How a Scavenger Hunt App Can Increase the Relatedness to Your University

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ABSTRACT
Previous research has shown that to have a meaningful experience, one of the six human needs must be satisfied. We want to examine if a scavenger hunt with augmented reality elements can help to build relatedness to the course of study and the university. Therefore, we conducted a study with six participants. They took part in a scavenger hunt at the Hochschule der Medien in Stuttgart. A Prototype of the app *ScavHu* accompanied them through this experience. The results confirm our initial hypothesis that a scavenger hunt app can improve the relatedness with the university. The results of the relatedness to the course of study are not that clear. We suggest that there wasn't a huge impact. It would be interesting to see how the results behave when the study is repeated with a revised prototype and participants that fit the target profile even better.

Author Keywords
Relatedness; scavenger hunt; experience design; university; augmented reality; human needs; application, app.

INTRODUCTION
At the time of Pokémon Go and Snapchat with its funny filters, the term augmented reality is no longer just a theoretical construct. One technical definition for augmented reality is "*a technology that works on computer vision-based recognition algorithms to augment sound, video, graphics and other sensor-based inputs on real world objects using the camera of your device*"[1]. This technology finds more and more points of contact with our everyday life. So, it is no wonder that many games or gamified applications incorporate this technology.

Bacca et al. [1] were interested in which way augmented reality can be helpful in the educational area. They reported that augmented reality "*is effective for teaching abstract or complex concepts*" [1]. Furthermore, augmented reality has been often used in language learning. But has also been applied in painting appreciation due to the possibility of adding virtual information to the real world. It was generally noted that the use of augmented reality extended the experience and improved learning performance and motivation.

Poretski et al. [6] have shown that users may assign virtual objects with value and experience a sense of relatedness. They can also develop psychological ownership over these objects. These processes are similar to those of interaction with physical objects. And the engagement with the application has a huge impact. What does this term relatedness mean and why does it play a central role in this work?

Hassenzahl and Diefenbach [2] showed that the well-being of a person can be seen as a consequence of the fulfillment of needs. The following six basic human needs have been named by Wiklund-Engblom et al. [7]: Autonomy, Relatedness, Competence, Stimulation, Influence, and Security. The concept of relatedness describes the "*feeling that you have regular intimate contact with people who care about you rather than feeling lonely and uncared of*" [2]. These needs can serve as the basis for designing meaningful experiences and technology is used to design and create these experiences [2]. However, this technology must be carefully designed because it deals with such a crucial aspect of life [5].

Hassenzahl et al. [4] defined experience design as an approach that places pleasant and meaningful moments at the center of all design decisions. And according to Laschke et al. [5], experience design demands that the story be set straight and meaningful before dealing with the technological implementation. Experience in the context of experience design is seen as "*an episode, a chunk of time that one went through—with sights and sounds, feelings and thoughts, motives and actions [...] closely knitted together, stored in memory, labeled, relived, and communicated to others. An experience is a story, emerging from the dialogue of a person with her or his world through action*" [4].

Hassenzahl et al. [3] reviewed 143 artifacts. They identified six strategies of designers to create relatedness experiences: Awareness (56 of 143), expressivity (42 of 143), physicalness (18 of 143), gift-giving (11 of 143), joint action (12 of 143), and memories (4 of 143). These strategies will be examined in more detail in the following paragraphs.

[1] https://www.3pillarglobal.com/insights/augmented-reality-introduction-and-its-real-world-uses
(last called on 11.03.2020)

They understand awareness as the "*state of knowing about the environment in which you exist*" [3] and a feeling of relatedness can be created through ambient designs. An advantage is that no direct communication is necessary, and you don't need to interrupt what you're doing.

Expressivity helps to express and reflect emotions, feelings, and affections. The functionality of the artifact's ranges from simple on-off signals to complex symbols which allow developing an own language of communication between people.

Physicalness has two sub-strategies. The first one, physiological parameters, focuses on the physical signs of being close to another person like a heartbeat or body heat. The second one is about imitating gestures that are performed with emotionally close persons like handholding. One limitation of this strategy is the requirement of a certain degree of simultaneity.

The fourth strategy is gift-giving. The giver voluntarily gives goods to the recipient without expecting anything in return or compensation.

It has also been proven that joint activities can strengthen relatedness by creating a shared experience. An example of this is the new establishment of routines in a partner relationship.

And last but not least is the re-experience of joint moments from the past. It is a huge advantage that the partners do not need to re-experience it together. But this strategy expects the user to invest more effort because he or she has to document the special moments to enable the potential to re-experience them.

Some of these identified strategies can be used to model relatedness when designing a new concept. Whereby some have greater limitations than others. Which ones should be used can only be weighed up on a case-by-case basis.

Hassenzahl et al. [4] showed that people go through events with others to feel connected. However, interaction and communication during an event, such as a concert, is likely to be limited. This is partly because the event itself requires full attention or because of norms such as not speaking during musical performances. During the event, communication is mainly non-verbal, using short glances, gestures or laughter. Finally, the feeling arises that the experience as a whole was more meaningful because it was shared. Often communication and interaction before and after is intensified since it is restricted during the event. Without the phase of anticipation (before) and cooling off (after) the experience would feel incomplete.

For many young people, the start at an unknown university is very exciting and stressful [8]. In the beginning, they know neither the buildings, the teachers nor their fellow students. In this study, we wanted to take a closer look at whether and how the relatedness of newcomers to a university and their course of study could be improved. Specifically, we asked ourselves the question: Can a scavenger hunt with augmented reality elements help building relatedness to the course of study and the university?

MATERIAL & METHOD

This section describes the concept, all used methods, techniques, and instruments.

Concept

When students are new to a university, they may experience feelings of unknownness and isolation due to the lack of information and the whole new situation. The concept presented here is intended to counteract these feelings and thus enable meaningful choice through information but also to facilitate the development of relatedness.

We want to develop a scavenger hunt app combined with augmented reality elements to serve the human need relatedness. For this purpose, we developed a concept for an app, named *ScavHu*, which is used during the scavenger hunt to get from station to station. *ScavHu* contains game elements outside the context of a game to motivate the user and create a positive user experience. Such game elements are for example quizzes and collecting objects. Therefore the app can be assigned to the category of gamified apps. The technology includes augmented reality and a mobile application that runs on a smartphone.

Our target group is students starting with their Master Computer Science and Media (CSM) at the Hochschule der Medien (HdM) in Stuttgart. They already have a technical background from their bachelor's degree in CSM. A huge amount of them is not familiar with the university because they have studied at another university. They are usually between 20 and 28 years old. Due to their choice of the study program, they can be assumed to have a certain affinity for technology and an interest in current developments in the field of information technology.

For further understanding, a brief overview of the course structure is provided. The standard period of study is three semesters and 90 ECTS[2]. There are a few compulsory modules (master thesis and two modules on project management). The selection of modules is large. The following main focuses of the CSM course exist:

- IT-Management
- Media Technology
- Software Technology and Engineering
- Machine Learning
- Mobile Media and Networks
- Interactive Media, Usability and Games

[2] European Credit Transfer and Accumulation System - https://ec.europa.eu/education/resources-and-tools/european-credit-transfer-and-accumulation-system-ects_en (last called on 13.03.2020)

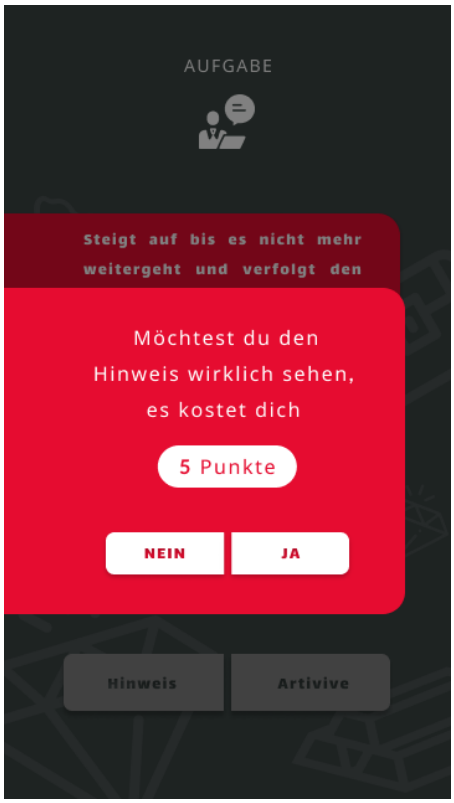

Figure 1: Insurance if the hint should be shown

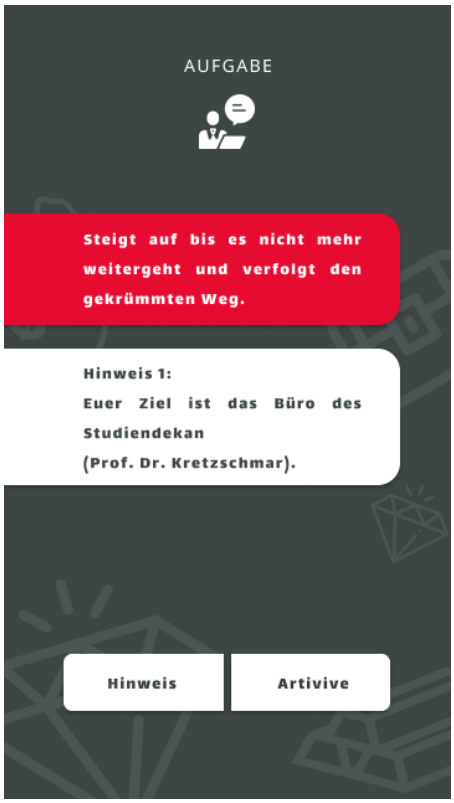

Figure 2: Presentation of the task and its first hint

Every student has to create a StudyPlan at the beginning of his or her studies using the study information (study and examination regulations, module descriptions, etc.).

The StudyPlan contains professional objectives, choice of specializations and maps the choice of modules to these. Then it will be discussed with the Dean of Studies, who points out conflicts between objectives and module planning.

ScavHu includes riddles, so-called tasks. The solution of these tasks will lead the scavenger hunt participants to the next station. There is no time limit in which the next station has to be found. If you are stuck, two hints can be requested to help you solve the task. Requested hints reduce the points per round. Examples of the dialogue are shown in Figures 1 and 2. The missing time limit and the reduction of points should encourage the participants to take their time to deal with the contents so that a meaningful experience can be made. Being the fastest will therefore not be rewarded. Once at the next station, the participants scan their surroundings with an augmented reality tool of their smartphone. If the trigger is detected, a representative of the station gives interesting information about the station in a short video. Afterward, a quiz question is asked about the information just given. If the question is answered correctly, 20 (no hint), 15 (one hint) or 5 (two hints) points are added to the user score depending on the previously requested hints. Additionally, the participants get a reward for the correct answer.

These rewards vary depending on the station, more about this later. If the question is answered wrong no points are added and the participants don't get a reward.

At the end of the scavenger hunt, the participants can look at all their rewards in a collection.

The use of *ScavHu* is part of the introductory course for first-year students. After the Dean of Studies has said a few words about the structure of the course and the upcoming days, the professors will briefly introduce themselves and their modules. Afterward, mentors (fellow students from older semesters) introduce the app *ScavHu*. They explain what the first semester students have to expect in the next hour and explain the rules of the scavenger hunt. After the mentors have divided the groups, one member of each group installs *ScavHu* on his or her smartphone. With the help of a QR code, the app can be found quickly. As soon as all team members are ready, the respective team can start. The order in which the stations are run varies for all teams, with the last station being identical for all. Here all freshmen meet again and have time to get to know each other and to clarify open questions. This process uses a phase of anticipation before using the app (the joint action), followed by a cool-down phase. This structure allows the feeling of the shared experience to unfold as complete and meaningful. In the end, there will be an award ceremony and the members of the team or teams with the most points will receive a small gift. After the event, the app unlocks all possible rewards for each team.

Figure 3: Quiz question of IT-Management

An e-mail with a link to a website is sent to all participants. Everyone can log in with their team name and view their team picture and all rewards, not only the won rewards.

This makes it easier to remember the joint action and receiving the gift will increase the relatedness to the university. Also, the given information is helpful to orientate themselves.

Besides, *ScavHu* can be individualized by a group name and a group photo. Here it would be possible to choose the course of study, as this type of scavenger hunt would also be suitable for first semester introductions of other courses of study.

The tasks are small puzzles. Their solutions describe the way to the next stations. Stations can either be the offices of professors who represent the area of compulsory modules or one main focus of the CSM course. But also, university facilities such as the library or the cafeteria can serve as a station. An employee of the respective facility would be a representative. For example, a library staff member informs about the opening hours and loan periods for different media. All stations represented by professors are connected with a token. For example, if the quiz (Figure 3) is answered correctly, the participants receive an IT-Management token (Figure 4) at the station of the IT-Management focus.

Figure 4: Token of IT-Management

The main information of the video sequence is then displayed beneath the token. For ethical reasons, it would not be justifiable to collect the representatives directly as a reward. The representatives are human beings and should never be used like things you can collect. A collection of tokens, which represents the main focuses, avoids this problem. The rewards of all other stations, such as the library, are links to the respective internet presence.

Furthermore, *ScavHu* could be used to help participants get started with the creation of the StudyPlan. After completing the quiz, each participant could use stars to rate the stations associated with the main focuses. The ranking could go from one to five stars. At the end of the scavenger hunt, each participant could then be sent this ranking by email and a list of the modules of his or her three highest scored main focuses. However, we would like to emphasize that this is only the starting point for independent research.

Case Study

In this study, we wanted to analyze the possibilities to increase the relatedness of the students to the course of study and the university. Therefore, we created a prototype for *ScavHu* to introduce the students to their course of study. Certain functions were prioritized for the minimal viable product[3] (MVP). These restrictions had to be made to guarantee a quick development of the prototype.

The basic functionalities for the MVP were tasks, hints, quizzes, collection of main focus tokens and links as well as a faked score. To reduce the complexity of the prototype, we decided to cover only three of the six main focuses of the course of study and two facilities. The prototype included one collectible token for each of the main focuses and one link for each of the facilities.

[3] *"a basic version of a digital product that is developed first in order to test the product idea and get reactions from users before developing a more advanced version"* - https://www.oxfordlearnersdictionaries.com/definition/english/mvp (last called on 11.03.2020)

Figure 5: Marker of the IT-Management station

The following stations are represented:

- IT-Management
- Mobile Media and Networks
- Interactive Media, Usability and Games
- the cafeteria
- the student parliament office

The implementation of the StudyPlan was excluded from the MVP because not all of the main focuses were represented. Furthermore, it would increase the complexity of the prototype. Also, the tracking of the real score was not realized since it would have an immense impact on the prototype creation. Therefore all teams were shown the same value at the end regardless of the hints used. But there was no impact on the experience of the participants because they thought the score would be tracked. They were informed after the study was finished.

We were looking for a simple method to implement the augmented reality aspect of our concept. After research, we found the augmented reality platform Artivive. Artivive is an augmented reality platform for art and offers the possibility to capture tracking points from images and the integration of videos, images or audio files into the 3D scene. Usually, it is used for augmented reality experiences in museums or art exhibitions. The mobile app of Artivive was the best option to realize the augmented reality function. We designed different looking markers for every station which was necessary to link a station to its video in Artivive. The marker of the IT-Management station is shown in Figure 5.

Figure 6: Request to change to Artivive

Throughout the user test, participants used Artivive to scan a marker and start its video. This was then played at a fixed position in the camera image relative to the marker.

Figma is a browser-based UI and UX design application for prototyping. We used it to create the click-prototype of *ScavHu*. The reason why we didn't use the competitor product AdobeXD was that Figma offered collaboration with multiple users for free. There were some limitations on Figma. It wasn't possible to implement keyboard input and picture taking easily. Due to the limitations, we implemented mockups to symbolize the individualization of the groups. For example, an input field was shown but there was no possibility to make an input. That is also the reason why we used Artivive and Figma in combination, as it was not possible to implement Artivive in Figma. The participants had to change from the prototype to Artivive every time they arrived at a station to start the videos as shown in Figure 6. After seeing the video, they had to switch back to the prototype.

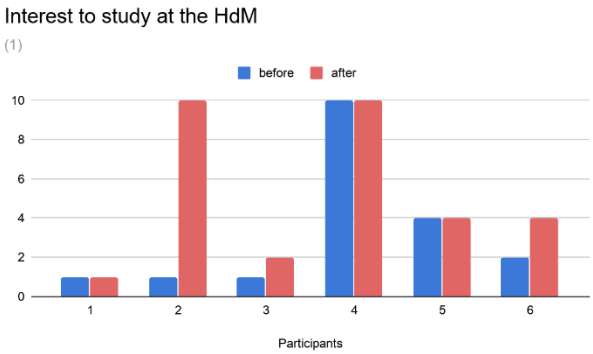

Figure 7: Interest to study at the HdM

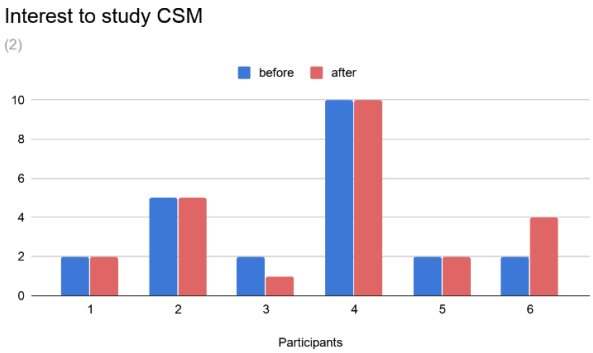

Figure 8: Interest to study CSM at the HdM

UX Evaluation Method

We used the deductive research approach[4] to figure out the scientific question. After the research period, we established our scientific question to define our study and develop the prototype.

We have chosen a mixed-method approach, which means we have collected quantitative and qualitative data. Therefore, we used semi-structured interviews and questionnaires.

The semi-structured interviews were used to learn more about the experience of the participants. So, we asked them to give us feedback on how they perceived the experience and if they have any other comments to improve it.

Also, we collected the demographic data and their previous experience with smartphones, augmented reality and the university with a questionnaire before the study begins. Another questionnaire was handed to them after the study was finished. It should capture the experience with the prototype and the influence on their interest in the university and the course of study.

To have the possibility to analyze spontaneously expressed comments, an observation video of the participants was recorded. It was also useful to analyze problems that could have occurred during the test. The video was deleted after analysis.

RESULTS

A total of six people took part in the study. They went through the scavenger hunt in two teams at different times on the same day. Both needed about 30 minutes for the scavenger hunt. Each team was provided with a smartphone (One Plus T7 - Android Version 10). Both required applications were already installed and ready to use. Continuous internet access via WLAN was provided.

The participants of our user test were on average 25.17 years with a standard deviation (SD) of 1.722. It was a mix of four female and two male participants. One of them was a student who studies CSM at the HdM. All other participants are employed in areas not related to computer science and had no connection to this university. Each of the participants has several years of experience in using a smartphone. Also, they considered themselves very competent users of smartphones. They use it daily for several tasks like surfing, communicating, reading or gaming.

Regarding the previous experience with augmented reality, we can divide the participants into two groups. Only three of six participants already had experience with augmented reality on a smartphone or augmented reality glasses. They mentioned it was used for entertainment or work purposes.

According to the questionnaire, each of the participants found the prototype easy to understand (9.8 out of 10 with a standard deviation of 0.408). Furthermore, they found it easy to learn how to use it (9.5 out of 10 with a standard deviation of 0.548).

We asked the participants about their interest to study at the HdM before and after the user test. We wanted to analyze if there is a basic interest and how the scavenger hunt with our prototype is affecting them. If we look at the result as shown in Figure 7 we can see an increase of interest for three of the participants. Participant 4, who studies at this university, had already the highest possible rating. The mean value at the beginning of the study was 3.17 (SD= 3.545). Afterward, the mean value was 5.17 (SD= 3.920).

We also asked about their interest to study CSM at the HdM. The opinion of four of the participants stayed the same, as we can see in Figure 8. The deviations of participants 3 and 6 are only weakly pronounced. The mean value at the beginning of the study was 3.83 (SD= 3.25). Afterward, the mean value was 4.0 (SD= 3.286).

[4] "*A deductive approach is concerned with developing a hypothesis (or hypotheses) based on existing theory, and then designing a research strategy to test the hypothesis*"- https://research-methodology.net/research-methodology/research-approach/deductive-approach-2/ (last called on 11.03.2020)

Nevertheless, four of six participants confirmed that they were animated to study at the HdM by the experience.

The participants were asked to define three adjectives to describe the experience. They mentioned the following, only positives, words:

- interesting (4x)
- exciting (2x)
- fun (2x)
- informative (2x)
- instructive (2x)
- new (2x)
- active
- adventurous
- communicative
- cooperative

To measure if the students' understanding of the course of study was increased, we asked the participants to describe the course of study in a few sentences. Each of the participants could describe the basic structure of the course of study according to the videos they had seen. So, if we exclude the participant who is studying this course, we conclude that the participants have developed a basic understanding of the study course.

The results of the semi-structured interview show that five participants made six positive comments about the interactivity aspect. Besides, three participants were saying that it was a completely new experience for them and that it was therefore fun.

In total there were six comments in which the participants gave suggestions for improvement. Four of these comments related to the concrete implementation of the prototype. In two comments the participants also mentioned that the technical terms in the videos made it harder to understand.

Most of the spontaneous comments made during the study are related to task solutions and the exchange of ideas between the participants. Few comments related to the direct implementation of the prototype, such as "Is this the right marker or do we need to look further" (P6). Only one comment referred to the general concept: "Let's try it before we lose five points. Thank God there is no time limit." (P1).

DISCUSSION

We had four limitations. First, all of the test users were related to us. To reduce the influence on their reactions and answers, it was initially made clear that honest answers are desired and that the personal relationship should not play a role here.

Secondly, all except one participant are practicing a profession that is not connected to the field of informatics. It could be a reason for the level of interest in the university and course of study. Maybe people who have not yet received a completed vocational training could have a higher level of interest.

Another limitation is that one participant studies CSM at the HdM. This person had previous knowledge about the university, the course of study and localities. Due to this, the person tried to withhold the extra knowledge without being asked.

Last but not least, not all of the main focuses were represented. The selection of the main focuses could influence the results.

The results of the questions aimed at the simple comprehensibility and usability of the prototype suggest that it can be used without prior knowledge. This makes sense in the context of a first-semester introduction, as previous experience can vary considerably. Therefore, an exciting and above all problem-free experience could be created for everyone.

The initial interest of the participants in studying at the HdM tended to be slight low, with an average value of 3.17. This could be since five of the six participants have already arrived in working life and have already studied or have completed an apprenticeship. Even though the initial interest was rather low, it could be increased by 2.0 through the experience. This shows the positive effects of the joint experience. It would be exciting to see how the initial interest behaves if the participants are interested in studying at a university.

The interest in the CSM program was assessed with an average value of 3.83. However, no strong increase in interest was observed after the experience. The mean value only went up to 4.0. This could be because five of the six participants have professions that are not in the field of computer science. This suggests that their interest in the field is not very pronounced. It would, therefore, be interesting to see how interest in the course changes when students who already have a bachelor's degree in media informatics take part in a repeat study. Since one would expect a higher level of interest from them.

The short description of the course of studies, which was correct for all participants, shows that a basic understanding was created. This implies that the course of study has been brought closer to them. However, it has already been described that in the subjective perception the interest in the study program was only slightly increased. This means that the assessment of the increase in relatedness is not clear. In our estimation, we would regard the relatedness to the study program as only moderately increased.

All adjectives describe positive emotions. That implies that the experience was perceived as positive. Furthermore, adjectives such as "communicative" or "cooperative" can be seen in direct connection with relatedness. From this, it can be deduced that the experience has created a feeling of relatedness in the participants.

The positive feedback expressed by all participants shows that the experience is generally perceived as positive.

Moreover, the novelty of such a scavenger hunt probably plays a role in the development of these positive feelings. As described in the introduction, such a positive experience can be seen as a consequence of the fulfillment of human needs. Based on the feedback in the comments such as "*I thought it was cool that you walked around, that you moved around a bit, that you could look at something, so just the interactive.*" (P2) we assume that one of the fulfilled needs is relatedness.

They also mentioned that it was hard to understand the video content when a lot of technical terms were used. This is probably since five of the six participants had little previous knowledge of media informatics. In the target profile, however, they would only be people who already had a bachelor's degree in computer science and media. The video content must of course always be adapted to the students' previous knowledge. Unfortunately, in this study, the participants differed very much from the target group in terms of previous knowledge.

CONCLUSION

The results confirm our initial hypothesis that a scavenger hunt app like *ScavHu* can improve the relatedness with the university. The results of the relatedness to the course of study are not that clear. We suggest that there wasn't a huge impact. Although the understanding of the course of study was improved. However, these results may only be interpreted with the limitations in mind. These are the personal relationship, the participants' non-IT professions, the connection of one participant to the HdM and the limited number of main focuses.

It would be interesting to see how the results behave when the study is repeated with a revised prototype and participants that fit the target profile even better. Therefore, the prototype should include every main focus and a higher amount of facilities. Since the influence of the StudyPlan on the relatedness to the study program is not foreseeable, the addition of this feature would be very interesting. Furthermore, the study could be repeated with potential students on the study information day.

Because they fit better to the target profile and a larger number of participants could be reached. Also, the adjectives found could be used to create a semantic differential scale questionnaire for further studies.

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