SUMMARY

This article reports on a research done in the university environment at Aalborg University in Denmark. The research considers blended learning, which is a mix of face-to-face learning together with asynchronous technology induced learning, in order to improve the learning process students face today. It is recognized that the inclusion of technology in the learning process is associated with benefits which can improve the process. To support this student-to-student relationship in the learning process, value co-creation is considered as a main theory. In this research, it is thus sought to explore how value co-creation can be utilized for designing an IT solution to a problem currently experienced by.

The notion of value co-creation is presented in a framework from a previous research. This framework was build theoretically from a literature review, and it has not been previously tested in the field. The framework entails the constituents of the concept. One of these elements are value-creating activities, in which knowledge-sharing is regarded as a main activity. This focus of this research is mainly on this activity, due to the nature of the university context, that implies knowledge-sharing between students. It is acknowledged that this activity also provide an opportunity for students to tests and improve their knowledge on the basis of the feedback they receive from peers. Furthermore, the importance of sense of community is recognized, since it has a number of benefits associated, such as providing the student with a feeling of belonging, making them more involved in their education, thus motivating them to reveal their doubts, and thus obtain and provide knowledge. As the knowledge is shared online, trust in online communities is also considered for the artifact.

It is a desire of this research to propose a solution to a genuine problem, thus the methodology selected is design science research, as this allows for designing an artifact to solve a problem. The chosen methodology suggest few activities and these are presented below.

The research begins with an inquiry into the problem which is performed on the basis of two focus group interviews. The inquiry revealed a general problem, which is that students have difficulties with asking questions, which leads to a number of issues. There are two problem areas identified, which are also reasons for the main problem. The first is the lack of safe space, which implies that students feel they are supposed to know the answers to their own doubts, and so they are not inclined to ask questions, and thus obtain knowledge. The second is the lack of transparency, which implies that students feel alone with their difficulties, and do not realize that other students also have struggles in regards to the course material.

The objective for the solution is therefore to address the above-mentioned problem areas, and with this to diminish them. For this purpose, two features are proposed, namely anonymity, which has the potential to tackle the issue with lack of safe space, and a rating system, that addresses the issue of lack of transparency.

The artifact description, is then based on the utilization of the framework to inform the design of the solution. The elements of value co-creation were taken in consideration, and were transformed into a few features for the artifact, such as a "Lecturer approved" stamp, giving a new answer, elaborating on an existing answer, and writing of a new question. Designing with the framework led to features, which support value-creation, but not the general user interaction, therefore there was also a need to gain inspiration from other knowledge-sharing forums. For this, Jodel is selected and on the basis of the graphical design, several features are considered and it is described how they appear in the artifact.

The designed artifact underwent two rounds of evaluation, that relate to two versions of the prototype. The findings are presented in four parts. First, the transition between the two prototypes is explained, in relation to what was improved in the second prototype. Second, an overall evaluation of the artifact is presented. Third, the features and their utility are presented, along with a table to provide an overview. Fourth, the findings from the evaluations are analyzed with the lens of the value co-creation notion. The findings show that informing a design with the value co-creation framework, results in the design of an artifact that is reported to bring value to the students, and aid with the main problem researched in the study. The reported values are the creation of a safe space, and transparency, that were the two problem areas, together with sense of community.

Having examined the existing research on the topics covered, along with the findings from this research, the relevance of the results is discussed in three parts. This research contributes to a better understanding of the notion of value co-creation, and the dependencies between its components. This resulted in an improved value co-creation framework, which contributes to the general research on value co-creation. This study further adds to the existing body of research on value co-creation, by supplementing it with a pragmatic example of how value co-creation can be used to inform a design of an IT-based solution. Furthermore, it adds to the research on the matter in a university context by demonstrating how students can co-create value together. The designed artifact incorporates all the different components found in the existing literature, which are referred to as important elements of knowledge-sharing. Furthermore, the artifact allows for discussion, which enhances the sense of community and is regarded essential for the knowledge-sharing activity.

AALBORG UNIVERSITY

STUDENT REPORT

Title:
IT-Based Value Co-Creation and its Design Implications

Theme:
Master Thesis

Project Period:
Spring Semester 2017

Project Group:
is1023f17

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Date of Completion:
June 8, 2017

Abstract:

The university learning environment holds a long-standing tradition of lectures by professors in large impersonal auditoriums with little room for students personal insecurities, when they encounter topics difficult to comprehend. With the use of design science research, this article seeks to investigate how an artifact can solve a genuine problem currently experienced by students. For this, it was researched how the value co-creation notion can be used to inform of a design, that can support students in their learning process. On the basis of the theory on value co-creation, a solution was designed. One major component of this theory is knowledge-sharing, which is also the focus of this research. The findings show that an IT solution designed on the basis of the value co-creation notion, creates value for the students and has the potential to solve the identified problem in this research. The results of this research led to an improved, and more generic framework on value co-creation. This study further adds to the existing body of research on value co-creation by providing a pragmatic example of how this concept can be used to inform a design. More so, it supplements the existing literature on value co-creation in a university context, and knowledge-sharing between students.

IT-Based Value Co-Creation and its Design Implications

Lise Lotte Selnø & Hristina Todorova Prosenikova

Abstract—**The university learning environment holds a longstanding tradition of lectures by professors in large impersonal auditoriums with little room for students personal insecurities, when they encounter topics difficult to comprehend. With the use of design science research, this article seeks to investigate how an artifact can solve a genuine problem currently experienced by students. For this, it was researched how the value co-creation notion can be used to inform of a design, that can support students in their learning process. On the basis of the theory on value co-creation, a solution was designed. One major component of this theory is knowledge-sharing, which is also the focus of this research. The findings show that an IT solution designed on the basis of the value co-creation notion, creates value for the students and has the potential to solve the identified problem in this research. The results of this research led to an improved, and more generic framework on value co-creation. This study further adds to the existing body of research on value co-creation by providing a pragmatic example of how this concept can be used to inform a design. More so, it supplements the existing literature on value co-creation in a university context, and knowledge-sharing between students.**

Index Terms—**Value Co-Creation, IT design, Design Science Research, University, Students, Learning process**

I. INTRODUCTION

Bringing online education into the learning process, is a phenomenon known as blended learning, which means that the learning experience is a mix of both face-to-face classroom learning and online learning (Garrison and Kanuka, 2004, p. 96). Transforming the current learning process at universities to accommodate for the increasing technology usage is critical, in order to obtain the related benefits (Garrison and Kanuka, 2004, p. 96). As technology is constantly developing, we are also seeking and finding new possibilities for improving our routines. Learning is one area ripe for improvement, and several attempts has been seen over the last decade, such as Coursera or Team Tree House, which is online course portals to Kahoot, which is a platform for teachers to create quizzes for their students. This mix of classroom learning and online learning is challenging the traditional way of universities, but is necessary in order to realize the benefits associated (Garrison and Kanuka, 2004, p. 96). These benefits span from information that is "more thoughtful, reasoned, and supported by evidential sources" because of the permanency of the information to the sense of community created when dialogue is established (Garrison and Kanuka, 2004, p. 99). This sense of community is important as "students with stronger sense of community tend to possess greater perceived

levels of cognitive learning" (Garrison and Kanuka, 2004, p. 99) and it makes students feel less isolated, as well as give them greater satisfaction with their education (Rovai, 2002, p. 319). Online learning is a form of asynchronous communication, which is complementary to classroom learning. The benefit of this asynchronous learning is that students can learn independently of time and space, but still do it together, while the benefit of the synchronous learning is that students can meet and form a community (Garrison and Kanuka, 2004, p. 97). When merging both into a blended learning context, it is said to "provide the independence and increased control essential to developing critical thinking"(Garrison and Kanuka, 2004, p. 98). During learning it is common to come across topics that are difficult to comprehend, which makes the meaning unclear for students. This can affect students self-esteem, as their own expectations are not met. Furthermore, this feeling of defeat leads to avoiding asking for help when it is needed, and then Google is usually the sought help. However, Google cannot always provide the correct answer because some of the topics at the University are context specific, and relate to the selected course material. It is evident that the current way of learning has areas that can be improved, in order for more students to comprehend difficult topics. More so, creating a transparency, and revealing that everyone have issues in learning can be beneficial for the learning process of students.

It is a desire of this research to look into how students can improve their learning process together. On the basis of previous research on value co-creation, this article will explore how students can co-create value together through sharing knowledge, and what benefits can be obtained from this process. This leads to the following research question:

RQ: How can we utilize value co-creation to inform a design of an IT-based solution, that can support students in their learning process?

This article will begin with a description of value co-creation and its constituents, together with selected examples. Then it will be proceeded to existing solutions and research on value co-creation in the university context, along with existing literature on knowledge-sharing among students, the importance of sense of community, and online trust. This is followed by an overview of the research method used for this study,

along with the followed procedure. The initial inquiry into the problem will be introduced, which will be followed by the objective for the solution. On the basis of this knowledge, an artifact description will be provided. Thereafter, the findings from the evaluations of the artifact will be presented, along with a discussion that is in relation to existing research. Finally, a conclusion will be given, along with the contribution of this research.

II. THEORETICAL BACKGROUND

In this section, theory on value co-creation will be presented on the basis of research by Selnø and Prosenikova (2016), along with examples. This will be followed by existing solutions and research on value co-creation in the university context. Then follows an introduction to knowledge-sharing between students, sense of community, and why trust of information online is an important aspect when developing online solutions.

A. Value co-creation – definition and constituents

A research by Selnø and Prosenikova (2016) on value co-creation resulted in the framework, see figure 1, which describes the components of value co-creation. From this framework, it is evident that value co-creation can be understood as a range of activities performed in specific ways, by different stakeholders with attached resources, in order to obtain value. The value-creating activities happen on the basis of interaction between stakeholders and their resource exchange.

The framework is based on a literature review on value co-creation, and it represents synthesized theories found on the topic. To begin with, the framework identifies the different types of stakeholders, and puts them at an equal position in the process, in order to initiate and take part in value co-creation. Each of the stakeholders must contribute with at least one resource, which was argued in a research by Skaržauskaite (2013). Examples of resources can be time, money, energy, technology, knowledge. These then go into a pool of resources, which is a collective of all stakeholders' resources that are involved in the process. Depending on what type of stakeholders join with resources, a relationship type is created, which exist in a given context. Their resources can then be utilized through different modes of co-creation. The theory behind these modes originates from a research by Sarker et al. (2012). If two stakeholders bring the same kind of resource, for example, knowledge about the same thing, then the mode of co-creation is through addition, as one resource will build on top of another. At this stage, it is determined in what way the resources are utilized, and integrated in the process. This is followed by value-creating activities, that are then undertaken on the basis of these resources and the stakeholders involved. Examples of such activities are knowledge-sharing and governance, which originates from a research by Grover and Kohli (2012), and was further utilized by Mandrella, Zander, and Kolbe (2016). These activities are supported

by IT, meaning that IT enables, and enhances the actions of the stakeholders involved. Examples of IT are shared systems and IT platforms. The expected outcome of the activities is value, which is turned into benefits, that go back to the stakeholders. The framework consists of four types of value, a proposition adopted from Leclercq, Hammedi, and Poncin (2016), and these are value-in-use, value-in-exchange, value-in-context, and experiential value. Finally, as suggested by Ranjan and Read (2016), costs can incur for the stakeholders, such as exploitation of some of the stakeholders, which can be in the form of a free or unpaid labor. More so, Gummesson, Mele, Polese, Galvagno, et al. (2014) argues that there are other costs to the process of value co-creation, such as overflow of control, conflicting interests, as well as status differences that is referred to as unequal appropriation of value among the stakeholders.

Examples of value co-creation Value co-creation can be used and understood in different ways, as found in the research by Selnø and Prosenikova (2016). On example is a business constellation based on an **ERP-vendor partner relationship**, in which two companies work together in order to serve customers, which was seen in the research by Sarker et al. (2012). The example revolves around a technology company that provides software, and partners up with a sales company. Each of the companies has their own focus area. The technology company develops software, and the sales company distributes the software to end users. Value is created because each company has their own core competencies, and they only have to focus on these. Their different resources complement each other, and because of this utilization of resources, the technology company can focus on developing software, while the sales company can focus on managing customers. The relationship between the companies is contractually enforced, but each party depends on the other, thus allowing them to co-create value together.

The value co-creation process can also be initiated, and facilitated by customers. An example of this is seen with the Danish mobile application, **Fartkontrol.nu**, which lets users of the application share knowledge on where traffic speed cameras are located. Whenever users spots a traffic speed camera, they can report the location, and warn other users. If the camera has already been posted, the user can verify via a button that the speed camera is still there. Through this end-user to end-user communication, value is co-created whenever a user contributes with their resources, such as time and knowledge, for the benefit of others, as the contributor next time will be a receiver of the benefit.

B. Existing solutions and research on value co-creation in a university context

The university is a knowledge-sharing institution, where knowledge is shared lecturer-to-student, lecturer-to-lecturer, and university-to-business world. As this research deals with value co-creation in the context of
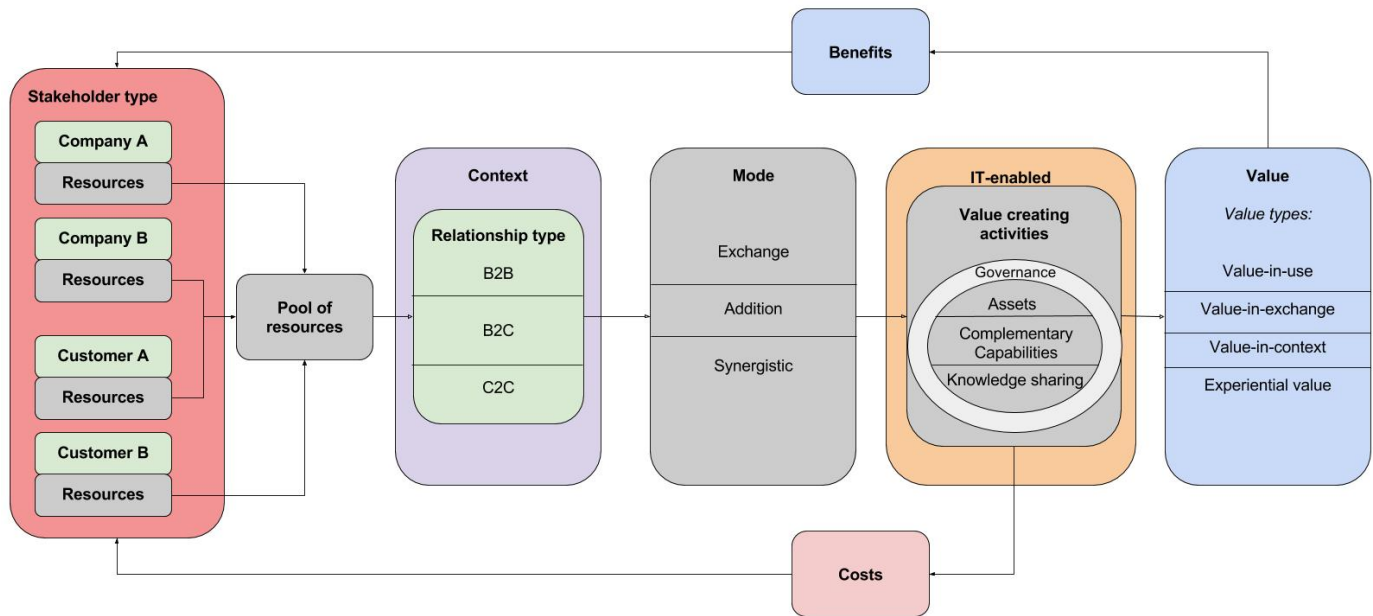
Fig. 1: The process of value co-creation adopted from Selnø and Prosenikova (2016)

universities, existing research on the topic was examined, and a few articles were found. These are by Maria, Dimitris, and Garyfallos (2014), Pantoja Diaz, Ribes-Giner, and Perello-Marin (2016), Gummesson, Mele, Polese, Diaz-Mendez, et al. (2012), and revolve around how students can be more satisfied with their education, in order for the university to be able to compete in the market. Value co-creation is in all cases seen as involving students in a process of making the educations better, by asking them about their opinion through surveys. Value co-creation in university context is realized through the integration of the resources of students and lecturers (Maria, Dimitris, and Garyfallos, 2014, p. 244). All of the articles are focused on the relationship between lecturer and the student, or the institution and the student, while none of them look into how educations can be improved by the student-to-student relationship. In summary, this area is under-researched, even though it is acknowledged that value co-creation incorporates a network of different relationship types as argued by Maria, Dimitris, and Garyfallos (2014).

C. Knowledge-sharing between students

As seen in the framework, knowledge-sharing is a value co-creating activity, and is regarded as a critical step in knowledge acquisition (Ma and Yuen, 2011, p. 210). In a research by Barak and Rafaeli (2004), knowledge-sharing in the learning process between students is explored. This is in regards to how the usage of questions created by students can improve the learning process. The questions took the form of a quiz with multiple-choice answers, in which students created both the questions, and the answers. This was done on the background of "To share knowledge one has to first develop it and then to consent

and act on contributing it for benefit of others" (Barak and Rafaeli, 2004, p. 101). By this, having students to create questions, and by that share knowledge, they first have to obtain knowledge. The study proposes that the inclusion of forced student-created questions, as part of the learning process, is contributing to three areas: self-assessment, peer-assessment and achievement assessment. Self-assessment refers to when students test their own knowledge by answering other students questions, and by that receive an immediate feedback (Barak and Rafaeli, 2004, p. 86). Peer-assessment refers to when students challenge their own knowledge by posting questions for others to review. The research argues that using questions in the learning process can enhance the individual students' learning, and may advance the peer-assessment into a community of students learning together (Barak and Rafaeli, 2004, p. 100). The use of online questions in the learning process can thus be seen as a means for students to co-create value together. Finally, the achievement assessment include lecturer involvement, and it is a part of the final examination.

In the research, knowledge-sharing is seen as two components: knowledge development and knowledge contribution (Barak and Rafaeli, 2004, p. 101), which can be further understood as providing and obtaining knowledge. The latter is an activity that happens on a social level, meaning that when a student realize an issue in understanding, the student need to seek others for help (Ma and Yuen, 2011, p. 211). The knowledge is translated into the students' own understanding, which is then available for passing on to other students with the same issue, thus providing knowledge (Ma and Yuen, 2011, p. 211).

D. Sense of community and online trust

When looking into how knowledge-sharing between students can happen, it is essential to also understand what would make students participate in this activity. For this, the sense of community is considered as an important aspect of motivation, that provides several benefits. The sense of community is defined as "mutual interdependence among members, connectedness, trust, interactivity, and shared values and goals" (Rovai, 2002, p. 321). It is further regarded as an aspect of the learning process, as it can increase persistence in courses, and motivate students to learn (Rovai, 2002, p. 321). A concept in the literature around sense of community at universities is classroom community, which is defined as "a feeling that members have of belonging, a feeling that members matter to one another and to the group, that they have duties and obligations to each other and to the school, and that they possess shared expectations that members' educational needs will be met through their commitment to shared learning goals" (Rovai, 2002, p. 322). A classroom community can thus be said to consist of two components connectedness among community members, and common learning goals (Rovai, 2002, p. 322).

The first component, connectedness, is the feeling of belonging to the community and being accepted and is important because "Once individuals are accepted as part of a nourishing learning community, they develop feelings of safety and trust" (Rovai, 2002, p. 322). It is further stated that safety and trust have a positive impact on students' willingness to speak openly and make them more inclined to share their doubts and "expose gaps in their learning" (Rovai, 2002, p. 322).

The second component, a common learning goal, can be seen as the feeling of a joint construction of knowledge and meaning in the community, and that the community enhances this acquisition of knowledge and understanding (Rovai, 2002, p. 322). A classroom community can thus be seen as "a social community of learners, who share knowledge, values, and goals" (Rovai, 2002, p. 322).

As the community is controlled by individuals, the balance between a weak, and strong community is delicate. The community will be weakened, if there is mistrust, competition, social cliques, only one-way communication, or if members do not share learning goals and values. On the opposite, it will be strong when students feel connected to each other, share goals and value, embrace two-way communication, and strive for the same learning objectives (Rovai, 2002, p. 322).

The sense of community is essential in a learning context, due to the previously-mentioned reasons. Furthermore, community as a social structure is also important in an online world, as recognized in a research by Ba (2001, p. 324). Online communities are serving various purposes, such as providing emotional support, and sharing of information, and the participants of the community often have a strong commitment to it (Ba, 2001, pp. 328, 329). More so, online communities involve a sense of belonging, and are places where contact is made, without individuals being at the same place, at the same time (Ba, 2001, pp. 328, 329). The community serves as an enforcer of trust, which can be seen as an ongoing calculation of value derived by comparing results with costs (Ba, 2001, p. 324). Trust is furthermore associated with knowledge about the members of the community, because this can make it easier to estimate the resources, such as quality of information, and by that reduce the uncertainty and risk (Ba, 2001, p. 325).

III. METHODOLOGICAL OVERVIEW

In this research, it is sought to explore a possible solution with the use of value co-creation, as a driver to inform a design. The selected research methodology is design science research, which can be understood as creating and evaluating IT artifacts, intended to solve identified organizational problems (Peffers et al., 2007, p. 49). This is further seen as a process that involves the creation of new knowledge through artifacts, meaning that learning is gained through building (Kuechler and Vaishnavi, 2008, p. 1). As there are several approaches to conducting design science research, this research is set to use the methodology proposed by Peffers et al. (2007), which consist of six activities. These activities span from problem and solution artifact identification, building and evaluating the artifact, and finally analyzing data and communicating the meaning to others.

The activities performed in this research follow the content proposed by Peffers et al. (2007). However, the research by Peffers et al. (2007) does not provide an approach for structuring and presenting the contents of this type of article. The structure and presentation of this research is a mixture of the content proposed by Peffers et al. (2007), and the research by Gregor and Hevner (2013), which is greatly influenced by Peffers et al. (2007). Consequently, that the rest of this article is structured as follows:

Problem identification: The first activity is to get an insight into the problem, and this is where the problem is justified. In this article, this is performed based on findings from two focus group interviews, which are further described section IV.

Objectives for solution: The second activity is related to considerations for the content of the solution, which are based on the knowledge about the problem. In this activity, the problem areas are considered, along with possible solutions addressing the particular issues. In this research, the activity is performed on the basis of the value co-creation framework, seen in figure 1, where each of the components are considered. This is further described in section V.

Artifact description: The third activity is a description of the artifact, which is also seen as the intended solution to the problem. According to Peffers et al. (2007, p. 55),

the artifact can be everything from models, methods, or other objects, and in this research it is a prototype in the form of a mobile application. This is further described in section VI.

Findings: The fourth and fifth activities are evaluating the prototype, followed by an analysis. The artifact in this research undergoes two evaluations. This is done in order to discover whether the problem is solved in a specific setting, such as an experiment or a simulation (Peffers et al., 2007, p. 55). The analysis determine the results of the evaluations, and to what extend the proposed problem is solved by the artifact (Peffers et al., 2007, p. 56). The analysis is described in section VII.

Discussion: The sixth activity is the relation between the findings of this research and the existing research. In this section the utility and novelty of the solution are reported as stated in (Peffers et al., 2007, p. 56). Furthermore, the limitations and the future work will be presented in section VIII.

A. Considerations for initial inquiry

For this research, a specific context is selected, which makes it possible to work with an actual example, and evaluate the solution with potential users. The selected context is Aalborg University, and it is chosen for the research on how value co-creation can be used to inform a design of an IT solution for a genuine problem at the current university environment. At Aalborg University, some initiatives are taken towards facilitating student-to-student knowledge-sharing, such as inflicted team work. Additionally, the university intranet, Moodle, includes an attempt to let students communicate their questions. However, to the knowledge of the researchers, there is a lack of an easily accessible system that facilitates knowledge-sharing between students, and that is supported by the university.

To inquire into this topic, focus group interviews are performed. This allows for discussions among the participants, and it has the potential to reveal insights into how students feel about their learning environment, and the problems they encounter. More so, this method for initial inquiry is appropriate time- and resource-wise for getting a basic idea of the current problems that the students experience. Due to the possible sensitivity of the matter, it is decided to search for participants among current study groups, in which students know each other. Thus, they can feel more safe, and willing to share their feelings, and thoughts related to current difficulties.

It is decided to have two focus groups with different types of participants, as this can give different angles on the matter. It is decided that one focus group contains students in the midst of their learning process, who still have lectures. While the other contains students, who have passed this stage, and who are currently writing their master thesis. By this, it is possible to get diverse opinions on the current challenges with the study environment, as well as insight on whether the

issues experienced by master thesis semester students are also faced by the younger generation of students. As a result, the first focus group represents students, who are currently attending lectures, and it consists of seven participants on their 8th semester (IDA8). The second focus group represents students, who have passed the process of studying for new courses, and so it consists of four master thesis students (IDA10). The number of participants from both focus groups, and their distribution can be seen in figure 2.
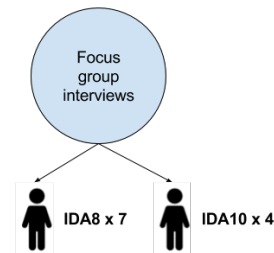

Fig. 2: Participants of the focus group interviews

Due to the research objective of this study, the value co-creation framework heavily influences the inquiry into the problem. The framework is used for the creation of questions, in order to ensure that all elements of value co-creation are addressed. The purpose of the interviews is to understand the current practises of students in their learning process, what kind of problems and frustrations they encounter during that process, and how they overcome these. Furthermore, the questions also revolve around how they feel about asking for help, and sharing knowledge with peers.

Before conducting the focus groups, a pilot test of the interview is performed. This is done with the purpose of discovering whether the questions are well understood by the participants, as well as the possible length of the sessions. The pilot test is conducted with two students, who are not part of the focus groups, and their feedback is utilized to revise the questions.

1) Data collection and analysis of focus groups: The sessions are audio recorded, which provides the means for the performance of a thorough qualitative analysis. The analysis is performed by listening to the recordings, and writing down quotes, along with their time in the recording. This results in a long list of quotes, from which patterns are extracted. Each of the patterns relates to a problem, under which the quotes supporting it are mapped. The patterns are extracted based on the meaning, and the relation to current problems experienced by students. This results in an overview of main problems, which students currently experience in the university environment. These problems are assessed based on how feasible and realistic it is for this research to design a solution that addresses them. The process of data collection and analysis can be seen in figure 3.
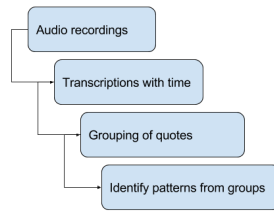
Fig. 3: Process for analyzing data from inquiry

B. Evaluations

The solution of this research undergoes two evaluations, which consists of two versions of a prototype. The first prototype is build in order to evaluate the general artifact. This is done on the basis of information from the focus group interviews, and the derived design considerations. The first prototype is evaluated, and the feedback from the evaluation is used for improving the prototype into a second version, which is subject to a second evaluation, also seen in figure 4. The purpose of the first evaluation is to validate the overall idea of the solution and its usefulness. The purpose of the second evaluation is to examine whether the artifact creates value for the students, and if it has the potential to aid with an identified problem. In the following, information on participants, evaluation and analysis from the two evaluations is presented jointly.

1) Participants: In the first evaluation, the prototype is evaluated with two students on their eighth semester (IDA8), and two master thesis students (IDA10). The IDA8 students performs the evaluation as a group, and the same goes for IDA10. In this way, it is possible to get complementary feedback, due to the differences in their semesters. The first evaluation is performed with four students, who also took part in the focus group interviews, and thus already have insights to the matter.

For the second evaluation, it is decided to include eight participants, and to focus only on IDA8 students, because it can potentially be easier for them to recognize and relate to the problems in the current university environment, since they are currently attending lectures. Consequently, they can contribute with insights on whether the solution has a potential to aid in solving the problem, and bring value to the them. The second evaluation is performed individually with students who did not take part in any earlier inquiry, or evaluation. This was done in order to avoid a learning effect (Lazar, Feng, and Hochheiser, 2010, p. 51), which means that the new participants have no prior experience and thus opinion on the prototype.

2) Procedure: The two evaluations follow the same procedure, which consists of three components: briefing, testing of scenarios and debriefing. Firstly, the participants are introduced to the overall idea of the prototype, its main features, and the goal of the evaluation. Secondly, the scenarios are done with the purpose of showing the participants the whole functionality of the prototype.

There is a total of eight scenarios with associated tasks, each of them demonstrating several features. The participants perform these tasks on their own smart-phones, using a link to the prototype. The scenarios include tasks around seeing questions, asking a new question, creating and elaborating on an answer, as well as searching for a keyword. In this way, the participants can get a better feeling of the prototype, what they can do with it, and what it can offer. Thirdly, the debriefing consists of a semi-structured interview, which is again based on each of the elements of the value co-creation framework. Furthermore, the interview includes questions on the prototype, and its potential to help solving the problem.

3) Data collection and analysis on evaluations: Both evaluations are recorded with a smartphone and an audio recorder. The audio files are transcribed in order to code the data. The coding of data is performed in two stages. In the first stage, the interview questions are transformed into categories, under which quotes belonging to each question are mapped, using different colors for each respondent, and noting the time of the reply.

Having all quotes mapped under each interview question, the second stage begins. The purpose is to identify main categories across all comments related to the features, and to examine the utility of the prototype. One example of a category is anonymity, and by that all comments about anonymity are grouped under this category. Furthermore, the content that relates to the elements of the value co-creation framework is also grouped. For example, a comment about the stakeholders, is grouped under the stakeholder element. From these groupings of quotes with their associated title, it is possible to extract meaning and patterns from the data.

IV. PROBLEM IDENTIFICATION

This research begins with an inquiry into the learning process of students, and thus identifying a problem and its related causes. This is done in by conducting focus group interviews, and is followed by an analysis. In the following section, the data and findings from these interviews are presented.

The participants were asked questions around how they cope with difficulties, and how they feel about expressing their doubts, and asking questions in general. Responses showed that when a difficulty is encountered, many of the students first turn to Google, Youtube, and other communication forums. If they still have doubts, they turn to their families, or boyfriend/girlfriend, or they ask for help in their study groups. Most of the participants reported that they like working in groups because they can easily ask a fellow student for help. However, it was noted that in one of the groups, an individual was at a higher level in one course than other group members, which makes the other members feel insecure about their own abilities, and the knowledge they possess. It became evident that because some students have a
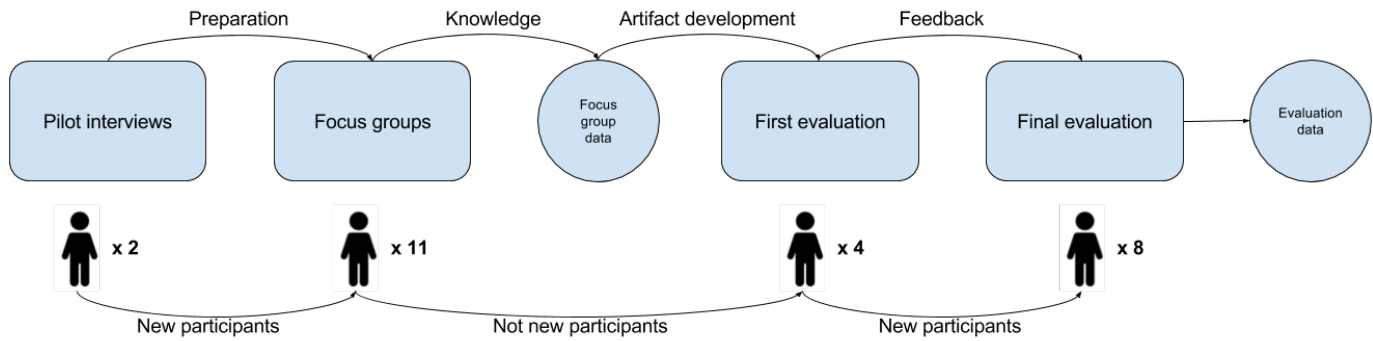
Fig. 4: Evaluation flow

stronger background in certain fields, they are the go-to people when seeking for an answer to a question. This creates an idea that only this person is able to answer questions correctly, which discourages other students from trying. Several participants answered that, if someone asks them for help, they would point in the direction of the person, who is always answering questions. The issue with different backgrounds can be seen as leading to the main problem, which is that students **feel uncomfortable in asking questions**, for which there are two reasons identified. These reasons are further referred to as problem areas.

Firstly, it was reported that students feel that they are **supposed to know the answer** to their own doubts, and so they are afraid that they might look stupid, by revealing that they have a hard time understanding a topic. One participant noted "I have a really hard time asking people for help", and this statement was further supported by other respondents. Furthermore, several participants pointed out that they do not like to put their faces and names on questions because it makes them feel defeated or stupid. They see asking questions as a weakness, and they have an inner expectation that they should know everything, in the same way it appears everyone else does. This creates hesitation around asking questions because it affects their self-esteem and puts more stress and negative feelings on the student. More so, even though students have difficulties in understanding, they are reluctant to ask lecturers for help because they are afraid they might not understand the answer provided the first time, and they would have to ask again. As expressed by one respondent, and supported by the rest of the group "sometimes you might feel stupid, if you have to ask again, so you don't want to ask". Additionally, according to the participants, they also feel uncomfortable asking the lecturers because they generally feel like they are wasting the lecturers' time. According to a participant "I kind of feel that if I ask more (to the lecturer), I will take up (other students) time because (the lecturer) have only two hours to get around all the groups". This statement was further supported by the other participants.

Secondly, students **feel alone with difficulties in understanding topics**. One respondent noted "I really feel I would like to ask someone ... but again I am very shy about asking, I feel like I should know this, I should learn this by myself". This was supported by several participants, who reported that, if they have trouble understanding something, they keep it to themselves because no one else raised the question, and they do not want to be the only ones asking questions, thus creating a downward spiral.

In summary, the hesitation around asking questions is an actual problem that students experience, and this is caused by two problem areas. Firstly, that is the feeling that they are supposed to know the answer to their own doubts. Secondly, students feel alone with their difficulties. Asking and answering questions are integral parts of knowledge-sharing, which are main activities at the university. It is therefore considered that there is a need for addressing this problem, and designing a solution that has the potential to aid in solving the problem, and bring value to the students. There are many possible approaches to this solution depending on the field of the researcher, and since this research is within the Information Systems field, the approach to the problem is to propose an IT solution.

V. OBJECTIVE FOR SOLUTION

The objective for the solution is to address the previously mentioned problems areas, to support students in their learning process and to bring value. This section revolves around the envision of the artifact, technology selection and its usage. This is followed by addressing the identified problem areas with suggestions for features, which have the potential to diminish the currently existing problem experienced by students.

The initial inquiry led to the discovery of one main problem experienced by students, namely that they feel uncomfortable asking questions. Existing research by Barak and Rafaeli ([2004](#)) argues that the formulation of questions, as well as answers by students improves the learning process, because by that students obtain knowledge. Therefore, in order to improve the learning process, it is important to find a solution to the problems experienced by students, and help them feel more comfortable sharing their knowledge in the university

context. A possible solution would be to design an artifact that would make students more inclined to share their doubts, and obtain, as well as provide knowledge. Thus, it is chosen to design a knowledge-sharing platform, as a prototype, for students at Aalborg University. This would provide them with the possibility to share and gain knowledge, in the form of questions and answers. This has the attached benefits of getting support with topics and course materials they find challenging. It is envisioned that the artifact would represent a place, where students can freely share their doubts, and get help by their peers.

Technology selection: It was considered that the appropriate form of the solution would be a mobile application, due to its convenience and accessibility. In this way students would be able to share knowledge in the bus on the way to university, after lectures when sitting in the canteen, and when participating in group discussions. As many young people today turn first to their mobile phones for quick information, this is deemed as an appropriate technology choice. Furthermore, on a mobile application the camera is readily available for use, which makes sharing of information in other forms, such as photos, more convenient. Consequently, if students want to accompany the explanations they give, or the questions they ask with pictures, there would be a more accessible way to do so.

Time and location of usage: It is envisioned that the application would be used by students before and after lectures. Most students prepare for lectures by reading the given materials posted on Moodle, watching videos, and by asking friends or relatives for help. It is therefore envisioned that the solution would represent an additional source of knowledge, where students would be able to find answers to their questions, as well as share their doubts. Regardless of the time of usage, the artifact would support students in their learning process by providing them with access to the community of students and their shared knowledge.

A. Addressing the identified problem areas:

To begin with, section IV revealed that there are two areas which cause the main problem, and these are addressed by specific features in the artifact, solely dedicated to diminishing the problem areas. It was found that students do not feel comfortable asking questions because they feel that they are supposed to know the answer to their own doubts, and so they avoid asking questions because they might appear stupid in the eyes of their classmates. This speaks of a **lack of safe space** for students in the current university environment, where they could reveal their doubts, without being judged by their peers. This issue could be addressed by making the users of the prototype anonymous. It was considered that questions could be asked anonymously, meaning that the person asking the question should be unknown.

The other problem area that causes the main problem is that students feel alone with the difficulties they ex-

perience. This speaks of a **lack of transparency** between students, which could reveal that others have struggles too, and would thus make students more willing to share their doubts. This issue could be addressed by finding a way to visualize that other students have the same doubts. A possible way to do so could be to create an option for students to express their support for questions and answers. This could be in the form of a rating system, where the number of votes would be shown. This would help students realize that they are not alone with the difficulties they experience in the learning process. The rating system would further increase the quality of the information shared in the artifact, which is also related to establishing trust by validating the answers and questions.

In summary, the importance of asking and answering questions for the learning process is recognized from existing research, and these are activities that students do not feel comfortable taking part in, as identified in this research. Therefore, there is a need to design an artifact that can potentially aid in solving the problem. The choice of solution is to create a knowledge-sharing platform for students, which would make them more inclined to take part in asking and answering questions. Furthermore, anonymity and rating system are two features that have the potential to diminish the lack of safe space and transparency.

VI. Artifact description

For this research, the solution is considered as an artifact, due to the nature of the methodology selected, and it will be described in this section. The considerations and features of the artifact are derived in two rounds. First, the value co-creation framework, seen in section II-A, is utilized in order to establish the base of the artifact and the necessary features to support value co-creation. The artifact, however, needs to not only support value co-creation, but also general user interaction, and therefore a second round of derived features is presented.

A. Designing from the framework and derived features

In the first step towards the creation of the artifact, the abstract framework is considered piece by piece, and is used to derive inspiration for features. The elements of the framework are thus translated into features of the artifact, and these are described below.

1) Stakeholders, resources, relationship type, and the context: In the university context, and specifically for the case that is addressed in this research, the possible stakeholders are students studying IT Design and Application Development (IDA), lecturers and teacher assistants (TAs) on this education, as well as Aalborg University as an institution. Each of the stakeholders possesses one or more resources, which is also the needed premise for participating in this collaboration in the first place. These resources are then gathered into the pool of resources, which is regarded

as the collective of all stakeholders' resources, which in this case are identified as knowledge, energy, time and expertise. The relationship type in this case is student-to-student, with possible involvement of lecturers and TAs. This relationship between the stakeholders exist in a given context, which is the university. These considerations of the elements are translated into two features of the artifact.

Overview of user information: The stakeholder element led to the consideration that users on the platform must be logged into a profile associating them with their user type, for example, student, lecturer or TA. This will provide the system with knowledge on what type of user is behind an action, and it is necessary in order to control whether a user should be allowed to write new questions, and answers in a course. The ability to write a new question is seen as locked down to current students in a class, while answering a question can be available for everyone with a connection to that particular class, such as current and former students, or lecturers. Reading of information, on the other hand, will be available to everyone using the platform, and not locked down to specific users.

Lecturer approved stamp: The stakeholders and their associated resources led to the consideration to include another type of stakeholder, namely the lecturer, in the form of a "Lecturer approved" stamp. This is done in order for the other stakeholders to utilize the additional resources, namely expertise and advanced knowledge in a certain matter. This would contribute to the artifact by giving the other stakeholders (students) a confirmation that the knowledge shared in the artifact is correct. By this the "Lecturer approved" stamp is also related to the activity of governance seen in the framework, since it can be regarded as a mean to provide quality control of the information. The "Lecturer approved" stamp can be seen in figure 6.

2) Mode of co-creation and the value creating activities: From the value co-creation framework, it is seen that there are a few ways in which resources can be utilized in the process. In this case, the resource is knowledge, and this can be utilized through addition and exchange. In the university context, the mode of exchange is naturally present in the environment, since knowledge-exchange is the basis of learning. Furthermore, IDA students all have different backgrounds in their bachelor degrees, and so when perspectives from two IDA students are being exchanged, they complement each other, thus enriching the general picture for the solution. Discussing together on a particular topic in a course is an example of learning through addition, where knowledge is supplemented and gained through building on top of each others' understandings of a topic. From the value co-creating activities knowledge-sharing is considered a primary activity, as students at Aalborg University are subject to Problem Based Learning, which puts emphasis on team work. The other value-creating activity considered
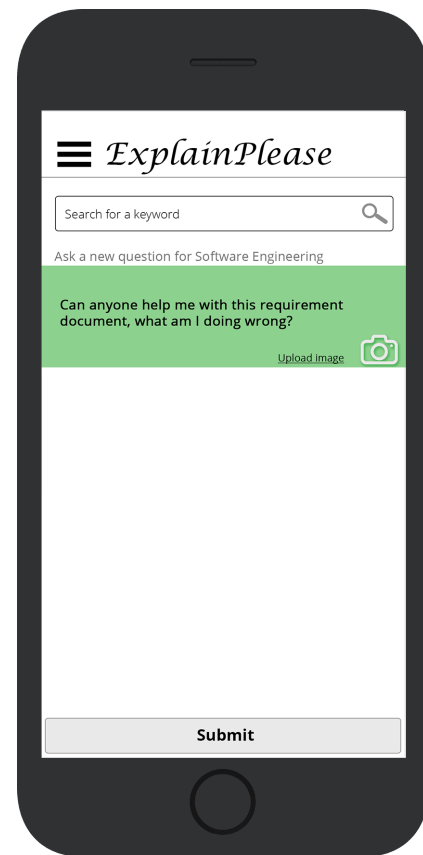

Fig. 5: Asking a new question

for the artifact is governance, which is enforced by the community of students, the lecturers, as well as Aalborg University as an institution. The students will use their own knowledge to estimate whether the information shared in the artifact is correct, and in this way they would use each others' resources to establish quality control.

Give an answer, elaborate on existing answer, and write a new question: The consideration of the mode of co-creation, led to the inclusion of the exchange and addition modes. These two modes are translated into two features of the artifact, namely give an answer to a question, and elaborate on an existing answer. Addition refers to knowledge-sharing, where the student answering a question can post a completely new standalone answer to a question, regardless if other users previously answered it. Exchange refers to when an existing answer is further elaborated. The solution will make use of these two modes, because in this way the students will have freedom to share their knowledge, and will not be limited by other students, which would be the case if the activity of knowledge-sharing is solely constrained to exchange mode, because then students would only be able to elaborate on an existing comment. As initiators of knowledge-sharing, there is a need for users to create new questions, in order to let other users discuss the issue. In figure 5, it is seen how a new question is submitted.

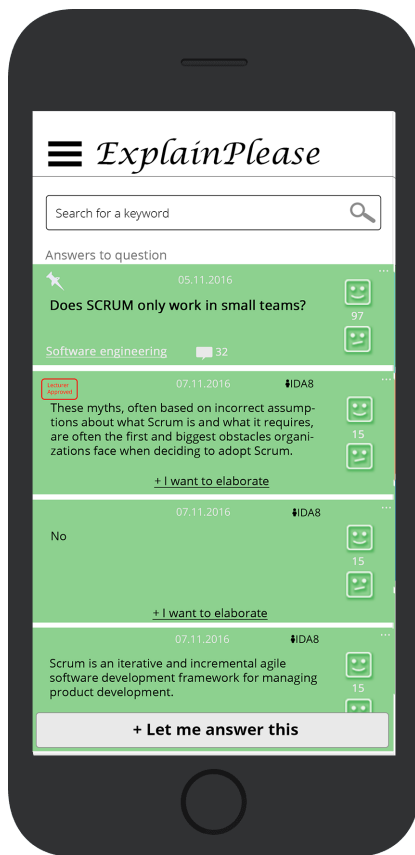*Community control:* Considerations were made for the

Fig. 6: Support buttons and lecturer approved stamp

governance activity, and since this is a knowledge-sharing platform, students will depend on the information in the artifact, and so the knowledge shared has to be reliable. Therefore, there is a need for a strong governance around the information. Considerations on who should be allowed to post answers to questions, and who should be allowed to read them. In regards to posting answers to questions, it is necessary to ensure that individuals have the required background. This means they must currently attend the course, have attended it previously, or be a lecturer. It is seen that reading of information should be available to everyone using the platform, and not locked down to specific users. From section V, two problem areas were identified, where one of them was transparency, for which a feature that has the potential to diminish the issue was proposed. The feature is a rating system, where current and previous students can express their opinion in a quantitative way. For that a community rating system, as a way to show agreement of a question or answer is designed. Therefore, this is a main feature under the governance activity, which will ensure quality of information, by giving current and previous students the option to upvote, or downvote questions and answers. The rating system can be seen in figure 6.

Anonymity: As it was found that students feel uncomfortable putting their face and name on questions, there is a need to accommodate this issue. This is because it can inhibit students from participating in discussions. This problem is referred to as the other problem area found in section V, and the proposed solution is to make the users of the artifact anonymous. Considerations were made in regards to the extent of anonymity, meaning that there is a need to maintain trust and credibility. As there is a balance between trust of information, and knowing who is behind an answer, it is considered that there should be a specification of the user type, and the semester of the user. More so, thoughts were given in regards to whether anonymity would apply for both questions and answers, in regards to who created them.

B. Design inspiration and derived features

Designing with the framework led to features, which support value co-creation, but not the general user interaction. It follows that the previously-mentioned features formed the base of the artifact, but translating the framework into a specific artifact requires more. For that, design and feature inspiration was gathered from another knowledge-sharing mobile application.

1) Design inspiration: Jodel was chosen as a design inspiration for the artifact, as this is a popular social mobile application among students in Aalborg. Jodel is an anonymous discussion platform, which lets users post short messages (Jodels), images and comments, and each message is displayed in a random color. Users can rate all messages, images and comments by an upvote or downvote arrow. Between the upvote and downvote arrows, there is a number that represents popularity, where an upvote gives +1 while a downvote gives -1, and in this way the community controls the content. The community control is enforced when a message, comment, or image receives a total of -5 in overall rating, as it is then automatically removed. From Jodel, a few elements was adopted, such as the use of colors, by that a color is attached to a course, as the well as the community control by the rating system, which can be seen in figure 7.

2) Derived features: Jodel was used for design inspiration, as well as for feature inspiration, that focuses on supporting general user interaction. Additionally, there are other sources used for inspiration, such as Moodle, and these considerations and derived features are presented below.

View questions and answers: It is a desire for this artifact to support students in their learning process, and so the information there will be available to all users. It was therefore selected to not hide any questions or answers, and to have a course page, where all questions and answers could be viewed by all users. The information is thus not restricted to just the person, who originally asked for it. This feature can be seen in figure 18 in appendix.

Overview of courses: During an education, users will go through various courses, with several courses each semester. When a user has a question for a specific course,
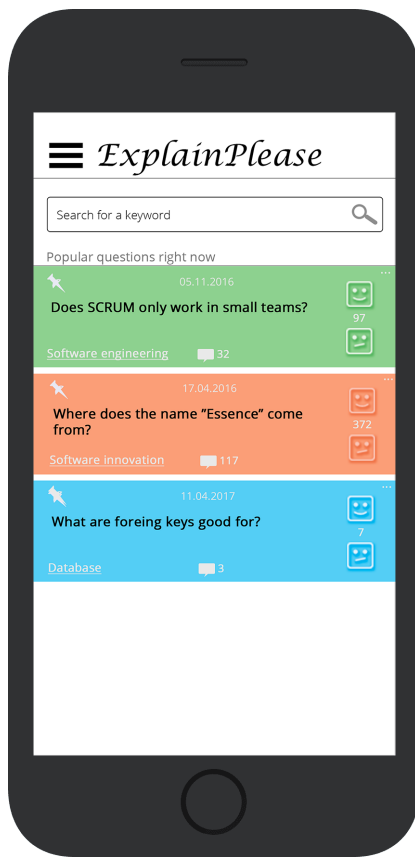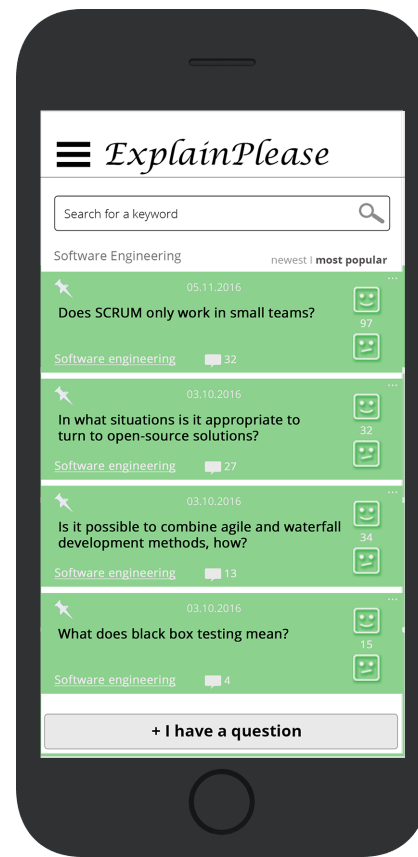
Fig. 7: Frontpage

Fig. 8: Sorting of content

it is necessary to have an easy way to access that course. It is thus considered necessary to include an overview page with all courses, such as previous, current and upcoming, which are related to the specific education of the user. This will give the user a way to prepare for new courses, or go back to be reminded of what happened in an earlier course. This feature can be seen in figure 15 in appendix.

See pinned questions: As users will interact with many different questions over time, it is considered necessary to have a way for users to save, and easily access them again. It is thus considered, that there is a need for users to put a pin in questions, in order to be able to follow discussions. This will furthermore enhance the discussion element of the artifact, as this can happen over a period of time. The pinned questions are saved on a list, which can be easily accessed. This feature can be seen in figure 16 in appendix.

Search for a keyword: Due to the vast amount of content in the artifact, it is considered that there should be a way for users to search for existing knowledge. This will both improve the general content in the artifact, as there will be less repetitive questions, and also make it easier for the user to get information, if the question is already answered. This feature can be seen in figure 12 in appendix.

Sorting of content: As users will use the artifact at different times, and for different purposes, it is considered that there is a need for different ways to sort the content

listed. If users want to use the artifact for a specific course on the day they have the lecture, then the newest questions could be what the user is looking for. However, if the goal of using the artifact is to get an overview of the course, then the user might be looking to sort the results by popularity, which is a feature seen in figure 8.

VII. FINDINGS

In the following section, the findings from the two evaluations are presented. Each evaluation is based on different versions of the artifact, also called first prototype and second prototype. Thus, the first evaluation considers the first prototype, while the second, and final evaluation considers the second prototype. The second prototype is improved on the basis of the feedback from the first evaluation. To begin with, the transition from prototype one to two is presented, and it consists of areas chosen for improvement of the prototype. Afterwards, the utility of the main features of the second prototype is evaluated. Finally, the analysis of the empirical data through the lens of value co-creation is presented.

A. Improvements

From the first evaluation, feedback on the prototype and its usefulness was provided. Based on that, two main points were elicited, and implemented in the second version of the prototype.

Increased anonymity: In the first prototype, students were semi-anonymous, so it was considered that their university e-mail would be used as identifier. However, the participants reported that some e-mail addresses make it too evident, who the students are, and so there was a need to increase the anonymity. The chosen solution was to use the name of the students' education and their semester, which would give an indication of the person and their background, without revealing personal information. This improvement can, among others, be seen in figure 6.

Community control: In the first prototype, there was only an option to upvote answers and questions. However, all participants commented on the lack of a downvote option, and reported the need for a community quality control. According to them, having a downvote option would allow the crowd to define the quality of answers and questions. Considerations were made in regards to how a downvote option could be expressed in an appropriate manner and the chosen solution was to use emojis, since they indicate a given feeling that one can associate with, and does not send a strong message like thumbs down.

Furthermore, a few participants expressed a need to see a date on the questions and answers. The chosen solution was to show the date of creation, because this would help determine the relevance and quality of the questions and answers.

B. Overall evaluation of the artifact

In general, most of the respondents expressed their eagerness to try out the developed application. A respondent noted "if I had the app now to study I would definitely use it", while another commented on the prototype's innovativeness and that it represents a "new way of rethinking how to communicate between not only teachers and students but students and students". Finally, a participant concluded "I hope that you are just one step away from making it work". Furthermore, many of the participants pointed towards a particular value, which is the narrow focus of the artifact. A respondent noted "This app (the artifact) is very narrow and related to answer/asking questions, I would use this much more than Moodle" and other comments like "When you download this application, you know what you can do. When you log into Moodle, you have no idea what you can do, there are many features, and it confuses you". This value was further supported by another respondent, who commented that the artifact is "..more manageable and much easier to navigate in. It is solely dedicated to asking and answering questions, and that is very important for students".

In summary, having only a few functionalities is preferred. This supports the idea that users appreciate to have one artifact dedicated to accomplishing only one particular task, instead of having many features for various tasks in one single solution.

C. Features and their utility

The two evaluations provided similar results, and in the following, the results from the second evaluation are presented, which was focused on the utility of the features. The results from the walk-through of the scenarios during the evaluation revealed the stronger and weaker areas of the second prototype. In table I, all of the features are mapped, along with the responses from each of the participants on their usefulness. In the following, a few main features are presented, together with one feature that was found less relevant. The main features are selected based on their relation to the activity of knowledge-sharing, and their relevance to the problem for which the solution is designed.

1) Write an answer to a question and elaborate on an answer: The two features, can be seen in 9, as "Let me answer" this and "I want to elaborate this". Most participants reported on the usefulness of the two features.

For the first feature, it was reported that it provides the option for students to express their different opinions and perspectives on a topic. More so, one respondent noted "I think it's a good idea because the first answer might be explained in a better way". However, there was one respondent, who could not imagine herself/himself participating in a discussion, but according to her/him it can be helpful for others. The same respondent reported that she/he would neither elaborate on existing answers.

For the second feature, comments were that sometimes people would try to explain something, but would forget details that were important for understanding the matter. Furthermore, most of the participants noted that the feature provides the option to improve the quality of an answer, and as reported the answer "will be more complete". Additionally, a participant stated "I think it's a good idea to have comments to a specific answer. So it stays in the same context and you don't lose track of the different answers. I would definitely use this feature. In a lot of other forums where you can discuss, this functionality is missing because you sometimes can read replies to an answer that was way before, so I actually think that this is very good".

Based on their experience the participants recognized the need for these two features for such an artifact that is based on knowledge-sharing. Since the solution is build around students helping each other, it is assumed that some answers might not be complete, or sufficient in their explanation of the matter. These two features provide the option for other students to express their perspectives and opinions on a topic, as well as supplement a particular answer with the missing information. Performing these activities will improve the quality of the answers, and this will further provide students with the means to share accurate information.

2) Anonymity: This feature, see figure 9, refers to the option for students to be unknown in the application. Most of the respondents reported that this is a very

TABLE I: Confirmed utility of features from second evaluation
F = Feature and P = Participant

	P1	P2	P3	P4	P5	P6	P7	P8
F1: Write a new answer	X	X	X		X	X	X	X
F2: Elaborate on an answer	X	X	X		X	X	X	X
F3: Search for a keyword	X	X	X	X	X	X	X	X
F4: See pinned questions	X	X	X	X	X	X	X	X
F5: Overview of courses	X	X	X	X	X	X	X	X
F6: Anonymity	X	X	X	X		X	X	
F7: Community control	X	X	X	X		X	X	X
F8: Lecturer approved stamp	X	X	X	X	X	X	X	X
F9: Overview of user information			X			X		
F10: Sorting of content	X	X	X	X		X	X	X
F11: Add a new question	X	X	X	X	X	X	X	X
F12: View questions and answers	X	X	X	X	X	X	X	X

useful feature, and that they prefer to be anonymous. Several respondents noted that the anonymity feature might make shy people more inclined to participate in discussions, and get answers to their questions. One respondent said "I would feel more comfortable because it's completely impersonal, so you can ask whatever you want, and nobody can say that it was you who wrote the question". Furthermore, a participant reported "anonymity would encourage me more to actually write some answers, or questions as well". Additionally, a few participants reported that they would like the option to switch between being anonymous and not, since they might miss some recognition of their effort. A few respondents, however, noted that there are two drawbacks of anonymity, which is that they do not know who they are discussing with, which can harm the trust of information, and that some users might be offensive in their response.

In summary, this feature addresses one of the problem areas found in section V. Thus having reported that students would feel more comfortable asking questions because of the anonymity, argues that the feature diminishes the problem area, thus it is useful for this type of solution. More so, the feature is useful because it would make students more inclined to perform the activities of asking questions, and giving answers to questions, which directly addresses the main problem, for which the solution is designed to aid with. It further relates to the activity of knowledge-sharing, thus this feature sharpens the artifact, and contributes to the possibility of improve the learning process of students. Additionally, the drawbacks mentioned will not prevent students from using the prototype, neither will it make it less appealing for sharing knowledge. More so, these drawbacks can be reduced by other implemented features. For example, it is reported that the community control and "Lecturer approved" stamp, will improve the trust
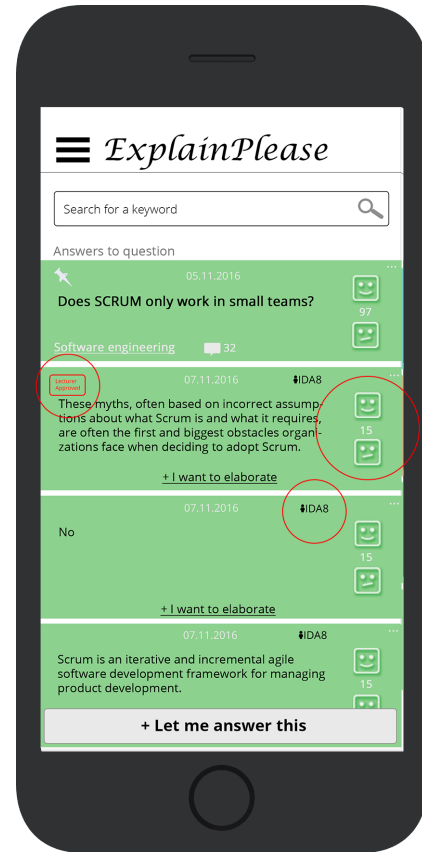

Fig. 9: Anonymity

of the information.

3) Community control: This feature, also see image 9, allows for rating questions and answers in the prototype. Most of the respondents reported that the rating system is useful for this type of solution, because this would let them express their support towards questions and

answers. A respondent noted "I think it's useful to see that other students have the same question about the subject", and this was further supported by other participants. However, most of the participants also reported that they dislike the downvote on questions. A participant stated "A platform like this should be for any questions, also the one that you are afraid to ask in class, I think there should not be any bad questions". This was supported by several students "I don't think I would use the other face (negative emoji) because it's a question ... I wouldn't put the icon to them because maybe I would show them that their question is stupid, or they shouldn't be asking stuff like that, so maybe I will make them feel stressed and not open to asking questions". Furthermore, a respondent noted "definitely useful to have the rating system, but it can be abused. People might misuse the "meh-smiley" (negative emoji) because of grammar or poorly written questions/answers. People rate based on their mood and not what is actually there".

In summary, this feature addresses the other problem area found in section V. The findings show that the feature indeed helps diminishing the problem, and it is useful because of two main reasons. Firstly, the feature will be used by students to express support to their peers, which is related to creating a sense of community, where the members support each other and provide help. In this way they would indicate that they have the same question, and would support the student who asked the question in first place. More so, the rating system provides them with an option to express their opinion for the answers given to a question, which is related to improving the trust of the knowledge shared in the artifact. Additionally, the evaluation pointed towards the willingness of students to support each other in their doubts, therefore the participants were not pleased with the downvote option for questions, thus this part was considered not appropriate. Secondly, in regards to the identified problem area of lack of transparency, the feature is considered useful because it will make students aware that they are not on their own with their doubts. By having the option to rate questions, the students will be able to see what their classmates struggle with, and this would also support them in being more confident, and not feeling alone when they encounter problems with the course material.

4) Lecturer approved stamp: This feature, see figure 9, allows for confirmation that an answer provided is correct. All of the participants in the evaluations reported that the feature is very useful, and that it will make them trust the information in the prototype more. One respondent noted that with the stamp she/he "would be more sure about the quality of the answer", while another said "the Lecturer approved stamp is definitely my favorite, because then at least you know that you are on the right track". More so, one participant noted "I think that is a good function. I think it's very useful, because you know

you can rely on the answer. You have a quality mark that this is correct". Additionally, another respondent stated "I really like the Lecturer approved stamp because it makes you feel a bit safer. You know that this is right, it is not just some students opinion and how he perceived it". All students reported on the necessity of the feature, however, there was one respondent, who pointed out a drawback to it, which is that she/he would not elaborate on answer that was already approved by a lecturer, which can be an obstacle towards facilitating discussions.

In summary, this feature is useful for such an artifact where knowledge is shared among students. Taking advantage of the additional resource that a lecturer can provide benefits the students. That is because they need to know that the information in the artifact is reliable, and the "Lecturer approved" stamp provides this quality mark that the knowledge is correct. Thus, the feature increases the trust of the information, and it helps students rely more on the knowledge provided by their fellow students.

5) Overview of user information: This feature refers to the option to view the individual profile page that contains student name, a list of courses in which the student is enrolled in, name of education and semester. Several participants did not see the purpose of this feature, and they reported that it is useless because "it doesn't add anything new, it is something that I know, or I can get elsewhere". Additionally, a participant stated that the meaning of the profile is for other users to be able to view it, but since users in the artifact are anonymous, she/he did not see the meaning of the feature. More so, another respondent noted "It would probably not be something I would go in and look at because, of course, I know what I am studying and my courses, but it gives a nice overview". This feature is not related to sharing knowledge, which is the main purpose of the artifact. More so, it neither provides additional information, nor an option to perform an activity on the artifact. It follows that features that do not bring any new and important information to the user, and do not serve the purpose to accomplish a particular task, do not bring any value to the users, and are considered less relevant.

In summary, from the evaluation of the features, it was evident that the participants considered most of the features useful and that the artifact is capable of serving as a tool for sharing knowledge among students. However, the evaluations also pointed out that there is still room for improving the elements of the artifact. The possible future corrections could consist of removal of the profile page, implementing a switch between anonymity, and removing the downvote from questions.

D. Elements of value co-creation

In the following, data from the two evaluations is presented through the lens of value co-creation. Consequently, the elements from the framework are used as a driver for the analysis of the data.

1) Stakeholders, resources, relationship type, and context: As seen in section II-A, context refers to where the relationship type exists. In this regard, the context is Aalborg University, which is what turns individuals into students, and students into users of the artifact. The stakeholders involved in the artifact are students, who co-create value together with other students, which makes it a student-to-student relationship type.

The participants reported that they would use the artifact to read, rate, ask questions, and give answers. It follows that each of the stakeholders would contribute with resources such as time, energy, knowledge, in order to perform the mentioned activities. Furthermore, the respondents from both evaluations were asked how it would matter for them if there are different types of stakeholders involved in the artifact, such as TAs, and PhD students. All of them reported that this would increase the value of the application, and it would make them trust the information more. According to one participant "It definitely makes it seem more professional and it would prompt people to ask proper questions". The same respondent added "It would increase the credibility of every answer, because people would take it more seriously, and you would have other people answering that know more about it like a TA". Additionally, a participant reported that the involvement of different types of stakeholders "will benefit the application. By having all the different people, it would broaden the knowledge of the application, and so it will bring higher value".

In summary, the results indicate that considering all the possible stakeholders in the process, and by this designing a feature that allows for the utilization of all the resources, brings value to the stakeholder. Consequently, the findings indicate a relation between types of stakeholders, and value and benefit. Each stakeholder is associated with resources that can be provided to the process, and involving different types of stakeholders will results in a diversity of resources added to the pool of resources. In this case, the involvement of various types of stakeholders, such as PhDs and TAs, will add to the common pool of resources with expertise, better knowledge, time and energy, which will be utilized in the process. This will increase the value of the prototype because the quality of questions and answers will be improved, and the students will trust the knowledge shared more.

2) Mode of co-creation: The mode of co-creation refers to how the resources are utilized in the process. The evaluations showed that students would share their knowledge through exchange and addition. These two modes are translated into two features of the prototype, namely F1 and F2 as seen in table I. The two features combined allow for discussion on a particular topic, and the importance of this combined activity for sharing knowledge was recognized by all participants. One participant noted that "A lot of the concepts are not

black and white, and I think it's good to discuss these parts, so it is not only one answer that is correct but there may be many answers, and a good discussion about it". This was further supported by other respondents.

In summary, the modes of exchange and addition are sufficient for students to perform the activity of knowledge-sharing, because this allows for discussion, which is in the core of knowledge-sharing between students in this solution.

3) IT-enabled value-creating activities: The following refers to the value-creating activities, which are supported by IT. In this research, the focus is on the the activities of knowledge-sharing and governance. These activities are enabled by IT through the artifact, which is intended to be in the form of a mobile application. The participants found this form convenient, since they can use the artifact everywhere they are studying, such as at the library and in the bus. With this, the choice of technology was supported, and it was acknowledged that this form could provide support at the time of need, as a mobile application is easily accessible.

Knowledge sharing: Participants were asked whether the artifact supports them in sharing their knowledge, and if there are any obstacles in performing this activity. Most participants reported that there are no obstacles, and that the artifact provides all the means for sharing their knowledge. One participant noted "Since users are anonymous it allows you to get knowledge, even if you are a shy person, so I think it gives a chance for everyone at the university to gain more knowledge through this communication channel". However, there was a participant that considered the rating system an obstacle, because one might be afraid that other students would downvote the question or answer, and it would inhibit their desire to contribute.

It was further found that the activity is subdivided into four other activities, which also correspond to the usage of the artifact. These are read content, rate, answer, and ask questions. All participants noted that they would post their questions in the application. Additionally, most of them would give an answer to posted questions, and they would also rate questions and answers. The only exception was one, who expressed that she/he would not use the downvote option because she/he would prefer to give an argument, why the question, or answer is not good. Lastly, all participants would read the content.

In summary, the evaluations made it evident, that the artifact provides all the means for students to share their knowledge. The only obstacle mentioned during the evaluations, was the downvote of questions and answers. It was considered that it might have a negative effect on the willingness of some students to participate in discussions in the artifact. Additionally, it became evident that the value-creating activities can be further divided into sub-activities.

Governance: In this research, governance relates, among others, to maintaining the quality of the content. It refers

to two of the features, namely F7 and F8 as seen in table I. When it comes to trusting the information provided by peers, a few respondents reported that they trust what is said by their classmates. On the other hand, several participants stated that they do not fully trust the information, when it originates from peers. However, one respondent noted that "people should just be aware that the answers are coming from fellow students, so they have to be critical of the source".

Since the artifact will be a source of knowledge, the knowledge there has to be trustworthy. The problem around trust is handled by having the crowd decide whether an answer is appropriate, along with having a lecturer approve the best, and most appropriate answers. All of the participants explicitly reported that these two features will increase their trust in the information provided by their peers. One participant noted "if there is the lecturer approved stamp I would be more sure about the quality of answers". Another respondent stated "I would trust it more if people have upvoted (an answer)".

In summary, due to the nature of this artifact, the information shared has to be reliable. Consequently, a focus was put on governance in order to ensure proper content, and higher quality information. It became evident that governance is a value-creating activity that needs to be present in the process because this can minimize the risks associated with the other activities.

4) Additional cost: The participants from both evaluations were asked about the pitfalls of obtaining knowledge using the application. Some participants expressed their concerns in regards to spam that can take place in the artifact. Additionally, one respondent noted that people have different ways of expressing themselves in written communication, and that "some can be very offensive in their answering style". Furthermore, the reliability of the answers was also pointed to be an issue. Most of the respondents expressed concerns that the knowledge provided by fellow students might not be correct. A participant reported "I'm always a bit skeptical about that because there are personal interpretations of everything, particularly if the topic is fluffy". However, several respondents reported that students would use their common sense, and would have to evaluate the validity of the answer based on their own perception and knowledge. One respondent provided an indication for acknowledging the accuracy of the answer, which is to look for vagueness in answers. However, according to the participants these costs would not prevent them from using the artifact.

In summary, it became evident that the relationship type between the stakeholders, in this case student-to-student, is associated with a possible cost. More so, the evaluations indicated that the value-creating activities, and in general the process of value co-creation indeed entails additional costs. In this case, the costs also derived from the activities of knowledge-sharing and governance, more specifically these are costs related to the trust and correctness of the information, as well as the writing style of students. It was further discovered that there is a connection between the use of the artifact and the related costs, and benefits. It became evident that the higher the value a stakeholder could achieve, the higher their tolerance towards cost get.

5) Perceived values from the artifact: Many of the participants pointed towards various values, that the artifact creates for them, and these are presented below.

Safe space: Several participants recognized the potential of the artifact to help them overcome their insecurities in asking questions. More so, it was reported that it offers a "safe space", where students can post the questions they regard as stupid, and express their doubts without feeling judged. A participant noted "it (the artifact) gives you that sense of comfort and confidence to ask these stupid questions, which you otherwise wouldn't have asked". According to another participants "First it (the artifact) would make me feel more secure because I know it's from students to students, so I would feel much safer, and it's going to be easier for me to just write a question because I wouldn't be shy". Another respondent refer to the artifact as to creating a "safe environment".

In summary, one of the values, that the artifact provides to students is that it creates a safe space for them. Consequently, the problem area of lack of safe space, as identified in section V, is diminished by the artifact, and so it has the potential to improve the learning process of students. That is because, by using the artifact students will be able to freely express their doubts, without any hesitation, which further enhances, and allows for obtaining and providing knowledge.

Transparency: A few participants commented on the issue of feeling alone in their doubts, and one respondent noted "I could get comfort in knowing that I am not the only one having trouble understanding a concept, because usually I am a bit insecure, if it is only me". More so, it was reported that the artifact would bring value to students by making them "feel more as a group, and feel like we are all in this together... so I think it could be nice for the overall feeling and to not feel alone in this". More so, another student reported that she/he would use it to see "what are the rest of my class mates are thinking about the particular course. From the questions you can see what they find difficult".

In summary, the artifact creates value by directly addressing the other problem area, as identified in section V. The artifact creates transparency, which make students more inclined to share their doubts, when they realize they are not the only ones having them. Thus, it can be argued that the artifact will improve the learning process of students, because it will be enhance the knowledge-sharing between them.

Community: Most of the participants reported that the specific context, which the artifact creates, is what brings value to them because in this way they feel as part of a community. The artifact was designed for students on

a specific education, who study the same courses, and are familiar with the specific course material. Most of the participants noted that for context specific questions, which relates to a particular course, or course material, they would prefer to use the artifact before using Google. A respondent stated "It is definitely valuable that it's a small community and we know that it's students from IDA". While another participant noted that the artifact creates a sense of community and she/he added "it feels like you belong there". More so, a participant reported that "It's good that it's fellow students, since we are all new to the subject, and we might have the same questions about it, and then we will be able to communicate in the same language". Furthermore, another participant noted that the sense of community brings value to her/him because she/he feels like other students understand her/him, and her/his struggles with the material better. In addition, another respondent stated "It's easier for us to relate to each others problems, you know exactly what they have read, if you have read it yourself".

In summary, another value the artifact provides to the students is the creation of a sense of community, which is also related to the context of use. The community provides the students with the option to communicate in the same language, relate to each others problems and provide relevant answers to their doubts, which could enhance the knowledge-sharing among them.

6) Benefits of the artifact: The above-mentioned values that the artifact creates are on an abstract level, and when combined, they result in a few derived benefits pointed by the participants and these are presented below.

The first benefit mentioned is the faster response time for questions. A respondent noted "It would make it easier to ask questions and maybe I would get feedback sooner, than if I send an email to one of the teachers".

The second benefit is the extension of the time period, in which students can ask questions. A participant stated "It makes it seem like I still have the opportunity to ask questions and the window has not passed". Additionally, another respondent reported "It could make me more inclined to ask questions because I don't think of the questions in class, I think about them afterwards, so I can do it at my pace, in my time".

The third benefit is an improvement of the understanding of the course material, in which most of the participants reported that the prototype could help them in learning the material better. A respondent reported "Students can explain it in a different language than the teacher, so maybe it is more relatable the way they speak about the issue than when the teacher speaks about it". Additionally, one participant explained that reading the content would make her/him understand the course material better. More so, a respondent stated "I will get multiple answers and get to see other opinions and perspectives and I think that's very important to understand the knowledge".

The fourth benefit is directly addressing the main problem identified in section IV, for which the artifact is designed to aid with. All of the participants reported that they would feel more inclined to express their doubts using the artifact, and that they see a potential of this prototype to help with the issue. One participant noted "It would help me with questions that I wouldn't ask in class", and another added "I would be more inclined because people cannot judge you when you are anonymous". Another respondent reported "I'm not asking a lot of questions, so I would really like to have this app, it would make me ask more questions". Additionally, students would also feel more inclined to answering questions, a respondent noted "I would be also more prone to answer something because if someone asks something in class I wouldn't try to answer it, because I cannot answer it in that moment, but if I see something that I have read before, then I feel confident about answering then I would answer". In summary, the values the artifact provides, results in multiple benefits realized by the students, such as faster response time for an answer, extension of time period for asking questions, helping students understand the course material better. Furthermore, it became evident that the artifact has the potential of aiding with the problem on asking questions. It was reported that students will feel more inclined, not only to ask their questions in the artifact, but also to give answers to questions. Consequently, this will increase the participation of students in discussions, which will enhance the knowledge-sharing among them, and will contribute to support the obtaining of personal knowledge. All of these benefits support students in achieving a more effective learning process with the aid of the artifact.

In this section, the findings make it evident that using value co-creation to inform a design of an IT solution resulted in the creation of an artifact that brings values and derived benefits for the students. This solution is regarded as novel by some of the participants, and it is an artifact that cannot be found in the current university environment. At Aalborg University, Moodle, is the only platform where students can share their knowledge. However, it is not student-to-student, but a mean for student-to-lecturer communication. It follows that this artifact represents a radical solution, which is different than what exists in the specific context of Aalborg University, and it is important, since it can potentially improve the learning process of students. Furthermore, even though this research, and the designed solution is for students is in context of Aalborg University, it can be argued that the context is not specific when it comes to course format, and when compared to other universities. Therefore, it can be argued that the reactions of the students to the artifact, and the findings, can also apply for other universities, which have the same teach practises.

VIII. Discussion

The aim for this research was to utilize the value co-creation framework, to inform a design of an IT solution that can support students in their learning process. This resulted in design of an artifact which during the evaluations, proved to be useful, and has the potential to aid with the main problem identified in section IV. The findings of this research contributed to the better understanding of the value co-creation framework and its elements. This section will begin with a description of what was learned about the framework during this study. This resulted in an improved framework of value co-creation which will be presented. Following this, are discovered dependencies between different components of the framework. Thereafter, the findings of this research will be related to existing research on design based on value co-creation, value co-creation in the university context, knowledge-sharing between students, sense of community and trust.

A. Working with the framework

Working with the value co-creation framework from figure 1 contributed to a better understanding of the notion and its components, and it also revealed areas for improvement, as well as dependencies between components of the framework. It became evident that inclusion, and consideration of the components in the framework was a great support, when striving for a solution, which incorporates value co-creation. It was found, however, that some components were either too specific, or not specific enough, which is why an updated version is presented, that enables the inclusion of value co-creation in a practical solution to a problem. Consequently, some details in the components have changed to either be less, or more specific, in order to not limit its usage and application. In the figure, see figure 10, the improved version in shown.

1) Improved framework: The first component of the framework is **stakeholder type**. This component changed from limiting a stakeholder to be either a company, or customer to a more generic stakeholder type. In this research, the stakeholders did not fit into these two categories, thus there was a need for a change. It is shown that stakeholders can be a number of different types, without any specification of their identity. As in the original framework, stakeholders bring their own resources, which is the entry criteria for joining a value co-creation relationship.

The second component is the **pool of resources**, in which all the resources are collected. This component did not change, and the various stakeholders resources are still combined, and used for value-creating activities.

The third component is **context and relationship type**. As the stakeholder types has changed from the specific company and customer types, the relationship type has also changed. It is not necessary to limit relationship types in advance, as these solely depend on the context, in which the relationship exists. In this research the context is Aalborg University, and the solution was designed for students helping each other, with a limited involvement of lecturers and TAs. This means that the main relationship type was student-to-student, and secondary lecturer-to-student, but these types only fit in the specific context of this research.

The fourth component is the **mode of resource exchange**, which in the original framework consisted of three types, namely addition, exchange and synergistic. In the solution from this research, the modes of addition and exchange were used for the design of the artifact, because they are specific, and tangible enough to work with. The last mode, synergistic, is too intangible for design, and so it is difficult to apply in a practical context. The two implemented modes, addition and exchange, was throughout the research considered to have a more appropriate naming, which turned addition into supplementary, and exchange into complementary modes of resource exchange. This now means that the resources, stakeholders bring to the relationship, and activities can support each other in two ways, either they build on top of each other, which is supplementary, or they are different types of resources which stands alone, and is thus complementary.

The fifth component is the **IT-enabled value-creating activities**, which from previous research were specified to four specific activities, which were adopted into the original framework. In this research, the focus was on the knowledge-sharing, and governance activities. It was evident from working with the framework that governance is the only activity that must always be present, in order for balance and control to be maintained. Additionally, there is no need to restrict the value-creating activities to three specific ones. It was further found that activities can consist of sub-activities.

The sixth component is the **value and the derived benefits**, which from previous research were set to four specific value categories. In this research, it was found that this distinction of the four value categories is not necessary, and it complicates the framework. The results show that a distinction could be made between values and benefits, by the level of abstraction. Value could simply be expressed as an abstract goal desired to achieve. An example of value from this research is a sense of community, which leads to a number of more tangible benefits. Benefits are thus seen as a tangible result of the abstract values.

The seventh component is the **additional costs**, which were seen as deriving from activities, meaning that participating in an activity could also infer costs to the stakeholders, especially if the governance activity is not maintained. In this research, it is found that additional costs are not just associated with activities, but can also derive from values. One example is the possibility of a negative attitude expressed by members of the community, which would discourage some of the
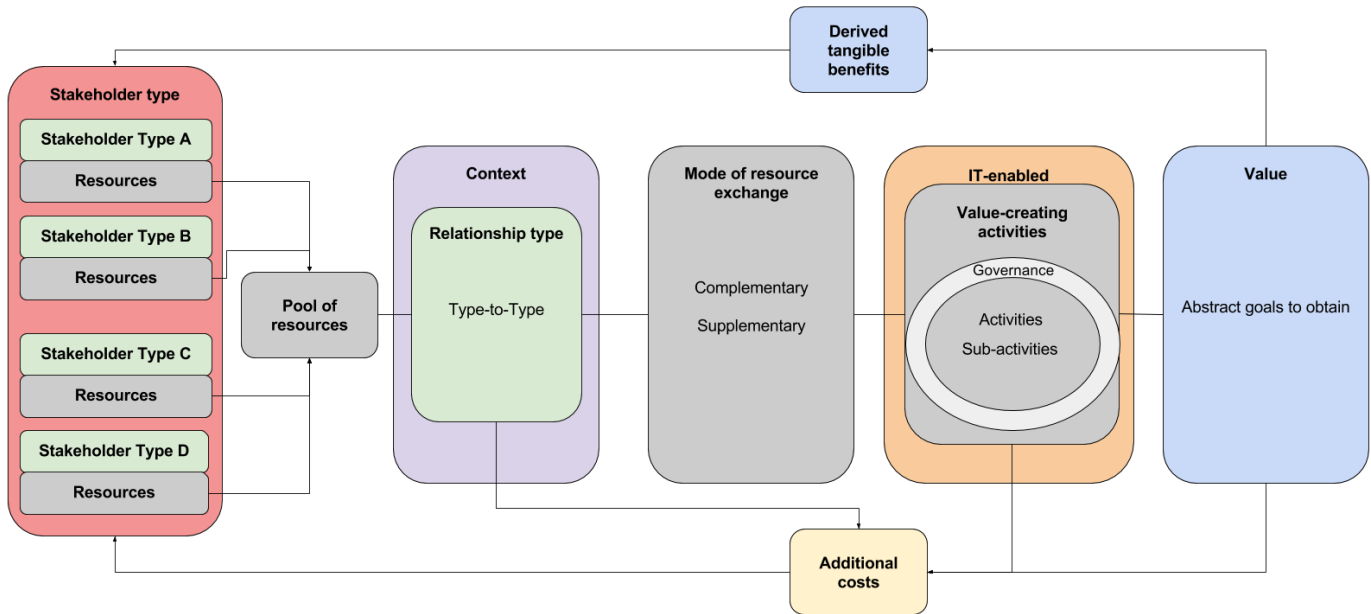
Fig. 10: The improved framework of value co-creation

other members to take active part in the knowledge-sharing activity. This would imply a weak community, as described in II-D. Furthermore, it was found that additional costs derive from the relationship type, and the context in which it exists. This study shows that student-to-student knowledge-sharing implied concerns about trust of information, which is seen as an additional cost.

In summary, working pragmatically with the framework, which came to existence theoretically, proved some weaknesses and areas for improvement. With the improved framework, it is believed that it can be utilized for solving problems, when value co-creation is inferred in the answer. It is furthermore believed that the framework, in its improved format, is more generic and can be utilized for more cases.

2) Dependencies in the framework: Along with the improved understanding of the framework, a deeper insight into hidden dependencies between components was established.

Firstly, **value and benefit depend on the stakeholder type**. It was found that including different, and multiple types of stakeholders in the process would result in higher value of the artifact. This is because each of them would contribute with complementary resources, which would bring diversity to the pool of resources.

Secondly, **value and benefit depend on the context**. It was found that when an artifact was personalized and customized to the specific context, it would bring more value to the stakeholders. This is because establishing a good understanding of the domain leads to the design of an artifact that supports users better.

Thirdly, **the additional costs depend on the relationship type, and the context**. The research showed that

the type of relationship incorporates additional costs for the stakeholders. In this research, the student-to-student relationship implies the additional cost of possible incorrect information shared in the artifact. However, if the relationship was lecturer-to-student, this additional cost would potentially not incur.

Fourthly, **the involvement of stakeholders in the process depend on the value and benefit compared to additional costs**. Even though obtaining knowledge from peers entailed additional costs, such as possibly misleading information, the perceived value was considered greater, due to the pool of resources. This is because students consider the value that the combined resources give, greater than the potential costs, which make them willing to accept the possible additional costs.

Fifthly, **value-creating activities and their sub-activities depend on the context**. The research showed that the value-creating activities can be divided into sub-activities. In this case knowledge-sharing between students consists of reading the content, rating, answering questions and asking questions. However, it is considered that these sub-activities would not be the same if the context was different. For example, it is considered that the activity of knowledge-sharing between students has its own characteristics, compared to knowledge-sharing in a business context. Therefore, the context is what defines the value-creating activities, and this would also imply other sub-activities, relevant for the main activity.

B. Relation to existing research

The findings of this study are related to existing research that revolves around a few areas. The results supplement the existing body of research on value co-creation, and knowledge-sharing among students. They further support

the existing research on sense of community between students, and online trust.

1) Design based on the value co-creation framework: The systematic literature review from the research by Selnø and Prosenikova (2016), which resulted in the creation of the value co-creation framework, forms the foundation for understanding of the notion.. Before embarking on a design journey to solve a problem, the existing literature on designing with value co-creation was examined. From this, an interest was initiated, as it was discovered how little the existing research has to offer on, how design can be informed using the value co-creation notion.

The existing literature on value co-creation is focused on theory as seen in section II-A, and so it is not sufficiently addressing design, neither does it provides an adequate number of pragmatic examples, as it only describes the abstract notion of value co-creation. For example, a recent literature review on IT-based value co-creation by Mandrella, Zander, and Kolbe (2016), which was used as foundation to the understanding of the concept, and the creation of the initial framework, analyzes the existing research on the matter, however it does not provide an evidence of research dealing with value co-creation being used to inform a design. More so, the research by Sarker et al. (2012), that is one of the practical examples found, revolves around how a technology and a sales company can utilize each others' resources, for the achievement of higher value. However, this research does not have any design orientation, thus it can be viewed as behavioristic explanation of what already exists. A third example is the research by Skaržauskaite (2013), which is a research on existing models for measuring and managing value co-creation. According to the research there is lack of existing literature on empirically tested models for managing co-creation. The study has not addressed design using value co-creation, and does not state other research that deals with this matter. The research by Grover and Kohli (2012), which was a foundation for understanding value co-creation, studies how IT value can be co-created between firms, taking into consideration four layers of activities. However, the suggested framework in this study is not used for a design, nor is this suggested for further research.

In summary, this study adds to the existing body of research on value co-creation, with a pragmatic example on how to use the framework to inform a design of an IT-solution.

2) Value co-creation in a university context: In the existing research, value co-creation is seen as an emergent concept in the university context as seen in section II-B. In the existing research, it has a strong focus on lecturer-to-student, or institution-to-student relationships, and it mostly revolves around students satisfaction with their education. In the existing literature, value co-creation can be observed between students and lecturers, who create value together by integrating their resources (Maria,

Dimitris, and Garyfallos, 2014). In this research, the importance of a lecturer-to-student relationship was recognized, as well as the value and benefits that can be realized, by integrating the diverse resources that these two types of stakeholders can provide. Therefore the lecturer-to-student relationship was taken into consideration for the designed solution of this study, which was in the "Lecturer approved" stamp feature. However, the focus of this research is on student-to-student relationship, and how students can co-create value together. Consequently, the findings from this study add to the existing literature in the domain, and further provide a pragmatic example of how value co-creation can be applied for solving a genuine problem in the university context.

3) Knowledge-sharing between students: In the existing research, knowledge-sharing consists of knowledge development and knowledge contribution, also understood as giving and getting knowledge as stated in II-C. It was argued, that formulating questions enhances individual learning, because students first have to obtain knowledge. More so, students test their own knowledge by answering questions by their peers and getting immediate feedback. For this study, the importance and the benefits of formulating, and answering questions for knowledge-sharing between students are recognized, and therefore both activities are present in the designed solution. From the findings it was found that answering questions has a strong impact on the individual learning of the students. It became evident that answering questions improve students' knowledge, and that by trying to explain a topic to a peer, students learn better. More so, the findings of this research show that discussion, which in this case consists of repetitive asking and answering questions, is in the core of knowledge-sharing. Discussion allows for supplementing the existing knowledge with missing information, thus improving the quality of the shared knowledge. Additionally, through discussion students get different perspectives on a matter which challenges their own knowledge and understanding, and further develops their critical thinking. It follows that the combination of the two components of knowledge development and contribution, can form a third component, namely discussion. Consequently, this study adds to the existing literature on knowledge-sharing between students, by acknowledging the importance of discussion for this value-creating activity.

4) Sense of community: In the existing research as stated in II-D, the sense of community is referred to as an important aspect of motivation, thus it is also viewed as an important aspect of the learning process, since it increases the persistence in courses and motivate students to learn (Rovai, 2002). Sense of community is what makes students initiate knowledge-sharing, and so it is seen as a premise for starting this activity in the first place. The findings of this research support the importance of sense of community, as it was reported that the value the artifact

creates for the students would make them feel more comfortable, and confident in participating in discussions. Furthermore, Rovai (2002) introduced the concept of classroom community, which implies the feeling of safety and trust, that contribute to the willingness of students to speak openly. More so, according to the literature, when trust is established students would be more willing to expose themselves and their doubts. The findings support the existing research, and it became evident that safe space is what makes students more inclined to share their doubts and ask more questions. Additionally, transparency was found to provide comfort for students, knowing that they are not alone with their struggles. Therefore, these two values that are closely related to the classroom community concept, contribute to sharing and obtaining knowledge among students. As the findings show, these values would increase students' willingness to be more open, and to share their problems with fellow students. It follows that the existing research acknowledges the importance of sense of community, safe space, and transparency for knowledge-sharing, and these also happens to be values created by the artifact.

In previous research, it was found that trust is an important element in transactions, whether they be of money or knowledge (Ba, 2001). Offline individuals can judge others based on a number of human parameters, but these disappears online, and thus there is a need for a new way of establishing trust. In this study, it was accommodated by implementing two features, namely a way for the community to control its own members, as well as governance from a higher-standing third party, the lecturer. The findings of this research showed that implementing these two features in the solution support the definition of online trust, which revolves around feeling confident that no one will exploit own vulnerability (Beldad, De Jong, and Steehouder, 2010). More so, the research showed that due to the implementation of these two features, students would be more likely to consider the benefits associated with using the artifact, regardless of the potential added costs.

In summary, the research contributed to a better understanding of the notion of value co-creation and the dependencies between its components. This resulted in an improved value co-creation framework, which contributes to the general research on value co-creation. This study further adds to the existing body of research on value co-creation, by supplementing it with a pragmatic example of how value co-creation can be used to inform a design of an IT-based solution. Furthermore, it adds to the research on the matter in a university context by demonstrating how students can co-create value together. The designed artifact incorporates all the different components found in the existing literature, which are referred to as important elements of knowledge-sharing. Furthermore, the artifact allows for discussion, which enhances the sense of community and is regarded essential for the knowledge-sharing activity.

C. Limitations and future research

The result and contribution of this research is based on a design approach, where the applicability of the value co-creation framework for designing solutions was evaluated. The results thus originate from an artifact and its evaluation, which was based on a restricted group of students in a limited quantity. This limitation of participants leads to the results only being relevant for this group of students, which further makes the validity of the findings questionable, as it cannot be inferred whether the same result would occur with different participants. Furthermore, the evaluation was done as a qualitative study with a following analysis, without any measurement of long-term effect. At this point, the findings only report on whether students believe the artifact could be useful, and not whether it actually proves to be. The choice of technology was selected early in the process due to the feedback on context acquired, in that the solution would be used in the morning before class and after class and no further exploration of other technology choices was thus explored. A major part of the solution has been the involvement of different types of stakeholders, namely students, TAs and lecturers. This study has only investigated the problem and solution from the students perspectives, and has not taken the willingness and appropriateness from the other stakeholders viewpoint into consideration.

For further research, it could be interesting to perform different experiments, such as one involving students from other educations, or performing a long-term experiment to evaluate improvement in the students learning process. For this to be available, the artifact should be developed into a fully functional mobile application, with an external centralized database. From this it would be possible to see whether the qualitative findings of this research corresponds to further research. It could also be interesting to investigate whether the same type of knowledge-sharing applies in a business context, and if the artifact could be utilized with the same features customized for the context. With an exploration into the business context, it would be possible to evaluate in different environments and it would be possible to verify whether there really is a need for distinguishing between stakeholder types the way it has been done between the original and improved framework. With this investigation it would be possible to further improve the framework. Another area for future investigation would be to challenge the technology choice and see if for example a web application could be an even better solution. Finally, as lecturers and TAs has not been included in this research, it could be interesting to include these stakeholders in further research, and investigate in what way this would impact the proposed artifact.

IX. CONCLUSION

As blended learning is becoming popular with the increased amount of technology available, it was relevant

to explore how students' learning process at universities could be enhanced. By that the purpose of this research was to look into how the value co-creation framework could be utilized to inform a design of an IT solution, that can support students in their learning process. By using the value co-creation framework to inform the design, all components were taken into consideration. The result was a design of an artifact that was considered valuable, and capable of aiding with the main problem, in regards to students having difficulties in asking questions. It became evident that the artifact brings value for students, such as sense of community, safe space and transparency, which are also elements, that the existing literature addresses as important for knowledge-sharing among students. It follows that the artifact can support students in their learning process, and can enhance their experience at university. Working with the framework resulted in a better understanding of the notion, and the dependencies between components. This resulted in the development of an improved and a more generic framework. This study further adds to the existing body of research on value co-creation by providing a pragmatic example of how this concept can be used to inform a design. More so, it supplements the existing literature on value co-creation in a university context, and knowledge-sharing between students.

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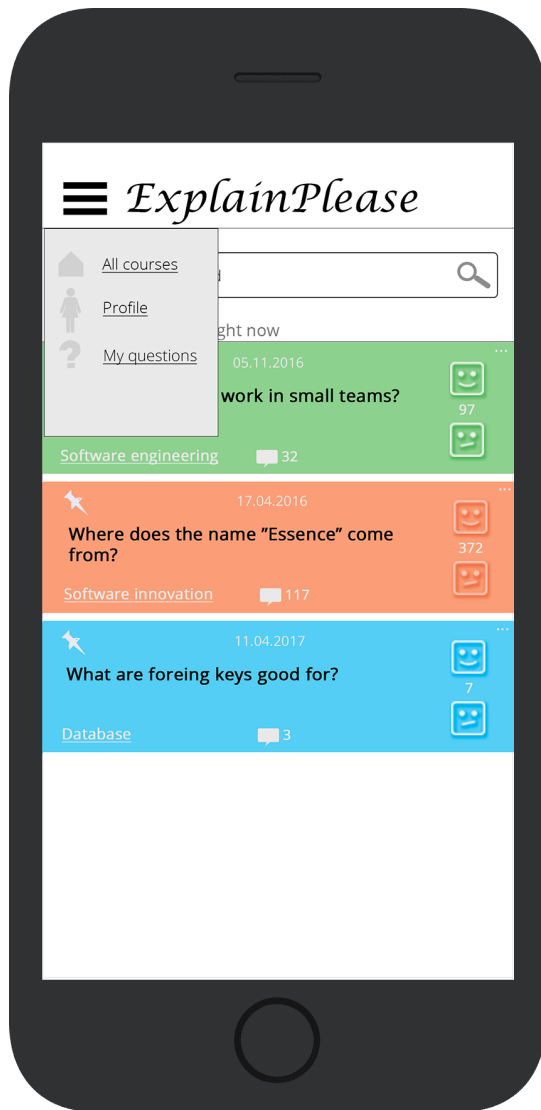
Appendix

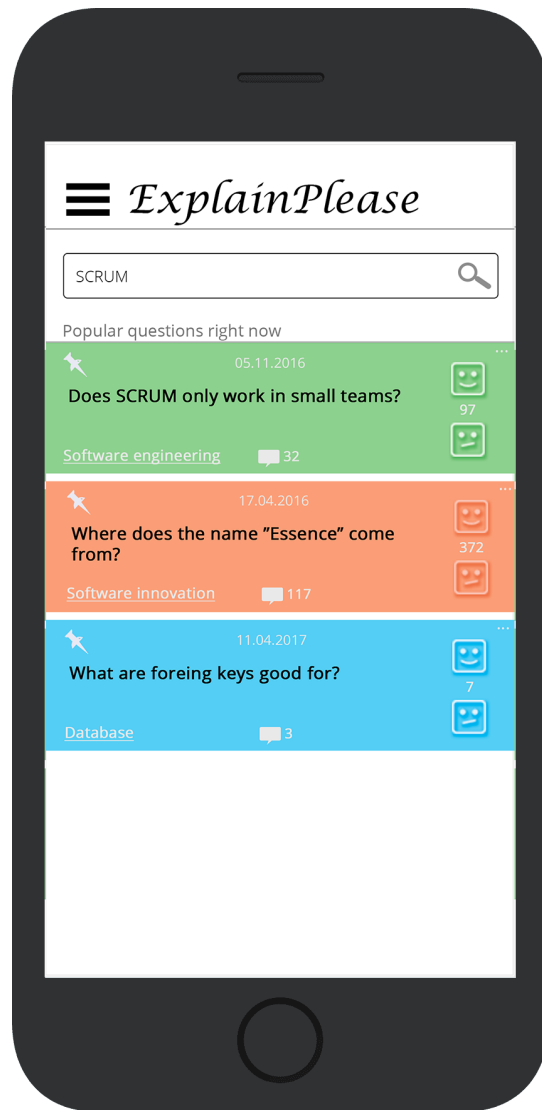Fig. 11: Front page with navigation

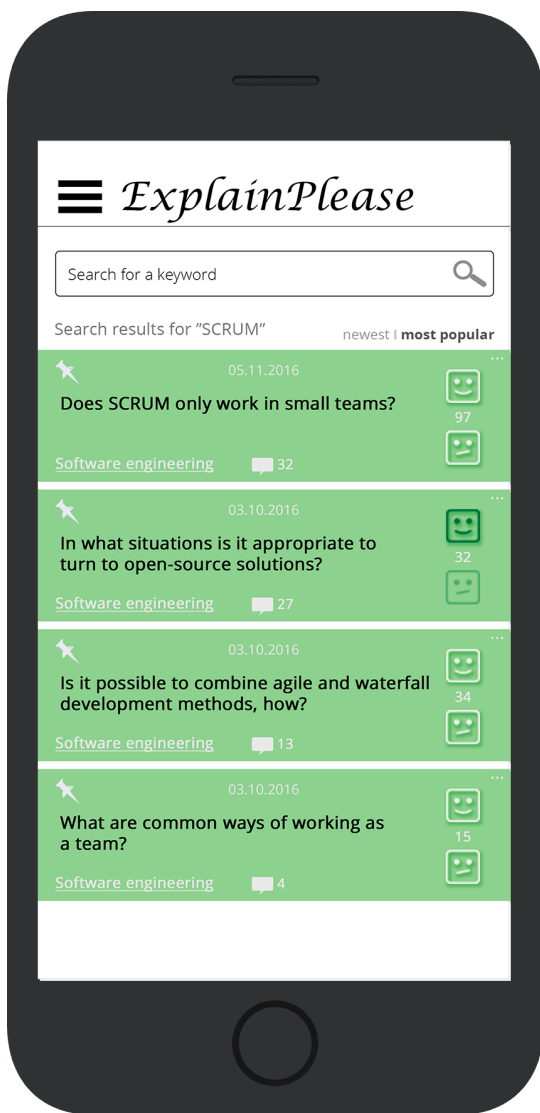
Fig. 12: Front page with search
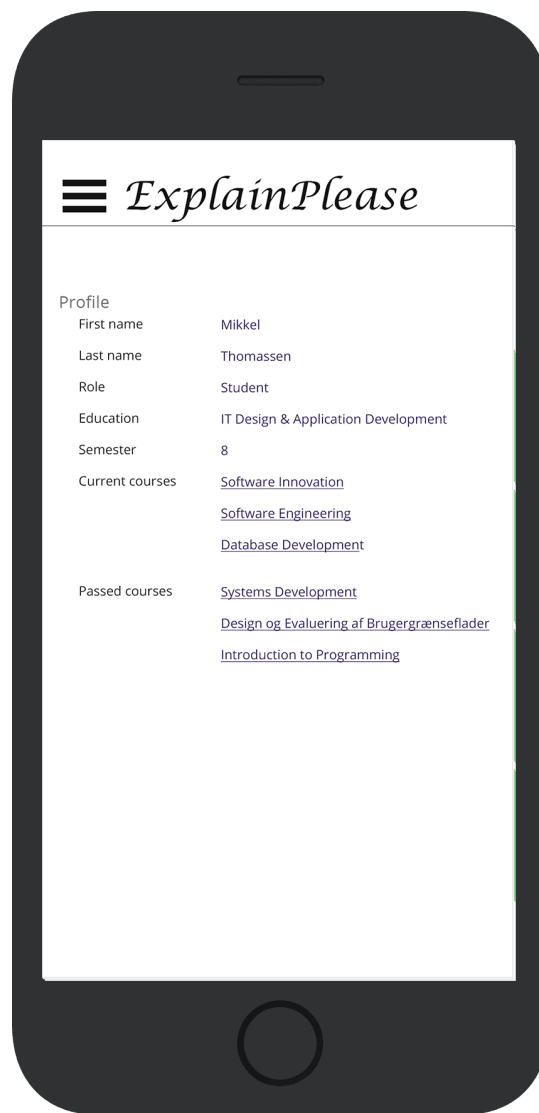
Fig. 13: Search results

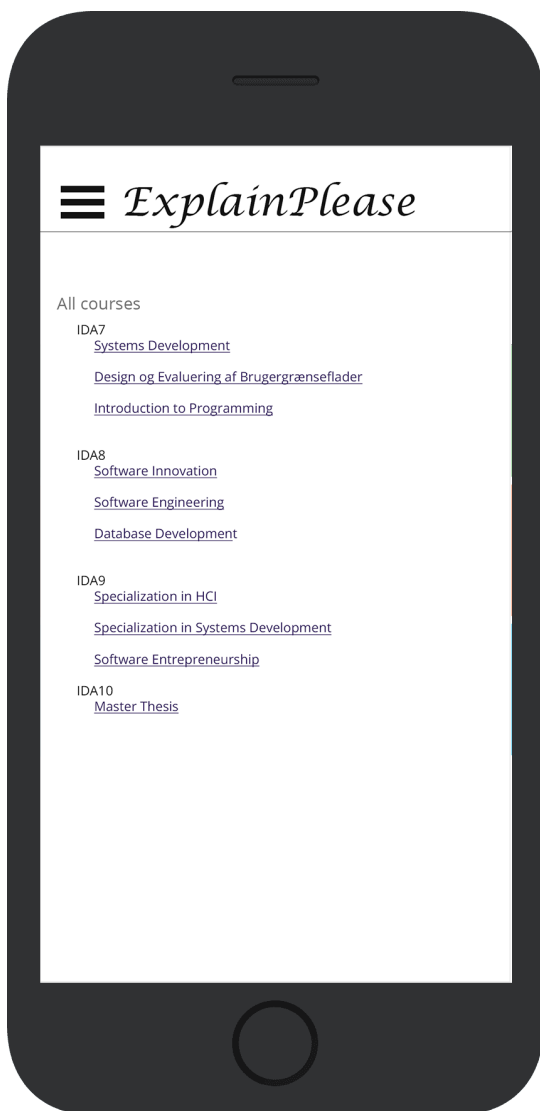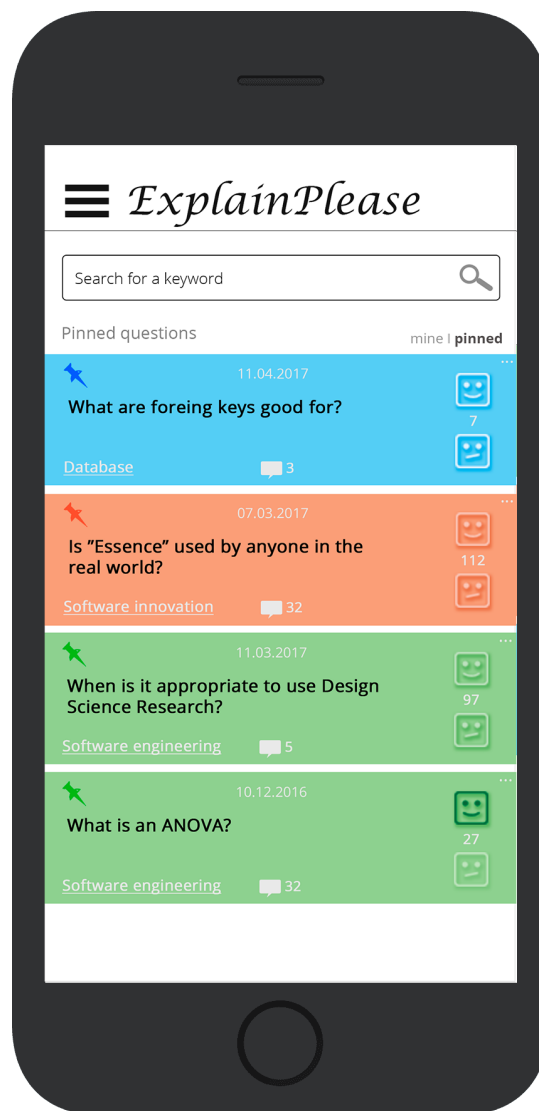
Fig. 14: Profile page

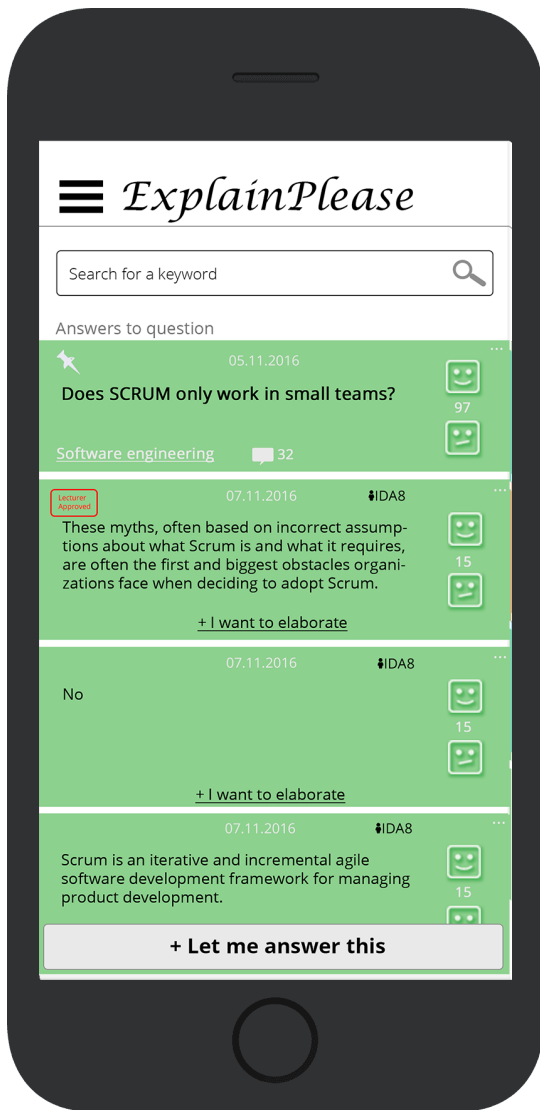Fig. 15: All courses

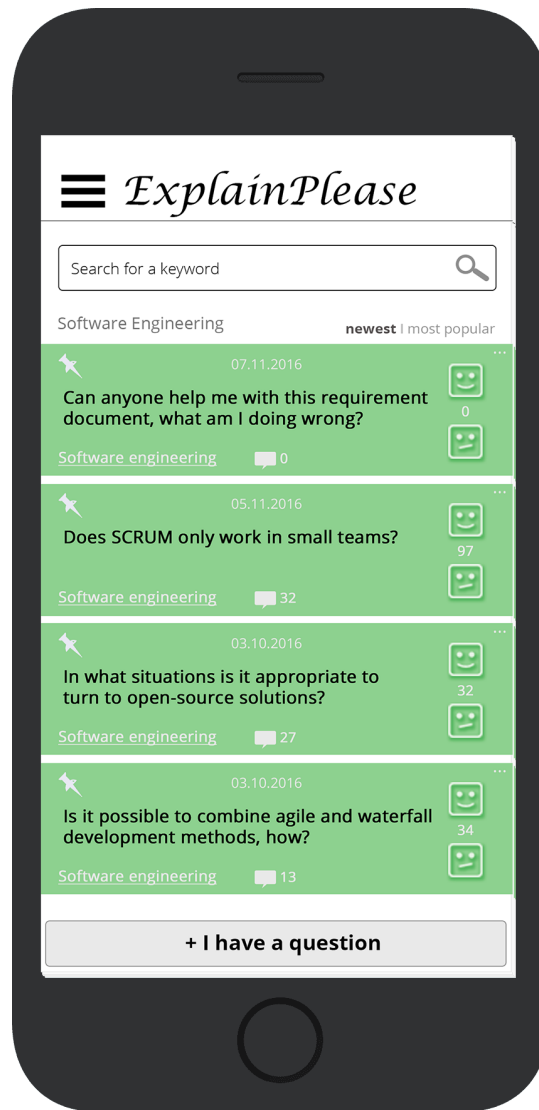Fig. 16: Users pinned questions

Fig. 17: Course page
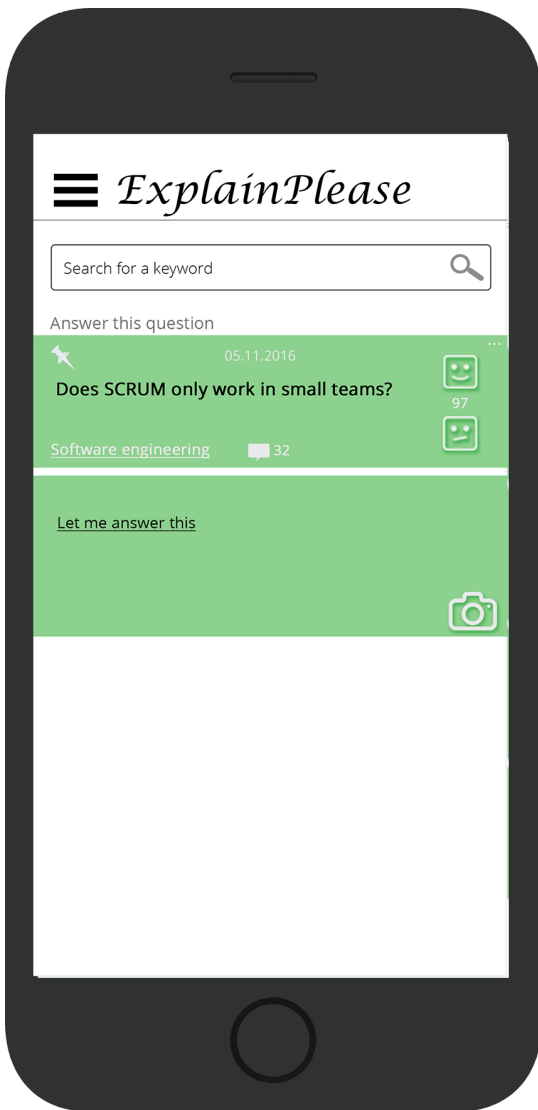

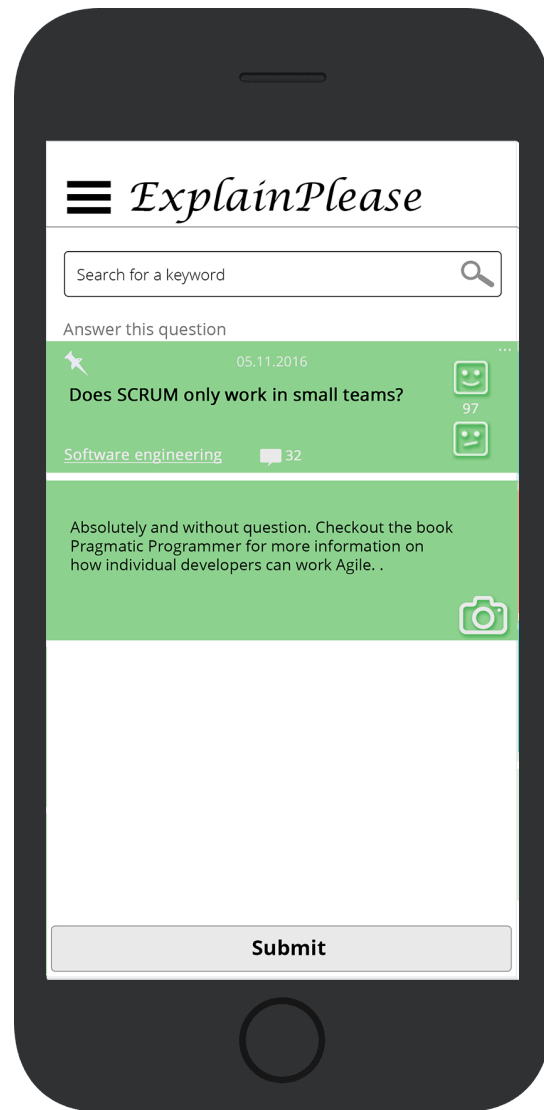Fig. 18: Course page with new question

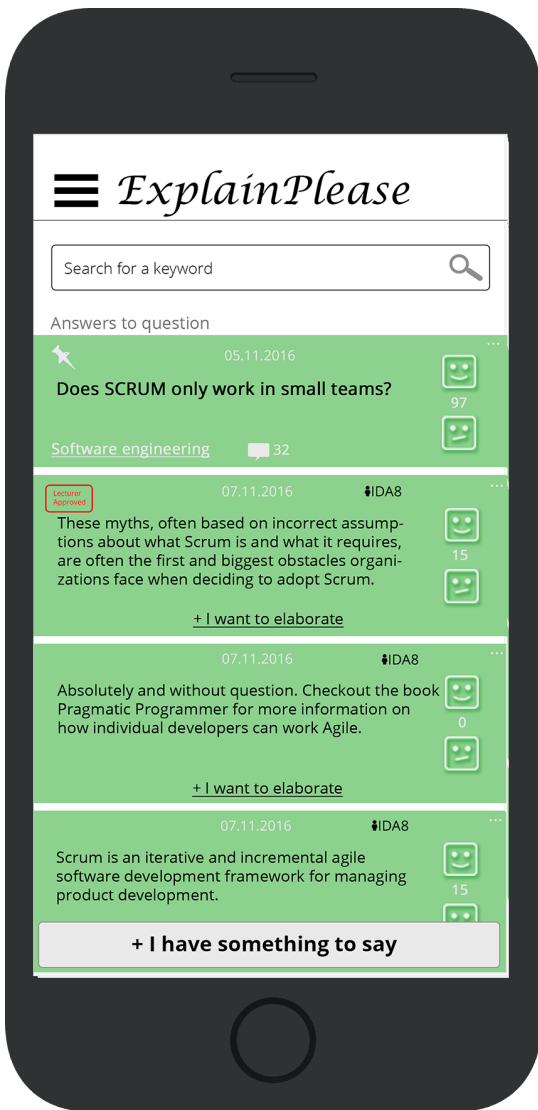Fig. 19: New answer to a question

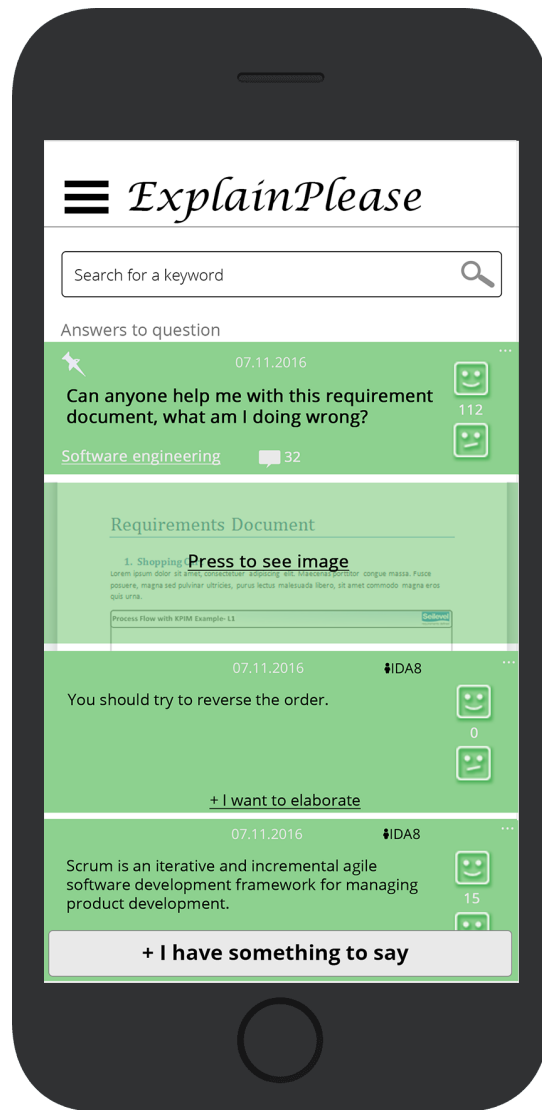Fig. 20: Create answer to a question

Fig. 21: See the new answer

Fig. 22: This is the player profile page.
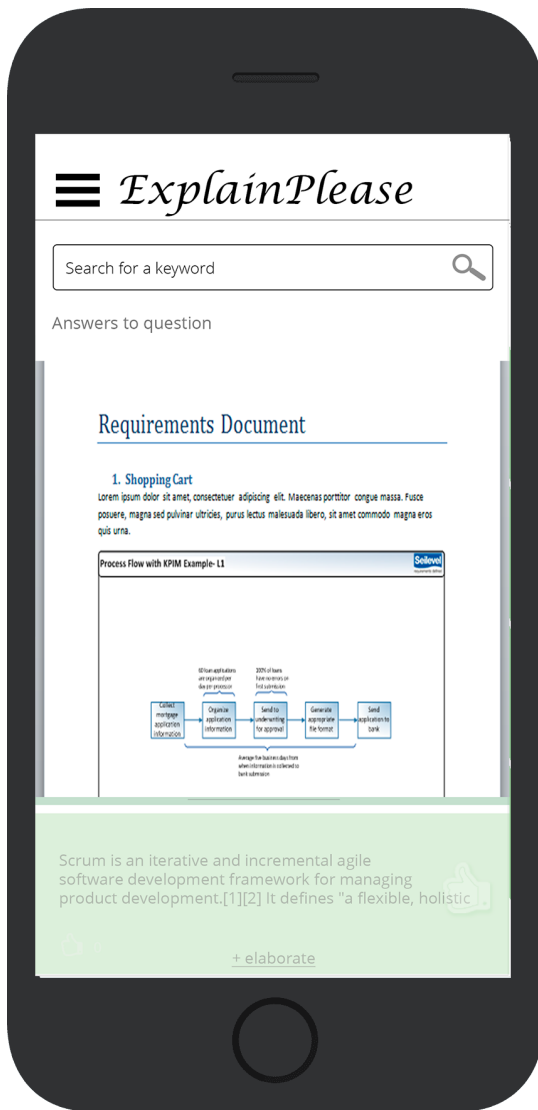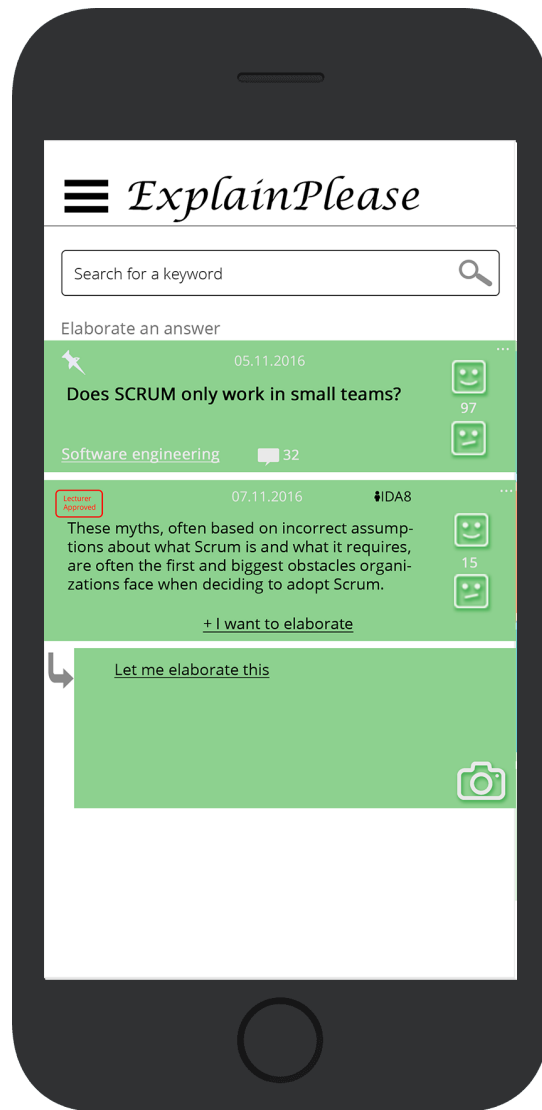
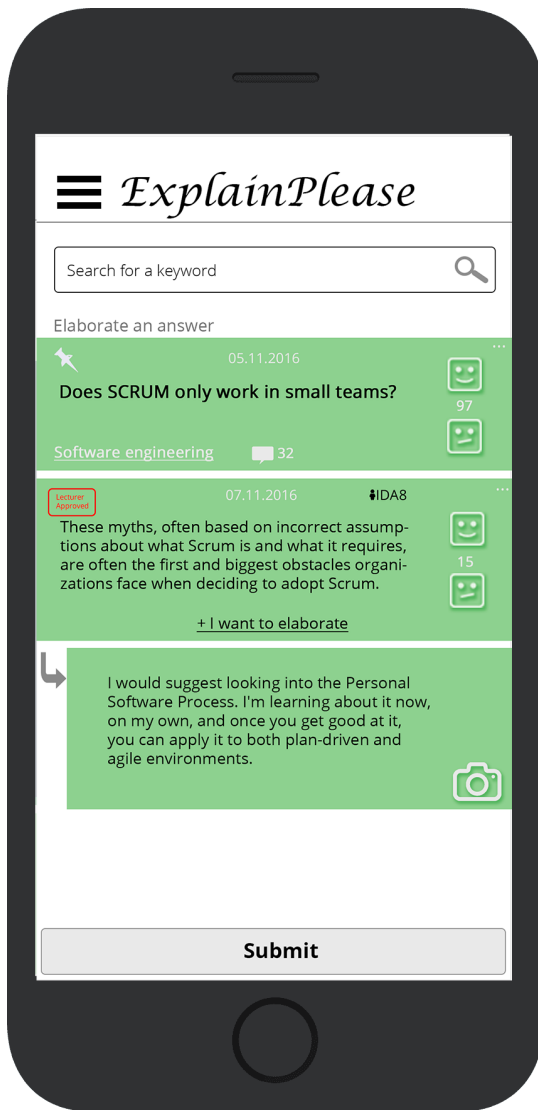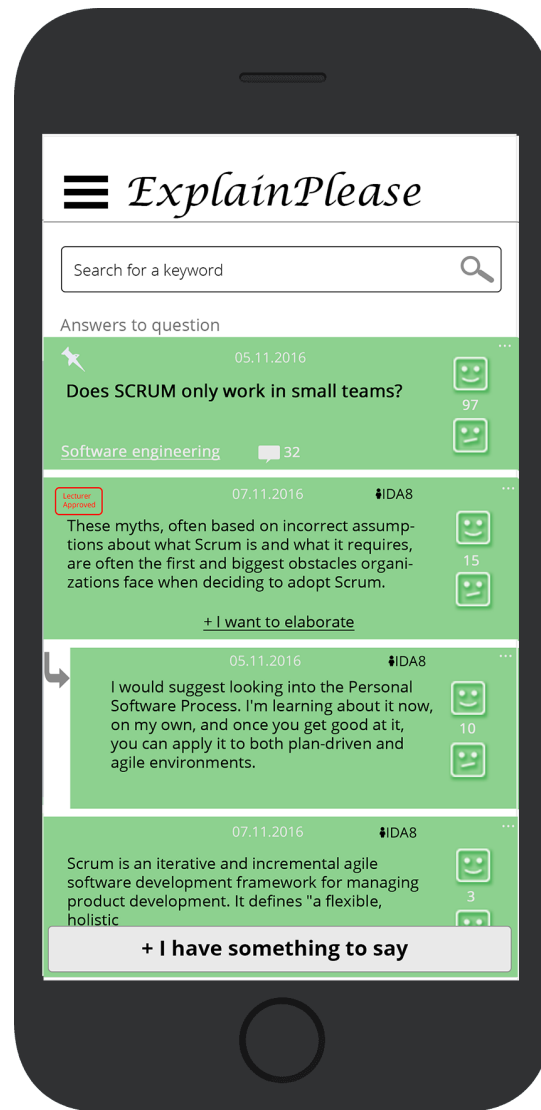Fig. 23: Hold to view image

Fig. 24: Elaborate an answer

Fig. 25: Write elaboration

Fig. 26: See elaboration

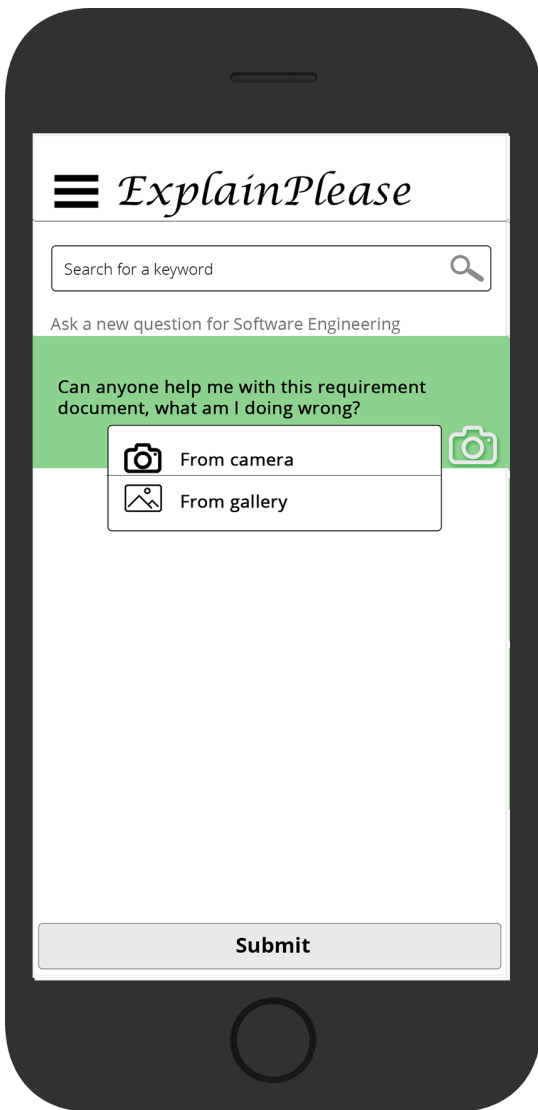Fig. 27: Answer with elaboration

Fig. 28: Ask a new question
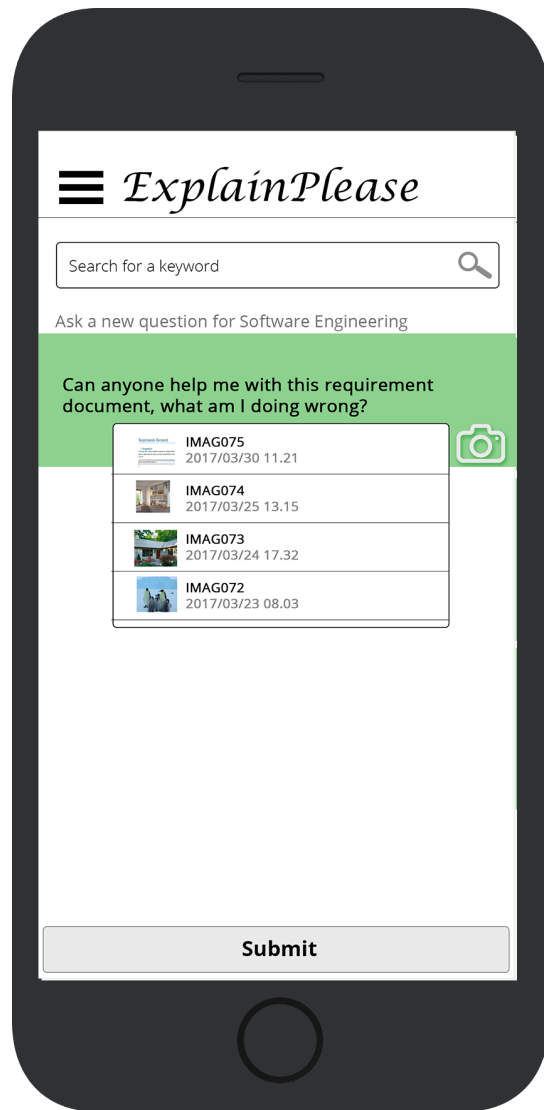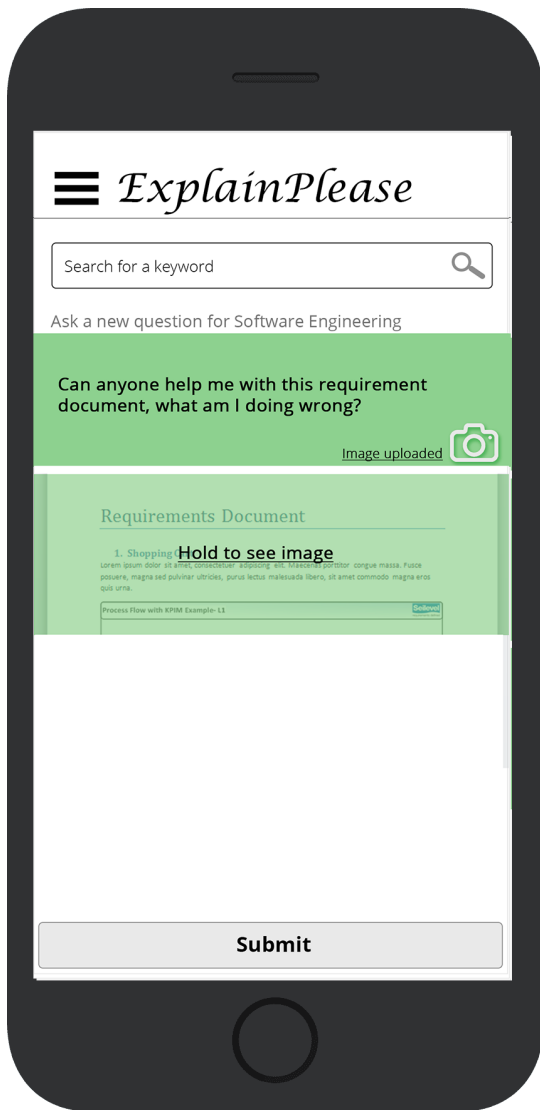
Fig. 29: Upload image to question

Fig. 30: Choose image to question

Fig. 31: Question asked with image