up to 4 weeks after which period if will be fully anonymized. In accordance with the General Data Protection Regulation (GDPR) I can have access to my information and can request my data to be deleted at any time during this period.

I understand that my participation in this research is voluntary and that I may withdraw from the study at any time without providing a reason, and that if I withdraw any personal data already collected from me will be erased.

I understand that my participation is not a requirement for my course, and that participating or not will not impact me.

I consent to allow the fully anonymized data to be used in future publications and other scholarly means of disseminating the findings from the research project.

I understand that the data acquired will be securely stored by researchers, but that appropriately anonymized data may in future be made available to others for research purposes. I understand that the University may publish appropriately anonymized data in appropriate data repositories for verification purposes and to make it accessible to researchers and other research users.

I understand that I can request any personal data collected from me to be deleted.

Figure 11. Consent form to accompany the Diary Study

K User Study Information Form

Universiteit Utrecht

Information sheet for participation in the research project

"What problems students encounter regarding findability on the Blackboard mobile application"

You have been invited to participate in a user study for the course Advanced Qualitative Research Methods at Utrecht University. The study aims to investigate what problems students encounter regarding findability using the Blackboard mobile app. You will be given a series of tasks, in which the goal is to find a specific item on the application. During the completion of these tasks we ask of you to 'think-aloud', where you verbalize your thought process.

The study is conducted by Samuel Spithorst and Mark Rietvelt.

Participation
Your participation in this study is completely voluntary. You have the right to withdraw from the study at any time. You are not obliged to give any reason for withdrawal. Upon withdrawal, all of your data will be permanently deleted.

Benefits & Risks
You will receive no direct benefit from participating in this study. However, you do help us to learn more about the problems students encounter regarding findability using the Blackboard mobile app. We foresee no risks associated with participating in this study.

Confidentiality
During the completion of the tasks both the microphone and phone screen will be recorded. This footage will be transcribed and anonymized, upon which the recordings will be deleted permanently. Transcribed data will not be linked to you personally, only to an identification number. The data will be used exclusively for the assignment within this course. The data will be stored on Utrecht University OneDrive servers.

If you have any questions or comments regarding this survey or the study as a whole, please contact us at m.r.j.p.rietvelt@students.uu.nl or s.f.spithorst@students.uu.nl

Figure 12. Information form to accompany the User Study

L User Study Consent Form

Consent form for participation in the research project

"What problems students encounter regarding findability on the Blackboard mobile application"

Please read the statements below and tick the final box to confirm you have read and understood the statements and upon doing so agree to participate in the project.

☐ I confirm that I am 18 years of age or over.

☐ I confirm that the research project ***"What problems students encounter regarding findability on the Blackboard mobile application"*** has been explained to me. I have had the opportunity to ask questions about the project and have had these answered satisfactorily. I had enough time to consider whether to participate.

☐ I consent to the material I contribute being used to generate insights for the research project "**What problems students encounter regarding findability on the Blackboard mobile application*".***

☐ I consent to audio and screen recordings being used in this study as explained in the information sheet. I understand that I can request to stop recordings at any time.

☐ I understand that if I give permission, the audio and screen recordings will be held confidentially so that only Samuel Spithorst and Mark Rietvelt have access to this data and are able to trace the information back to me personally. The information will be held in a password protected secure place for up to 4 weeks after which period if will be fully anonymized. In accordance with the General Data Protection Regulation (GDPR) I can have access to my information and can request my data to be deleted at any time during this period.

☐ I understand that in addition to the recordings, other personal data will be collected from me and that this information will be held confidentially so that only Samuel Spithorst and Mark Rietvelt have access to this data and are able to trace the information back to me personally. The information will be held in a password protected secure place for up to 4 weeks after which period if will be fully anonymized. In accordance with the General Data Protection Regulation (GDPR) I can have access to my information and can request my data to be deleted at any time during this period.

☐ I understand that my participation in this research is voluntary and that I may withdraw from the study at any time without providing a reason, and that if I withdraw any personal data already collected from me will be erased.

☐ I understand that my participation is not a requirement for my course, and that participating or not will not impact me.

☐ I consent to allow the fully anonymized data to be used in future publications and other scholarly means of disseminating the findings from the research project.

Figure 13. Consent form to accompany the User Study