UNIVERSITY OF TWENTE

Digital Skills in University Students: A Self-guided Online Tool on Improving Students' Digital Skills

An Exploratory Feasibility Study

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Abstract

This study aimed to explore the perceived digital skillfulness of university students and the feasibility of making use of the *Digital Discovery Tool* by Jisc to improve students' digital skills. In the first phase of the study, seventy-seven students filled out an online self-assessment tool on digital skills. In the second part of the study, ten participants were interviewed on their usage and perceptions of the tool. The results of the first phase showed that students were proficient in ten out of sixteen areas assessed, namely: *Digital Communication, Digital Proficiency, Digital Identity Management, Digital Collaboration, Information Literacy, Data Literacy, Media Literacy, Digital Wellbeing, Preparation for digital learning* and *Digital Productivity*. The sample of the first phase scored higher than the sector average on twelve out of the sixteen areas assessed, namely *Digital Communication, Digital Proficiency, Digital Collaboration, Information Literacy, Data Literacy, Media Literacy, Digital Wellbeing, Preparation for digital learning, Digital Productivity, Problem Solving, Digital Innovation Digital Creation* and *Digital learning activities* . The results of the second phase revealed that most participants perceived the tool as useful in terms of helping them in increasing their awareness of the definition of the concept digital skills and their own proficiency therein. Moreover, it showed that in building their own digital skills, students consult each other, which should be considered to be facilitated by the university in the future.

Keywords: digital skills in students, self-guided online intervention, feasibility, online tool, digital capabilities, Internet skills

Introduction

In our current age of information and communication technology (ICT) also called digital age, people are faced with a labor market that requires its workers to be skilled in a variety of activities all around the computer and the *World Wide Web* (Goldie, 2016) ranging from being able to navigate a computer, editing digital videos or audios, to creating a chart from data, holding a video conference or creating an app. With technology evolving, highly routinized human jobs were replaced by computer-run machines, which were programmed to do what a person used to do (Autor, 2015). However, replacing one person's job by a computer, created multiple new jobs related to it such as operation, maintenance, troubleshooting and repair, safety and many more. Workers had to reinvent themselves and learn to operate these computers to be able to continue working. Nowadays computers are part of part of any sector, they can be found in educational institutions from primary school to universities, any office job and even on construction sites (Haas et al., 2000). It becomes apparent that technologies have become a major part in our society and thus illustrates the necessity for people to be able to cope with digital tasks.

Not everyone, however, has had the same opportunities in accessing technologies as well as developing the skills needed, which is referred to in the literature as the 'digital divide'. Early conceptualizations of the 'digital divide', also called first-level divide, used to refer to the gap between those who do and those who do not have access to computers and the Internet (van Dijk, 2006) which caused and accelerated already existing social inequalities between and within societies (van Dijk & Hacker, 2003). This stage was concerned with the mere access to computers and the Internet, with people benefitting from having access versus people being at disadvantage, at the lack of it. The first-level divide has been reformulated to not only the mere access of but also the possibility to keep up with the cost of purchasing additional devices as

well as the costs of software subscriptions necessary to perform activities online (Van Deursen & Van Dijk, 2018).It was believed that the digital divide would be solved when Internet access will be universal (Van Deursen & Van Dijk, 2018). It became evident however that even with Internet access becoming more and more easily accessible, the acquisition or absence of digital skills and usage patterns keeps perpetuating inequalities (Van Deursen & Mossberger, 2018). This can be referred to as the second-level digital divide. Whereas the first-level divide is concerned with differences in (infrastructural) access whereas the second-level divide holds, that access to the computer and the Internet, does not necessarily mean that people also know how to make use of these effectively and is thus addresses the differences in groups of people in terms of skills necessary to effectively use the Internet. Whereby people with less opportunities to use technologies also suffer from a lower level of ICT skills, which in turn leads to the perpetuation of social inequalities (van Dijk & Hacker, 2003, Van Deursen, 2014, Van Deursen & Van Dijk, 2018, Goedhart et al., 2019). This latter phenomenon has led to the further reinforcement of social inequalities because mainly those who possess the greatest (monetary) resources will have benefitted from ICT on a social, economic and educational level the most, leaving people of lower status or lower means at disadvantage (Goedhart et al., 2019). Recently, the outcomes of how people use the Internet are also taken into account, which is referred to as the third-level divide . This level is concerned with the differences in beneficial outcomes that one person will come to experience from being privileged with access to ICT as well as the possession of digital skills (Van Deursen & Helsper, 2015). It holds that the third-level digital divide is present when the possession of digital skills and Internet use do not lead to beneficial outcomes. Whereby individuals who consistently make use of the Internet to produce favorable offline-outcomes, experience a form of feedback, which enables them to further develop their digital skills, thus contributing to the widening of the inequality gap (Van

Deursen & Helsper, 2015). All of these levels exist in parallel and serve as perpetuators of social inequalities.

In the Netherlands, the levels of the digital divide are also prevalent and still leading to social inequalities. The 'traditional' first-level divide of inequalities of access to the internet can be regarded as good as extinct in the Netherlands, being a country with very high household internet penetration (Van Deursen & Mossberger, 2018). The second-level divide in the Netherlands is, however, still present with at least 17% of Dutch citizens having low ICT skills or lacking these altogether and another 6% never having used the internet (CBS StatLine, n.d.).

One would assume that in general younger generations that are born into the digital age will be familiar with a multitude of technologies from a very young age and thus be better equipped to navigate through the Internet and to handle digital challenges, but this seems to be only the case with the more basic operational and formal Internet skills according to a study by Van Dijk and Van Deursen conducted in 2011. They concluded that older age and lower educational level explain lower (basic level) ICT skills in a Dutch sample (Van Deursen et al, 2011) but not competence in more advanced skills. Whether the digital divide is already present in young adults however, in terms of more advanced, content-related digital skills, has not been established throughout the literature and thus calls for research. If the digital divide is already present in young adults, the Internet may actually reinforce the presence of already existing social inequalities or even accelerate them. Major changes such as including digital skill building in curricular alongside more traditional subjects, will be needed early on in educational systems to prevent the extension of the divide to even younger generations and to counteract the (possibly) already existing divide amongst younger generations (Van Deursen & Van Dijk, 2014).

In order to measure digital skills to find out in which groups of people the digital divide is present, these concepts have to be clearly defined. Many researchers have tried to define a

range of digital skills, but with fast developments in this digital age and differing conceptualizations of digital skills among disciplines, definitions cannot keep up with developments and consensus has not been reached. For clarification, this study will use the framework of the researchers Van Dijk and Van Deursen (2014) in defining digital skills. It managed to pinpoint digital skills into a well-defined framework of two categories of skills, namely medium-related and content-related skills which are made up by six types of skills: operational and formal skills making up the medium-related skills and information, communication, content creation and strategic creation skills making up the content-related skills. Van Dijk and Van Deursen applied their framework to the medium *Internet*, whereby the skills are respectively reflected in activities taken on the Internet, with *Operational Internet skills* as the very basics of making use of internet browser being the ability to make use of the URL field of a browser and being able to manage different file formats and *Formal Internet skills* as the ability to navigate the internet by using hyperlinks and the ability to maintain a sense of location and not becoming disoriented. Followed by the Internet skills that are content-related, which are of the skills of interest for this study, namely *Information Internet skills*, which are the skills to locate, choose from and evaluate information online, *Communication Internet skills* as the abilities to communicate through messages online and building an online identity, *Content creation Internet skills* meaning, being able to create proper content in the form of text, music, video, image or photo and finally *Strategic Internet skills* as the skills concerned with being able to make use of the internet in a goal-directed and beneficial manner (Van Dijk & Van Deursen, 2014). The aforementioned skills are part of a students' everyday-life, whereby the former medium-related skills are considered a pre-requisite to perform content-related skills, both of which students of higher education are expected to possess or acquire during their studies. This paper will mostly explore the content-related digital skills of the students of the University of Twente. The content-related digital skills are the focus of this

study, because it is assumed that university students already possess the medium-related skills, since they are of lower age and grew up in the digital age.

Increasing people's awareness of digital skills in general and making necessary resources to build one's digital skills available for everyone, could be one way to counteract the potential widening of the digital divide. Online interventions are a great means to reach a great number of people and thus if a certain intervention is very feasible, it might even be considered to include one such intervention into curricula. The *Digital Discovery tool* by Jisc (2020) is an online-intervention aimed at raising awareness about one's own digital skillset and level, consisting of a self-assessment of one's perceived internet skills and self-help material. After completing the questionnaire, students will get access to a wide range of online resources aimed at supporting to build these skills that one is lacking or to improve on already existing skills. The tool is currently adopted by a great number of institutions in the UK, having reached more than one hundred ninety different universities, with more than one hundred thirty thousand participants that have taken the self-assessment up until now (Jisc, 2020). This tool offers the great opportunity to explore the digital skills of Dutch students and examine whether such a tool is a feasible way to raise awareness of digital skills as well as to support the students in developing their digital skills. Since the tool is already adopted by a wide range of institutions throughout the UK, performing a feasibility study is necessary in order to determine whether this intervention actually proves itself to be effective in raising awareness and improving student's digital skillfulness, since no scientific efficacy-testing has been conducted so far. In this study, demand for the intervention will be tested, as well as limited-efficacy testing (Bowen et al., 2010). Limited-efficacy testing refers to testing whether the intervention is effective in a smaller convenience sample to determine whether it allows for greater-scale testing (Bowen et al., 2010). If the tool or certain parts of the tool turn out to be feasible in a

higher educational setting, this might allow for further testing extended onto lower educational settings or even onto a larger more general societal level.

The purpose of this study is to explore the digital skills of students of the University of Twente (UT) and to find out how the UT can support students in building their digital skills. Moreover the feasibility of the self-guided online intervention *Digital Discovery Tool* by Jisc will be explored on a smaller scale within the UT student population, to determine whether it is feasible to allow for further testing. A mixed-methods study, with the first phase of exploration of the UT students confidence in and range of digital skills and a second phase of in-depth interviews with selected students on the feasibility of this online intervention to improve and build on missing digital skills, as well as the students' self-management of digital skills and suggestions for the university, will be conducted. Two research questions with one sub-question were posed and guided this exploratory research:

RQ1: *How digitally skilled do the UT students perceive themselves to be?*

a) *How confident do the UT students feel about their own digital skills?*

RQ2: *How feasible is the use of a self-guided online intervention, like the Digital Discovery Tool by Jisc, to support students in improving their digital skills?*

a) *How useful do the UT students perceive the tool to be?*

Methods

Background

This study is part of the newly defined mission, vision and strategy of the University of Twente, which is a technical university with a behavioral and social sciences faculty. The university's mission is to put people first, empower its members and create social sustainability in the society. The vision is to become an institution contributing to the development of a digital, fair, and sustainable society by 2030. The UT wants to invite and equip its professionals and students to keep up with the developments and become confident, balanced, digital citizens. Larger, societal contribution is only possible however, if the members of the UT 'society' themselves are well-equipped, which is why the Library, ICT Services & Archive (LISA), as a department of the UT initiated this exploratory feasibility research project. The LISA department is responsible for the digital processes at the UT, within the three main fields concerning the university library, Information and Communication Technology and the Archive. Hereby, the first step is to explore the digital skill level of its students, to then initiate local change in its student population, who will be the ones to then contribute to the development of a digital, fair and sustainable society in the future (University of Twente, 2020).

Moreover at the time of conducting this study, the *Coronavirus* (COVID-19) *pandemic* globally affected people's lives. COVID-19 has put many world citizens in a state of unrest and uncertainty. In terms of the digitalization, however, the virus seems to act as an accelerator, forcibly speeding up the process of digitalizing healthcare, education and many other sectors. This is why this study will also address the implications of the pandemic situation on the development of students' digital skills.

Study Design

This exploratory study follows an explanatory sequential mixed-method design. The main rationale for choosing this approach is *completeness:* using a combination of both

research approaches provides a more comprehensive picture of how feasible the tool is (Doyle, Brady & Byrne, 2009). In terms of feasibility, there are two important insights to be gained in the first, quantitative phase, namely whether the students actually fill out the survey and whether they make use of the resources provided after completion. Assessing the students' current abilities also indicates to what extent a tool to support digital skills is actually needed. The answer to these questions alone, however, needs to be enriched to be of greater value. Therefore the second, qualitative phase aimed to explore why people did or did not fill out the survey, how they experienced the use of the tool, why or why not they made use of the resources and also whether it stimulated them to look for resources themselves. Both perspectives will be integrated in order to draw a well-weighed conclusion on the feasibility, to provide access to a self-guided online intervention for the students of the UT to support the improvement of their digital skills.

Participants

The main selection criterion for participating in the quantitative phase was to be an enrolled student at the University of Twente in Enschede, Netherlands. Furthermore, students were instructed to choose the self-assessment profile 'Current students (Higher Education)'. A convenience sampling method on a volunteer basis was employed. Participants were recruited by making use of a variety of mostly online recruitment methods. Additionally, an advert of the *Digital Discovery Tool* was placed on the UT's BMS test subject tool, Sona systems. The study was also advertised on social media platforms of the UT as well as mentioned in UT-related email-newsletters. Participating students were provided with an illustrated overview of their own digital skills as well as digital skill-building resources after completion of the self-assessment tool, which served as incentive for to participate in the first, quantitative phase. For the second phase, a purposeful convenient sample of 10 students was selected out of the participants who indicated that they are willing to take part in the second phase of the study.

In the first phase, 202 students filled in the first online-questionnaire containing questions on sociodemographic data as well as instructions on how to access the intervention tool. 32 participants stopped the questionnaire prematurely and thus 167 students completed the first questionnaire. 87 students took the self-assessment by filling out the questionnaire provided in the *Digital Discovery Tool* by Jisc. Out of the 87 students, 81 took the assessment-profile 'Current students (Higher Education)' that was required, with and 4 participants terminating the tool prematurely. Therefore, 77 participants completed the assessment entirely with the appropriate question-set.

The sociodemographic data obtained from the first questionnaire may not represent the actual sample of 77 students correctly, since more students have filled out in the first questionnaire than students have completed the assessment. Nevertheless, a description of the composition of the sample, obtained from the first questionnaire, will be given. Students who participated came from a variety of different fields of study, with 89 enrolled in a Social Science such as Psychology or Communication Science, followed by 39 enrolled in a Technical Study such as Creative Technology or Technical Computer Science, followed by 24 enrolled in an Engineering study, 9 enrolled in Math or Physics and 6 students doing a double degree. 121 (72.4%) students were currently enrolled in a Bachelor program and all others were enrolled in a Master's program. Most of the participants were either Dutch (46.71%) or German (41.92), with a total of 17 different nationalities. 98 (58.68%) students were female, 68 (40.72%) students were male and 1 person preferred not to say. The age of the participants ranged from 18 to 28 years, with a mean age of 21.73 years. The majority of students coming from a Social study, is found both, in the first questionnaire as well as the sample characteristics obtained from the tool itself, with 42 out of 77 students coming from a Social study.

81 participants expressed interest in participating in the follow-up interviews, 10 participants were contacted via email, 0 rejected and 10 accepted and participated. The only

inclusion criterion for the second phase of the study was to have completed the intervention-tool and to have expressed an interest to participate in a follow up study.

A purposeful, convenient sample was collected, based on the goal of reaching a high degree of diversity in terms of field of study, education level of study program and nationality. Out of the 10 students who participated in the online-interviews, half were female or male and half were enrolled in a Bachelor or Master program and the age ranged from 19 to 25 with a mean age of 22.2 years. 4 participants were Dutch, 2 German and the other 4 were Zimbabwean, Belgian, Malawian and Mexican coming from 9 different study programs, ranging from Psychology, to Applied Physics.

Materials

The 32-item *Digital Discovery Tool* by Jisc (2020) is designed to measure self-reported digital skills. Jisc is a registered non-profit organization from the UK that promotes the implementation of digital technologies in research and higher education. To provide the participants of this study with access to the *Digital Discovery Tool*, the UT purchased a *six*-month subscription for the tool, costing £3000 which is approximately 3290€, granting access for around 9600 students. The tool consists of a questionnaire on digital skills and a personalized report containing information on one's scores, including some recommendations on how to improve one's digital skills. The questionnaire of the tool is based on the six elements of the digital capability framework, which will be explained in a later section. Median scores are obtained for each of the questions and compared to the data-set of all other higher education students that have previously taken the tool.

To gain an overall insight of the composition of the sample, participants had to answer a few additional questions in an online survey. These questions included the study discipline and year, nationality, gender, age and whether the participant is was willing to participate in a follow-up interview.

Digital Discovery Tool

The *Digital Discovery* tool consists of three parts. The first part is a questionnaire that aims to assess a person's range and level of digital skills. The second part is a personal report containing information on one's proficiency levels, as well as some suggestions on how to improve one's digital skills. The third part is the access to a resource bank, filled with online resources like courses, educational videos or blog posts, aimed at improving a person's digital skill level. There are multiple assessment-profiles of the tool, each of them tailored to the specific Internet activities that are characteristic for the target population. In this study, the profile 'Current students (Higher Education)' was selected.

The tool is based on the *Jisc six elements of digital capability framework (2020)*, which comprises six areas of digital skills namely: ICT (digital) proficiency; Information, data and media literacies (critical use); Digital creation, problem-solving and innovation (creative production); Digital communication, collaboration and participation (participation); Digital learning and development (development); and Digital identity and wellbeing (self-actualizing). These elements are reflected in the following fifteen composite variables (skills): digital proficiency and productivity; information-, data- and media-literacy; digital creation, digital research and problem-solving, digital innovation; digital communication, collaboration and participation; digital learning and teaching; digital identity management and wellbeing, respectively. With a sixteenth skill about digital skills for a work-context is included, leading to a total of sixteen elements. There are two questions for each of the sixteen elements, one *Grid question* where participants have to select all the digital activities that they engage in out of eight activity-options. The second question is a *Confidence question* in which participants can indicate their confidence level about their performance of the skill in question. The *six elements of digital capability framework* by Jisc (2020) closely matches the framework by Van Dijk and Van Deursen (2014) and is thus, at least in part, consistent with existing research.

Medium-related Internet skills as well as *Strategic Internet skills* seem to be reflected in the skill 'ICT (digital) proficiency'. *Information Internet skills* seem to be reflected in the skills 'Information and Data literacy' by Jisc. *Communication Internet skills* seem to be reflected in the skill 'Media literacy' and 'Digital Identity' as well as in the category 'Digital communication, collaboration and participation'. *Content creation Internet skills* seem to be reflected in the skill 'Digital creation' and also 'Digital learning activities'. *Strategic Internet skills* seem to be reflected in the skill 'Digital problem solving' as well as the skills 'Preparing for digital learning' and 'Digital skills for work'. With the skill 'Digital wellbeing' being the only skill beyond the framework by Van Dijk and Van Deursen (2014). Jisc describes the skill 'Digital wellbeing' as the ability to take care of ones "*personal health, safety, relationships and work-life balance in digital settings*" (Jisc, 2020).

After completing the self-assessment, the participant is provided with a written and visualized individual report summarizing their current digital skills. In this report, the participant can find how proficient they are in each of the composites, ranging from *developing* to *capable* to *proficient*. Resources can be informative, animated videos about a certain skill, guidelines and tips from other universities or Jisc, blog posts, free online courses, workshops and many more.

Interviews

Ten semi-structured interviews were conducted which were comprised of around fifteen questions each. The domains and questions that guided the interviews can be found in t Table 1. The interview questions were based partially on the *Internet Intervention Model* by Ritterband et al. (2009). According to this model, a behavior change that an intervention aims for, happens via a route whereby environmental factors, user characteristics and properties of the intervention play a major role. A major and universal environmental factor at the moment is the pandemic-situation, which was discussed on its implications on the development of

participants' digital skills in the interviews. The *coronavirus-pandemic* has caused major restrictions in pursuing professions, education and in general social relationships in person. To get the outbreak of this pandemic under control, lock-down-like measures came into place in countries like Italy, Germany, the Netherlands and the UK, where non-life-essential (public) contact points were closed and where ever possible, transferred onto an online space. Common practices during times of the COVID-19 were working and learning from home. With online-environments becoming essential daily practices, peoples' digital skills might have been affected, which is why it was investigated whether and how participants experienced a change in their digital skillfulness due to the pandemic-situation.

Opinions on favorable and unfavorable properties of the tool, framed as *strengths* and *weaknesses*, were also acquired in the interviews.

Table 1

Interview schema

Questions	Domains
1. *Were you familiar with the term 'digital skills' before participating in this study? How do you think did the tool cover these? What did the term 'digital skills' mean to you before participating in this study?*	Existing beliefs of digital skills (user characteristics) and content quality of the intervention (intervention)
2. *Does your environment (e.g. friends, family, university, community, media, culture) place an importance on being digitally skilled? Which part? How does it show? What role do digital skills play in your personal environment and your work/educational environment?*	Role of digital skills in participants environment (environment)
3. *What do you (normally) do to build your own digital skills?*	Personal digital skill management (user characteristics)
4. *Has the current COVID-19 situation affected your digital skills in any way?*	Effects of COVID19 on digital skills (environment)

5. *Did you have any prior expectations regarding this tool? If yes, were they met? What did you expect of the tool before completing it?*	Preexisting expectation towards the tool (user characteristics)
6. *How did you experience the tool?*	Intervention experience (intervention)
7. *How do you feel about your personal insights report?*	Feelings towards intervention results (intervention)
8. *How useful was the tool for you?*	Perceived usefulness of the intervention (intervention)
9. *Did the tool stimulate you in any way? If yes, how? If no, why not?*	Effects of the intervention (intervention)
10. *What motivated you to make use of certain parts of the tool, or not?*	Motivation towards intervention (intervention)
11. *Would you recommend this tool to people you know? If yes, why and to whom? If no, why not?*	Recommendation of the intervention to others (intervention)
12. *What are strong and weak points of the tool? What did you like or dislike?*	Strengths and weaknesses of the intervention (intervention)
13. *How could it be improved?*	Improvement points of the intervention (intervention)
14. *Do you think UT students would benefit from this tool or a tool similar to this?*	Applicability of the intervention to the UT population (intervention)
15. *How could the university support you and other students in building and improving on digital skills? Is there a need for support?*	Support suggestions

Procedure

The study was conducted in April through May 2020 and consisted of two phases. Prior to the start of the study, ethical approval was obtained from the Faculty of Behavioral, Management and Social sciences (BMS). Consent was obtained from the participants at the start of the tool as well as at the beginning of the audio call. In the first, quantitative phase students filled out an online survey, and within that survey, were redirected to the *Digital Discovery Tool* (the intervention), to then assess their own digital skills. After completing the

self-assessment, participants were asked to return to the first survey, to indicate their perceived usefulness of the tool. Within the online survey, participants were informed about receiving an incentive for participating in a follow-up interview. After completion of the tool, participants were provided with a personal insights report about how they scored on the digital skills mentioned in the tool. The researcher was provided with an overall overview of how the sample is made up in terms of digital skill proficiency as well as the students' confidence in their skills, as well as a comparison of the average score on each skill of the UT sample, to the sector average of the assessment-profile 'Current students (Higher Education)'. In the second, qualitative phase a purposive sample of 10 students, with the aim of a diverse sample of students in terms of discipline, gender and age was selected out of all the students that indicated to be willing to participate in a follow-up interview. Participants were chosen in two points in time, whereby the first five participants were chosen two weeks after the start of the study and the last five were chosen four weeks after the start. These students were approached via email to indicate a suitable time to carry out the interview. The online interviews were then carried out after the participants were informed about their right to withdraw from the study at any time and agreed to be audio recorded. The interviews took on average 34 minutes and the participants were rewarded with a 10€ online-voucher from a shop of their choice after completion.

Analysis

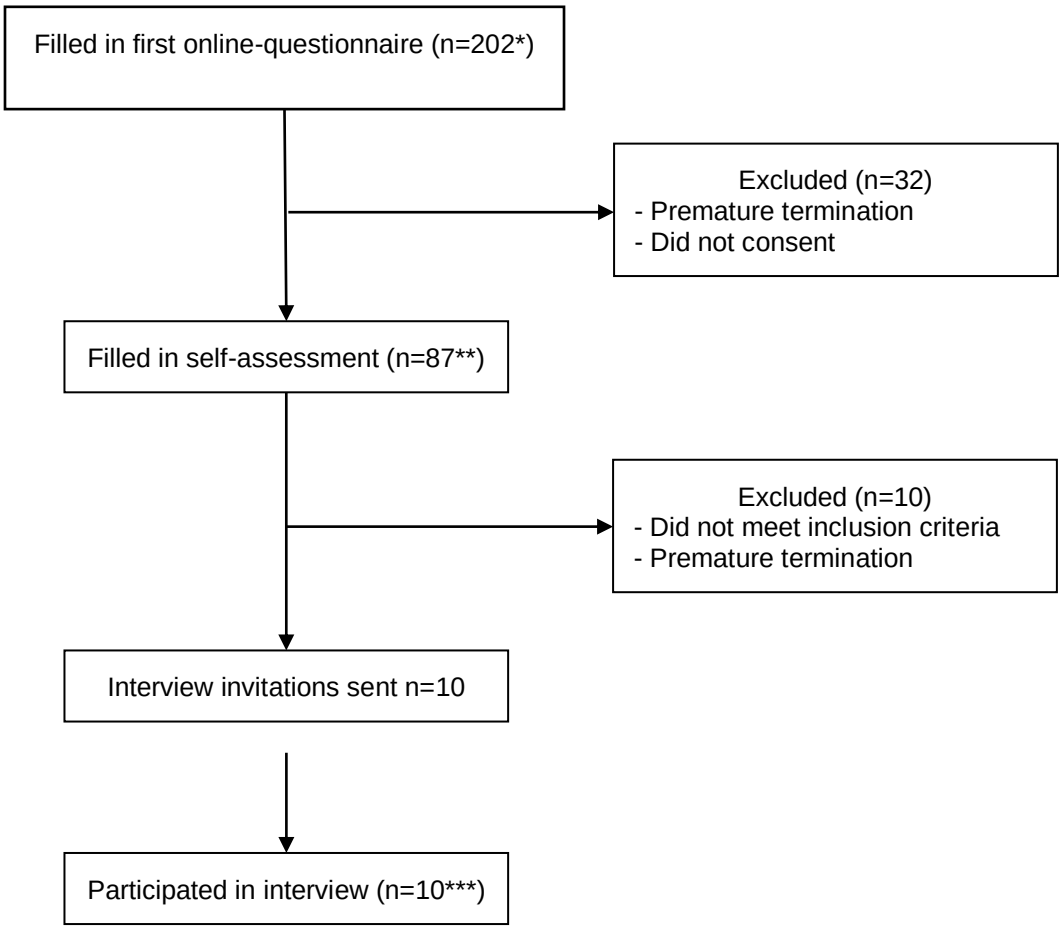
An insight as to how the UT students (our sample) stand in terms of digital skills was provided by Jisc and is presented in the results section. The overall (net) confidence score (NCS) of the sample was calculated by subtracting the proportion of developing (poor-scoring) participants from the proportion of proficient users (NCS = % Proficient - % Developing). The confidence levels were defined as follows: 'Developing' scoring 1-3.9, 'Capable' scoring 4-5.9 and 'Proficient' scoring 6-10. The interviews were audio-recorded, transcribed and coded

making use of transcribing software called *Amberscript* which was provided by the BMS-lab of the UT and the application *ATLAS.ti version 8.4.8 (1135)*. The researcher undertook a conventional, inductive content analysis approach (Hsieh & Shannon, 2005) of the transcripts in regard to the questions on personal skill management and suggestions for improvement and suggestions for the university. With regard to evaluating the feasibility of the tool, a more directed, deductive content analysis (Hsieh & Shannon, 2005) was employed, comparing the transcripts to some aspects of the *Internet Intervention Model* by Ritterband et al. (2009), was undertaken. The unit of analysis were specific themes. Solely manifest content was regarded.

Results

Figure 1

Participant flow diagram



*Dataset was used to determine sociodemographic sample characteristics.**Dataset was used to answer RQ1. ***Dataset was used to answer RQ2.

Perceived digital skillfulness of the UT students

Figure 2 shows the distribution of the proficiency levels with percentages. It shows that in six out of the sixteen elements, most students felt confident to be proficient (> 50%). These skills are *Digital Communication, Digital Proficiency, Digital Identity Management, Digital Collaboration, Data Literacy* and *Media Literacy.* In eight skills, the majority of participants felt that they were capable (45-56%), namely the skills *Information Literacy, Digital Wellbeing, Preparing for digital learning, Digital Productivity, Problem Solving, Digital Innovation, Digital Creation* and *Digital learning activities.* In the remaining two skills, the majority of the

students (50-70%) considered their proficiency level as 'developing', namely in the skills *Digital skills for work* and *Digital Participation.*

In total, the students were less confident in ten out of six-teen digital skills, than that they were confident in.

Figure 2

Results of the Confidence levels per skill of UT students

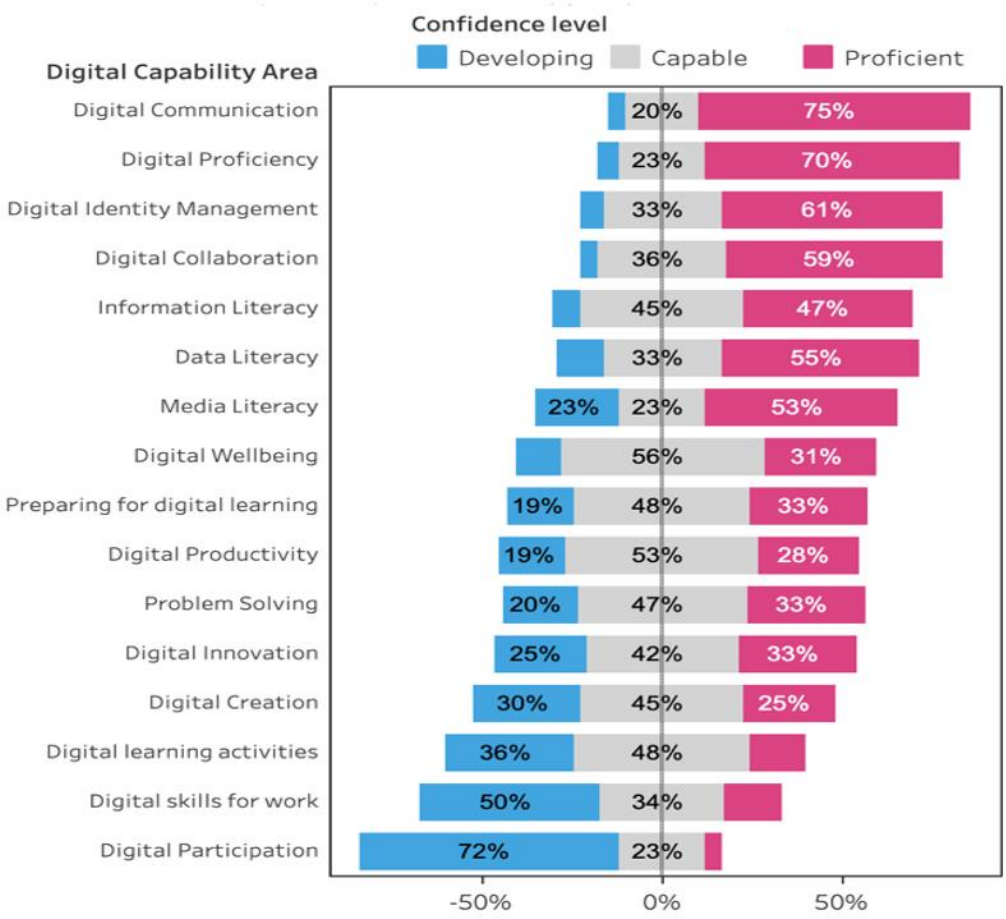


Figure 3 shows a comparison of the average score for each digital skill of the UT student sample to the sector average (SA) for that skill. The exact numbers of the UT students' scores for each area are as follows: 8.2 on 'Digital Communication' (.8 scores higher than SA), 7.7 on 'Digital Proficiency' (.4 scores higher than SA), 7.4 on 'Digital Identity Management' (.5 scores lower than SA), 7.4 on 'Digital Collaboration' (2.1 scores higher than SA), 7.2 on

‘Information Literacy’ (.8 scores higher than SA), 6.9 on ‘Data Literacy’ (.9 scores higher than SA), 6.6 on ‘Media Literacy’ (1.7 scores higher than SA), 6.3 on ‘Digital Wellbeing’ (.2 scores lower than SA), 6.3 on ‘Preparation for digital learning’ (.2 scores higher than SA), 6.1 on ‘Digital Productivity’ (.2 scores higher than SA), 5.9 on ‘Problem Solving’ (1.4 scores higher than SA), 5.9 on ‘Digital Innovation’ (.7 scores higher than SA), 5.3 on ‘Digital Creation’ (1.1 scores higher than SA), 4.9 on ‘Digital learning activities’ (.6 scores higher than SA), 4.9 on ‘Digital skills for work’ (.8 scores lower than SA) and 3.2 on ‘Digital Participation’ (.2 scores lower than SA). It shows students were proficient in ten out of sixteen areas, with a score of 6 or higher, capable in four areas with a score between 4 and 5.9, and developing in one area with a score lower than 3.9.

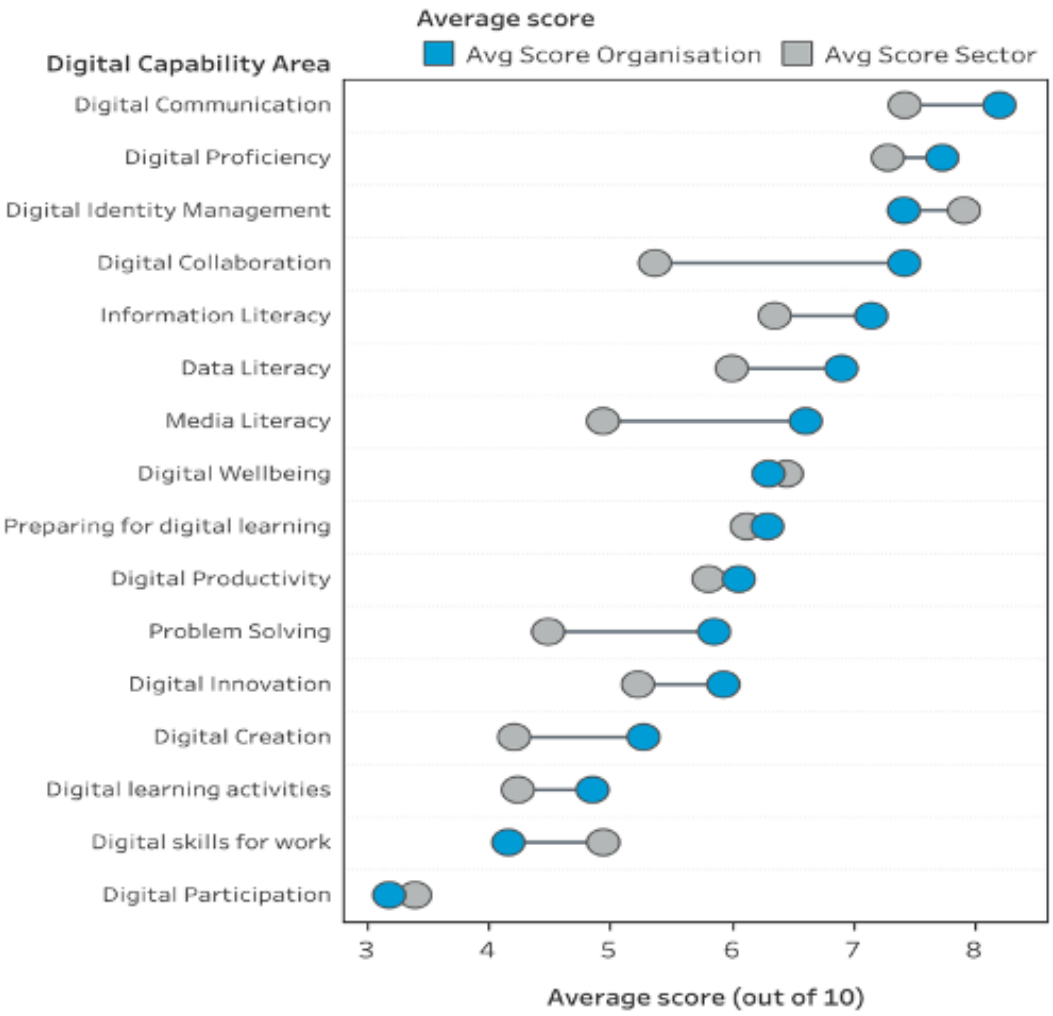
One can see, that the UT students scored higher than the sector average on twelve digital skills, with four skills (Digital Collaboration, Media Literacy, Digital Problem Solving and Digital Creation) 1.1-2.1 scores higher than the sector average. Jisc defines ‘Digital Collaboration’ as the ability to effectively work together online, with the ability to meet specific working group goals. ‘Media Literacy’ is defined as an understanding and the mastering of using media such as web sites, simulations and games. ‘Problem Solving’ according to Jisc is the ability to use digital evidence or environments to solve problems. ‘Digital Creation’ refers to all kinds of producing digital outputs like the creation of an app, digital images or mind maps.

The two scores that the UT students felt least confident in (Digital skills for work & Digital participation) were also two out of four skills that the UT sample scored lower on in comparison to the sector average. ‘Digital skills for work’ refers to one’s ability to acquire the digital skills that are required for one’s workplace and ‘Digital Participation’ refers to the degree to which people actively take part in digital environments over a longer time, like for example building a digital network. The other two elements that were lower than the sector

average were ‘Digital Identity Management’ and ‘Digital Wellbeing’. With ‘Digital Identity Management’ referring to the way that people develop and manage one or several digital identities across a range of platforms and media.

Figure 3

Average score of UT student sample in comparison with the sector average students in higher education



Feasibility of the tool in improving students’ digital skills.

The interviews revealed five topic areas, relevant to answer the research question. The areas are as follows: Digital skill management, Perceived usefulness of the tool, Facilitating

and Impeding factors (to the uptake and effectiveness of the tool, and Recommendations for the university.

Table 2

Interview results and related codes and quotes

Group	Domain	Related codes	Related quotes
Digital skill management	User characteristics	Consulting other people	"I do ask other people to help me" (F22)
		Online Research	"informing ourselves through the Internet already helps" (M25)
		Self-Practice	"trial and error" (F22)
		Not actively	"I'd never sought to develop my digital skills, they just grew" (M21)
		Goal oriented	"I' really only trying to develop digital skills when I need them" (F22)
Perceived usefulness	Intervention	Awareness	"I was surprised by the digital wellbeing part, that didn't cross my mind before" (F22)
		Change	"I would like to know more about these things, which can also come in handy in everyday life" (F22)
Facilitating factors	Intervention	Perceived ease of use	"easy going, very straight forward" (M22)

		Appropriateness of duration	"duration was also fine" (M23)
		Visually pleasing appearance	"it looked quite professional" (F23)
		Accuracy of tool content	"the actual questions are good and actual information you got out of it was good" (F23)
	Environment	Major role of digital skills	"major role in my personal environment" (M23)
		Digital skills for communication	"digital communication is quite big" (F22)
		Digital skills essential in the university setting	"it's pretty essential that you're able to watch the lectures that are put up" (M22)
	User characteristics	Being technically inclined	"I'm very in touch with tech" (M22)
		Self-improvement oriented	"I'm also looking to improve myself" (F22)
		Pleasure in discovering new technologies	"I do like trying out new software" (F19)
Impeding factors	Intervention	Inappropriateness of duration	"I don't think it should take so much time to get the information they need" (M22)
		Overwhelming nature of resources	"for someone that was thrown in there without

		Counter-intuitive layout	any knowledge it's overwhelming" (M25) "layout could be a bit more intuitive" (M25)
		No importance for digital skills placed by study program	
	User characteristics		"the digital skills needed were not that, yeah were not really necessary because also our test were mainly on paper" (M23)
		Belief of unconscious acquisition of digital skills	
		Intention to have a low Internet footprint	"I think my digital skills will improve as I move along" (F19)
		Prior expectation of less questions	"I don't like having such a wide, such a big Internet footprint" (M22) "I didn't expect there to be so many options" (M22)
Recommendations for the university	Tool related suggestions	Tool needs to be approved by university	"it would be very helpful if the teachers approve of this tool and would recommend it" (F22)
		Tool at the start of a study	"mainly somewhere near the start of the study" (M23)
	General support suggestions	Use already existing software and platforms to full potential	"have a lot of potential but they're not used as well as they can be" (M22)

	More classes/assignments	"more classes or assignments" (M22)
	Facilitate students-helping-students	"that the UT itself would kind of facilitate these opportunities for students to help out students" (F22)

Digital skill management

Digital skill management refers to the way students build their own digital skills. Three major ways, which were mentioned by 7 participants respectively arose. Firstly, participants mentioned that they consult other people as peers or teachers when faced with a digital challenge or task that they need support in. One participant mentioned, *"the first step would be to ask my peers"* (M21). Other participants mentioned to *"ask some classmates"* (M23), to *"ask [my] friends"* (F19) or to *"ask people in person"*(F22). The second way that participants built digital skills was to do online research. Online research comprises making use of google or Wikipedia, watching online tutorials on Youtube as well as searching for answers in blogs or forums. One participant mentioned that *"usually when I don't know, I just Google it"* (F19). Another participant pinpoints it by saying *"when I encounter something new, like a new software, I just look it out on Youtube and look out for tutorials"* (M22). The following quote expressed the order of firstly asking peers and if that is not possible or does not help, making use of Google: "*Well fine, I think the first step would be to ask my peers, because, you know, we're all in the same field. So maybe they know something that I'd necessarily know or that I maybe wouldn't. And can give me some, some heads up into the direction that I should be taking. If that is not an option or if that doesn't give any results, it's basically going down to Google"* (M21). This order was mentioned by half of the participants. The last major way that most of the participants go and shared was self-practice. The following quote by one participant also stresses the order again, with self-practice following after asking peers and or online research: *"Otherwise it's usually trial and error"* (F22). Other comments like *"practicing with the stuff"* (M21), *"trying something out until I get what I want"* (F23) or *"just try it out by myself"* (F23) are representative for the last major way of building their own digital skills. Two participants also mentioned that they never actively build their digital skills, whilst two other participants explained, that they do actively build their digital skills, but only when faced with a challenging

task. The quotes *"I'd never sought to develop my digital skills, they just grew"* (M22) and *"I'm really only trying to develop digital skills when I need them"* (F22) are representative for the two opposing ways, respectively.

Perceived usefulness

The major use that participants experienced from the tool was awareness. That the tool helped in terms of awareness, was mentioned by almost every participants. Awareness was seen by some participants as the starting point for change, as participants mentioned, the tool provided them with. Change that goes beyond awareness, was also induced in some participants, with students expressing changes in mentality, as well as behavioral changes. Some participants also expressed that they did not perceive the tool as useful at all, but nonetheless mentioned to whom or for what the tool might be useful for.

In terms of awareness, seven participants expressed that the tool broadened their understanding of what digital skills entail, with one participant stating *"I didn't understand that there were so many subsections to it"* (F23) and another stating *"I wasn't aware that so many skills actually entail digital skills"* (F22). The other most common point of increased awareness is the awareness of how digitally capable they are, with one student mentioning that the tool gave him/her *"a good image of my, my digital skills"* (F19) and another student mentioning that it has given him *"some insight into how I stand also in relation to […] other people"* (M21). Yet another student stated that she *"actually reflected on my digital skills and took some time to think about them more thoroughly"* (F22).

Awareness a starting point for change, was expressed by participants as liking *"the idea that you could divide your digital skills in all these categories, and I would definitely take that away to see if there are any areas that I can develop"* (F23). A different participant expressed that *"self-improvement starts with awareness … and the tool has helped with that"* (M21). One participant noted that the tool *"provides me maybe with a framework of which skills I need to*

prioritize in order to improve" (F23). Other quotes like *"instead of strengthening a strength you already have, it showed me more my weaknesses and where I can focus on"* (F23) and *"it gave me … pointers about how to improve"* (F23).

One participant mentioned that this tool encouraged her in *"being more careful"* (F19) in terms of online privacy, which reflects an intention for behavior change, while other participants expressed the intention to *"get[ting] to know more about digital innovation"* (F22) or *"being more up to date"* (F23).

A few participants stated that the intervention was not useful at all, because *"it didn't change my behavior"* (M25), or another stating that *"it wasn't so very eye-opening"* (M22). The majority of the participants however expressed that the tool would be useful for *"someone [who] really wants to develop their digital skills"* (M23) or if one was *"struggling a bit more during COVID"* (M22), thus for people that are lacking some digital skills or are aiming specifically to develop their digital skills. Half of the people would recommend the tool to freshmen students or students that are starting their studies during the coronavirus pandemic, as well as to students from a non-technical study, with quotes like *"especially recommend this to people who are in high school, maybe freshmen in university or those who are actually starting right now"* (F22) and *"as a psychology student, I think the social side maybe might find the tool more useful"* (F23).

Factors that facilitated the effectiveness of the tool

According to the model by Ritterband (2009), characteristics of the intervention itself, the environment of the user and characteristics of the user can facilitate or impede the effectiveness of an intervention.

In terms of the characteristic of the intervention itself, more than half of the participants note that the tool was *"easy going, very straightforward"* (M22) and that it was *"understandable"* (M22), as well as three participants noting that the *"duration was also*

fine"(M23). In terms of the appearance of the tool, almost all the participants expressed that they like it, with one saying that the pie chart is *"visually pleasing"* (M25), another saying that he/she liked the set-up because *"it's really minimalistic"* (F22). The simplicity and accuracy of the content is also a characteristic of the tool that is seen to facilitate the uptake according to Ritterband (2009). Content-wise all the participants expressed that the tool seemed to cover the concept of digital skills well and the report in the end was a good representation of their digital skills, with representative comments as "*I just thought that it really covered it well"* (M25) and *"it represents quite well on my digital skills"* (F23) respectively.

When it comes to the environment of the user, six participants mentioned that digital skills play a big role in their lives, with statements like *"quite a big role, I would say I think it's normal for me to be like six hours a day on my laptop or something"* (F22) or "*I use computers pretty much most of the day, both for personal purposes, personal entertainment and for my studies"* (F22). Four participants expressed that they communicate with their families digitally *"all my family is very distant so if we have to communicate, we have to use technology"* (F23). Six participants also stressed that digital skills are highly valued in their educational environment, some even stating that they are required. Comments like *"my education environment, its highly valued these digital skills, as are also a requirement"* (F22) and *"it's pretty essential that you're able to watch lectures that are put up, doing research to answer questions"* (M22), illustrate this importance. One environmental factor that all the participants had in common was that the coronavirus pandemic has caused them to be more digitally active, with generally more computer exposure time: *"because everything is online … I'm sitting at my computer like most hours of the day"* (M22), exposure to and usage of online platforms and software that participants' hadn't used before like "*I've definitely have to make use of like, you know, platforms I didn't know existed"* (F23) and *"now I'm using Skype, which I normally don't use"* (M21). Three participants mentioned that their study program is quite

technical: *"we use quite some digital models"* (M23) and *"I'm quite a technical person and I like technology and we have a lot of it in our studies"* (F23). Generally the coronavirus pandemic had caused seven participants to improve their online collaboration and communication skills, three participants to be more comfortable and confident doing certain activities online, two participants to use digital sources more efficiently and also two participants improved their self-efficacy in solving problems. *"one of the features I use a lot during the Corona crisis is sharing your screen. So I've increased my skills with that and how to present information on your screen to others to share your work"* (F23) is a representative statement showing improved collaboration and communication skills, *"I'm more comfortable dealing with everything online"* (F22), a statement representative for being more comfortable and confident online. With regards to the more efficient use and improved self-efficacy, the participants mentioned: *"you kind of learn how to deal more efficiently with those"* (M23) and *"I learned, I guess, to solve a lot of more problems on my own"* (F22). illustrate these respectively.

User characteristics that facilitated the effectiveness of the tool were participants' perceptions of themselves as 'technical': people that see themselves as *"quite a technical person"* (F23) or as *"very in touch with tech"* (M22). One person mentioned *"I'm also looking to improve myself"* (F22) which made her interested in improving digital skills as well, but also the attitude that computers are *"an extension of everything we do nowadays, so ... being proficient in that is I think […] important"* (M22), also had a facilitating effect towards the uptake of the tool. Two participants mentioned to *"do like trying out new software"* (F19) and *"to branch out and see if there are any new tools I can use that are more efficient than the ones I have"* (F23). A favourable attitude towards the importance of digital literacy: *"it should be made as widespread as possible"* (M22) by one participant, seems to facilitate the uptake of the intervention as well.

Factors that impeded the effectiveness of the tool

The same factors that can facilitate the effectiveness of the tool can also impede it. Starting with characteristics of the tool, more than 50% of the participants found the tool *"tedious"* (F23) or *"a bit long"* (F23) also and mentioned that the *"questionnaire was quite long and then the results were quote long as well"* (F19), thus the whole intervention in itself was experienced as long. The second most mentioned negative aspect of the tool was that the resources were experienced as *"quite overwhelming"* (F22) because of the many options to choose from and especially as they were presented in an already *"very cluttered"* (F23) report. In terms of appearance, one participant mentioned that *"the resources were now just not like doing it for me in the sense of presenting themselves in such a way that I really … want to watch them now"* (F22), with another participant criticizing that *"the layout could be a bit more intuitive"* (F23), with yet another two participants noting that the report *"wasn't that inviting"* (M25). When it comes to the content of the tool, three participants noted that the tool *"put emphasis on things I didn't necessarily consider to be necessary as like digital skill"* (M22), two participants felt like *"some of the questions were repeating themselves"* (M21) which in turn *"decreases your attention span"* (F23). Other than that single participants noted that the resources *"could be a bit more fitted personalized"* (F23) and that *"some … sounded, again, a little too techy"* (F22).

Environmental factors that could have impeded the uptake of the intervention were as good as barely present, with only one comment that in applied physics the *"digital skills needed were not […] really necessary"* (M23) since all the exams were written on paper.

With regard to user characteristics two participants hold the belief that one does not need to actively work on building and improving on digital skills, but that this can happen *"unconsciously"* (F22). Two participants noted that they *"don't really do social media"* (M23) with one participant explicitly stating that he doesn't *"like having such a […] big Internet*

footprint" (M22) and thus purposefully engages less in digital creation and participation. Some participants had expectations towards the tool that were not met, for example one participant told that the study was advertised wrong and that she expected it to be "*a questionnaire about something totally different than digital skills"*. Another participant mentioned that he *"didn't' expect so many questions"* (M22) and yet another participant *"expected it to be more of like a test"* (F23).

Recommendations for the university

Two different types of recommendations for the University arose. The first type are implementation-recommendations for this tool by Jisc and the second type of recommendations are general recommendations for the university with regards to supporting students in building and improving on their digital skills.

With regards to the implementation of the tool, one student requires the university to *"approve of this tool"* (F22). Three students suggest that the tool should be placed *"at the start of the study"* and that it should not be made mandatory but rather dependent on the study programme, thus it would be more useful for *"psychology students […] because we're not as much into digital stuff and everything else as everyone else"* (F23). The tool could be used to *"incorporate specific needs into a study curriculum"* (F23), was suggested by one student. This tool could also be used *"to get to a point where everyone has the same skills or […] basis level"* (M21) of digital skills, was mentioned by another student. Finally, it was proposed to use this tool to match ones digital skill level to the level that is required by the specific study programme, thus to incorporate it into *"matching tests and matching days"* (F23).

When it comes to general recommendations to the university, the participants made recommendations with regard to already existing procedures and support, as well as new suggestions for ways to support students better. One student noted that software and tools that the university already makes use of *"have a lot of potential but they're not used as well as*

they can be" (M22), and apart from making use of their full potential, *"both the staff and the students"* (M22) should be educated on how these are used. Another student also mentions, that what the university offers to the students should be advertised better, since for example the *"library tool LISA"* (F23), *"a lot of students didn't know that existed"* (F23). A single student referred to classes that the university offers in the first year or crash courses on certain topics, and they would like that these classes should also be offered *"a little later on […] because in your first year you're already overwhelmed with everything already and you don't even know which skills you're lacking on"* (F22) as well as to have crash courses *"more thoroughly"* (F22) or even until *"the desired skills are acquired"* (F22).

Recommendations that go beyond already existing support, ranged from 50% of the participants expressing the wish for *"more classes or assignments"* (M22) or projects *"where you have to use the things you learnt"* (F19) as well as wished by three participants, that this should be *"in a mandatory sense"* (M22), to a few students asking for more resources *"to reference back on, or not having to ask everyone else but just have an easy and also like a gathered way to look it up"* (F22), to the facilitation of students helping out students. The university should *"facilitate these opportunities for students to help out students"* (F22) *"like a club […] or it can be very official events"* (F22), these *"should be voluntary"* (M25). Expert students could *"maybe get a small certificate"* (F22). These things should aim at *"mostly the students that cannot pick up things so easily"* (M23), and especially the *"people who choose social science studies at a technical university"* (F23). Resources that students expressed the need for could be free *"tutorials and digital classes on programming"* (F23) and more *"instruction manuals"* (F23) in general. One student also expressed the wish to instead of just uploading assignments for the teachers to read *"we can obviously share it with the world instead"* (F19). To make it easier for students that did not do their bachelor at the UT, one student suggested to being more transparent already before starting a master programme and

"have a bar of expectations like what courses would require what levels" (M22) as well as to publish *"the learning objectives of bachelor courses that the master courses of this sort of follow up on"* (M23).

Discussion

The aim of this study was to explore the digital skills of the UT students and to investigate whether it is feasible to make use of a web-based, self-guided tool such as the *Digital Discovery Tool* by Jisc to improve the digital skills of the UT students. With regards to the first research question, on the UT students' own perception of and confidence in their own digital skills, it was found that the UT students were proficient in ten out of sixteen skills, with only one underdeveloped skill. Most UT students however were not very confident in their digital skills. Compared to the sector average UT students generally performed better than the sector average, apart from four skills, of which one skill, digital participation, seemed to be low by choice.

With regards to the second research question, it showed that the tool was helpful in terms of creating awareness on one's own digital skillfulness, as well as on the topic of digital skills itself. Participants perceived the tool useful in providing a starting point from where they can start developing, whenever they feel the need to. The findings are discussed in light of previous research and existing models on the uptake an acceptance of technologies, as well as a theory of behavioral change. According to the *Internet Intervention Model* (Ritterband, 2009) factors like 'user characteristics', 'environment' and 'website' (here: intervention) can facilitate or impede the effectivity of an online intervention in bringing about behavior change. According to the *Technology Acceptance Model* (TAM) (Davis, 1989), two major factors will determine whether people to accept and make use of a technology. One of these factors is the *perceived usefulness* of the technology. If people are convinced that the technology will benefit them in a way, they are more likely to use the technology. The other factor that acts as a facilitator towards making use of the technology is, that people find it easy or effortless to use the technology. Davis refers to this factor as *perceived ease of use*. A perceived usefulness, combined with a perceived ease of use would lead to a favorable attitude towards the

technology, which in turn would lead to a behavioral intention to use the technology and eventually to system use.

With regards to the *environment*, it was found that students found themselves more exposed to the digital world on a daily basis during the corona-crisis. This lead for some people to an improvement in some of their digital skills. For others it lead to a decreased interest in working on their personal self-development on a computer, after having spent many hours behind the screen already for coursework. This seems to be an impeding factor, opposing to a perceived ease of use, because investing in self-development is not seen as effortless, but as resource demanding.

User characteristics like being technically-inclined, did contribute to the general interest and appreciated usefulness of the tool in a positive way. People that were already more interested and technologically inclined considered being digitally skilled more important for all students, even though they did not personally experience the tool as very useful for themselves, they expressed that it can be especially very useful for people who are less digitally skilled. When looking at the interview-sample in its entirety however, rather than considering the individual user, attitudes such as neglecting the general necessity of digital skills, impeded the experienced usefulness of the tool. This seems to be in line with the TAM in terms of perceived usefulness and ease of use, since more technologically inclined people found it easy to work through. Perceiving the tool as generally useful, despite not being useful for someone already digitally skilled, could come from a general perceived importance of and necessity for being digitally skilled, which was expressed by at least two participants. Participants that described the tool as confusing or too long and participants that perceived the tool as not useful in any way, also did not read the report in its entirety, nor did they make use of or have a look at any of the resources. Some students also reported, that the aim of the tool was not clear to

them as well as the visualization of the results, which negatively contributes to the experienced usefulness of the tool.

With regards to the *website* itself, most participants experienced it as being a clear and understandable and easy to use. The resources however, were not advertised enough sufficiently or in a way that made it attractive for students to dig into them. Students expressed, feeling overwhelmed by the amount of information provided by the report and the number of resources to choose from, which in turn impedes the chances of making use of them. This finding could be explained through the concept of *overchoice***,** whereby "*increasing variety of choices can lead to choice deferral*" (Gourville & Soman, 2005, p. 393). This concept is also referred to as *choice overload*, and can cause a decision to increase in complexity through a large number of available decision alternatives (Iyengar & Lepper, 2000). This would explain the inaction of some participants with regards to the resources. Choice overload especially affects adolescents and adults (Misuraca, Teuscher & Faraci, 2015), which the study sample was made of. An optimum amount of choices has not been established throughout the literature yet, with one paper suggesting to offer between seven to ten choices or to offer a mix of choices of higher and of lower quality, so that people can contrast their choices with the lower quality ones, to reach a higher choice satisfaction (Bollen et al., 2010).

To answer the second research question, of how feasible it is to use a tool like this for improving the digital skills of the UT students, the *Stages of Change model* (SOC) by Prochaska et. al, 1992, will be taken into account to determine to what extent the tool by Jisc contributed to the improvement of digital skills. According to the SOC model, behavior change is a five-stage process, and depending on the stage that a person is at a given point, either a cognitive or an action oriented approach is needed to help people move further in the process. The early two stages of *precontemplation* (no intention to change) and *contemplation* (some intention to change, but no behavior) are seen as purely cognitive in nature. In this study,

participants that were not familiar with the term digital skills before and participants that expressed the belief of digital skills developing passively, seem to be in the first and second stage, respectively. The next stage called *preparation*, an intention to change and early inconsistent behavioral attempts to change, seems to be the stage that most participants find themselves in after completing the tool. With participants expressing the intention to be more careful online, to want to find out more about digital skills or to see this tool as a starting point for when they feel ready to improve on some skills, participants seem to have progressed form one of the first to stages, to the third one. The last two stages are the *action* stage and the *maintenance* stage, which both go beyond the scope of this study, since they both refer to consistent behavioral performance for six months and longer. Therefore it sees like the tool did contribute to facilitate behavioral change in the UT students with regard to digital skills, since the students did move forward in the stages of change, according to the SOC model.

All of the above mentioned, leads to the question of what students actually do to and obtain digital skills. Almost every participant expressed to directly learn from another person, and rather than taking a survey to find out about one's skills and then read and work through some self-guided material, students reach out to other students or people, to learn from them. This is to no surprise, since active and collaborative approaches to teaching (Terenzini et a., 2001) in this case between students, do lead to better learning gains. This does not only apply to the student-to-student and teacher-to-student relationship, but also to teacher-to-teacher relationships, because even teachers learn by involving their colleagues (Meirink et al., 2009). This is an important finding, that needs to be taken into consideration when planning a curriculum. A more interactive approach of teaching or rather learning from each other and through discussion, should be considered. One finding is surprising however, namely the fact that there is a discrepancy between how students actually learn (from each other) and what they would like the university to do to support them (more classes and assignments).

Limitations and strengths

A multitude of aspects limit the representativeness, generalizability and accurateness of this study. In the recruitment phase the self-selection bias, of only having participants that chose to participate themselves to take part in the study, biased the final sample.

In terms of the materials, the intervention tool itself was not scientifically validated. Moreover, the tool itself does not measure a participant's digital skills, but requires participants to estimate their own skill level.

Students did not make use of all the parts of the tool, which means their opinion on the intervention is only based on the self-assessment and not the self-improvement part of the tool. It was also noticed, that not all the participants understood the use of the scale in the tool or some results that were presented in the personal insights-report.

With regard to the second part of the study, it has to be noted that the interviewer was inexperienced and sometimes suggestive towards the participants, which might have caused participants to please the researcher. In the course of the interviews, the interviewer sometimes asked suggestive questions like *"Do you think there is something missing?"* rather than just taking in the answer of the participant or rather than posing a question with a more neutral wording with regard to the word 'missing'. Other suggestive statements the researcher made might have revealed the researcher's own opinion regarding a topic that is being discussed, which might have caused participants to respond in a way that is conform with the researcher's opinion. An example would be that the researcher shared with a participant that she also does not make use of social media, after the participant shared that with the researcher. This however could have also facilitated rapport building between the researcher and the participant.

When analyzing the data, the interviewer herself was solely responsible for coding the data, which means no interrater reliability was established. Moreover, deficient sociodemographic data caused that the representativeness was not given, which limits the

generalizability of the results. Only manifest content was considered in the analysis, which makes the results less rich than adding the latent content, such as pauses in speech, tonality, hidden meanings as well as facial expressions and body language. The two latter could not have been taken into account, since the interviews were audio-calls only, which might also be a limitation.

Regardless of the limitations mentioned above, this study adds valuable knowledge to the existing literature on digital skills in students, as well as the feasibility of using the *Digital Discovery Tool* by Jisc in raising awareness and improving digital skills. Moreover this study was a mixed-method study consisting of a quantitative as well as a qualitative phase, which enabled an in-depth analysis of quantitative findings. The qualitative sample was balanced in terms of gender and diverse with regards to educational backgrounds and data saturation was achieved.

Suggestions

Future research

Future research should be aimed at repeating the findings on a larger scale with special focus on limitations such as the lack of an inter-rater reliability as well as conducting an experimental study, with half of the participants receiving instructions on how and which parts of the tool they should make use of before being interviewed and a control condition of no instructions. Research should also aim to find out whether there is an optimum amount of resource choices that students need to be given, in order for them to act on improving their digital skills.

Recommendations to LISA and the UT

Recommendations were formulated based on the interview results which revolved around the implementation of the tool as well as general digital improvements that the university could implement. With regards to the implementation of this tool by Jisc, the

university is suggested to officially approve of the tool, to increase the likelihood of students making use of this tool, because this would make it trustworthy and credible to them. More over the university should advertise and stress making use of the tool to a greater extent to less or even non-technical studies like social studies. It is suggested to have students a make use of this tool at the beginning of their studies, bachelor or master. Teachers could use the tool to get an overview of the digital skill level of his or her class, to then invest some effort into building the skills that that the class is lacking or less proficient in. With regards to supporting students in building and improving on their digital skills, suggestions are posed on already existing material and procedures and on the facilitation of students helping students.

The first suggestion is to make use of the full potential of platforms and software, like Canvas, that the university already makes use of. Staff as well as students should be educated on how these platforms and software work and are made use of. This could happen formally through introductory classes but also informally by providing elaborate video tutorials or manuals that students and staff can refer back to. There should be a standardized way of making use of these platforms, that is consistent at least within one study program. A resource bank with references that students can refer back to, and more than one way to explain a certain topic, would also be useful to make sure that students have an alternative explanation, if the one provided during class does not help them in understanding the topic. This would be useful, since students have different learning styles and therefore having materials that explain the same topic in different ways, could increase students independency as well as facilitate understanding in more students. Knowing that there will references to refer back to will also decrease pressure during classes.

On the subject of students helping students, it is suggested to make use of the diversity of people and skills that the university has to offer. Facilitating the opportunity of students helping out students should happen by means of assessing and accrediting voluntary expert

students, to ensure that other students take these expert students for credible, as well as to create an incentive for these expert students to spend time helping out other students. It is important for students to have other students approved by the university, because otherwise students would not accept that this 'expert student' transmits knowledge that is conform with the university and thus would not be helpful for exams. This could be implemented by means of a digital skill building 'club', where students offer informal help to other students more like tutoring. It could also however be made more formal, by the university organizing official events like workshops or talks, throughout the year and with students giving talks or workshops themselves. These expert students could also be made public on the university website, for other students to reach out to, instead of teachers.

Conclusion

The students of the University of Twente turned out to be proficient in the majority of areas that were assessed, however, they were not as much confident in their own skills, which might explain their expressed need for support from the university. Limited-efficacy testing revealed that the tool is effective in raising awareness on digital skills and also acts as a starting point for change. Therefore it is suggested to use the *Digital Discovery* Tool by Jisc further larger scale testing. As addressed in this study, institutionally facilitating students helping out students in a way that does not require additional personal spare time and effort, could contribute to the improvement of students' digital skillfulness. Actual measures or tests on digital skillfulness, rather than self-reports, could help students in gaining confidence in their own skillfulness, by providing feedback on their skill level.

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Appendix A

Informed consent of the online questionnaire

Welcome to the study! Dear fellow student, We would like to welcome you to our study about digital skills and wellbeing within the digital age. We are conducting this research in order to find out how our students find their way around the digital world. We would like to find out how digitally skilled our students are and where the university can step in and offer support. Moreover, last year's study on the UT students' wellbeing did not turn out to be positive, which is why we are expanding the wellbeing question to the digital world in our study. With the results, we would like to come up with a solution on how the university can support you, the students much more, in regards to your digital skills and your digital wellbeing. Our whole research will consist of two parts, the first one being this online survey together with an online self-assessment tool by the UK non-profit organization Jisc. The second part will consist of approx. 45 minutes Skype-interviews with selected students that indicate their willingness to participate. You will be asked whether you are willing to participate in a Skype-interview on one of the following pages, where you can indicate your preference. If you are selected, you will be rewarded with a 10EUR voucher of your choice. When filling in the self-assessment tool, you will be asked to fill in your first and last name and your student-email-address. Our research project has been reviewed and approved by the BMS Ethics Committee. As to your privacy, Jisc's measures in terms of data protection do comply with our UT-regulations concerning privacy and ethics. The research data will be saved in SURFdrive, a service adopted by the UT which fully complies with its own privacy and security regulations. The study should take you around 25 minutes to complete. Your participation in this research is voluntary and you have the right to withdraw at any point during the study, for any reason. If you would like to contact the Principal Investigators in the study to discuss this research or would like to get

any information about the results, please e-mail s.kiflei@utwente.nl. or a.a.amazu@utwente.nl. By clicking the button below, you acknowledge that your participation in the study is voluntary, you are at least 18 years of age, and that you are aware of the right to terminate your participation in the study at any time and for any reason. We kindly thank you for your participation!

Appendix B

Consent of the interviews

I would like to stress that participating in this interview is voluntarily and you can refuse to answer questions, as well as withdraw from the study at any time without having to give a reason. To be able to analyze and code the content of this interview I would like to audio record it, is that okay with you?

Appendix C

Definitions of the sixteen digital skill areas by Jisc

Digital proficiency is the ability you have to use digital devices, applications, software and services. How quickly do you pick up new tools and skills? Do you cope when technology doesn't work first time, do you explore beyond the basic functions, and can you work things out for yourself? Proficiency concerns digital 'mindset' more than the use of specific tools, but of course you can only gain that mindset by trying different applications and developing your range.

Digital productivity is how you use your digital skills to get things done in the real world. Can you choose the right devices, applications, software and systems for the job at hand? Can you adapt the tools available to your own needs and those of other people? A digitally productive person can multi-task in a complex digital environment, but can also deal with distraction and overload. A digitally productive learner uses institutional tools such as learning environments alongside personal devices and services to create their own effective digital environment for learning.

Information literacy is your ability to find, evaluate, organise and share information, whether you are using it for academic or professional purposes, or as a learner. Information specialists recommend we are creative in how we find information, but critical in how we judge its value and credibility. Everyone in education needs a broad understanding of information-based rules such as copyright, referencing, and avoiding plagiarism.

Media literacy covers all the ways you receive and respond to messages in digital media, including text, graphics, video, animations, audio, and media such as web sites, simulations and games. Most of us also share and produce messages of our own, and that means

we need to understand issues such as audience, accessibility, user design and impact. As with information, media users need to ask why messages are designed as they are, how they affect us – and particularly how different media can be used for learning.

Data literacy is how you handle data as a special form of information. Data is used in diverse ways in education, from monitoring key performance indicators, managing your grades to generating new theories. Our own data – personal and organisational - can also be used, sometimes in ways we might not want. We all need a basic understanding of legal, ethical and security issues when we handle data, and good habits of personal data security.

Digital creation is a term we use to cover all kinds of digital production, from coding new apps to making digital images and web sites. Digital creatives have special techniques of digital production, but we all create digital artefacts as a side effect of thinking and participating in a digital world. Mind maps, digital sketches, facebook pages, even selfies can be seen as expressions of digital creativity.

Digital problem-solving is your ability to solve problems and answer questions, either using digital evidence, or using digital environments (such as simulations and virtual worlds) to test out solutions. Digital scholars have many specialist digital methods available, depending on their research area, but all of us take part in digital problem solving every day.

Digital innovation describes your willingness to try new practices with digital technology, take calculated risks, and look for new solutions. As a learner it may seem that you don’t have much opportunity to innovate, but in fact you are always trying things that are new to you, and sometimes what you discover might turn out to be new for other people as well.

Digital communication is any communication using digital media and networks. The ability to communicate well includes using different channels such as video and instant messaging, photo

sharing and chat. But it also includes an awareness of different audiences, different rules and requirements, and the changing boundaries between public and private communication.

Digital collaboration is the ability to take part in digital teams and working groups to meet specific goals, using shared tools and media. Even when participants are physically in the same organisation, even when you are working with other students who you see every day, digital collaboration can be an efficient way to produce shared materials, to plan and run a project, or to work effectively across various boundaries and differences.

Digital participation means taking part in a more open-ended way than collaboration, over a longer time, and in a range of different settings. This is how you join, facilitate and build digital networks, take part in a shared social and cultural life using digital services, build contacts and share ideas. Digital participation should always be safe and respectful.

Preparing for digital learning means being able to turn digital opportunities into learning gains. Preparing for digital learning might involve: setting up your digital environment (devices, apps, resources and web services) to suit your learning needs; practicing with different media such as online lectures, apps and quizzes; finding and using online resources for yourself; managing your time and tasks; looking for help online when you need it.

Digital learning activities are the different ways you learn in digital spaces and with digital media. These might include participating with in-class polling, online discussions, using digital media for learning, recording and showcasing your achievements, or producing digital outcomes for assessment. Effective digital learners are willing to try new approaches but know what works for them and can be critical of technology when it is used inappropriately.

Digital identity is how you develop and project a digital identity – or several identities- and how you manage your digital reputation. Most of us have identities distributed across a

range of platforms and media. Do you keep these separate, or aim to make them work together? How do you manage assets such as profiles, records of achievement, contacts and networks to achieve your personal goals?

Digital wellbeing is how you look after your personal health, safety, relationships and work-life balance in digital settings. Do you use your data and devices in pursuit of positive personal goals (e.g. health and fitness)? Do you participate in online activities and networks that make you feel good? We all need help sometimes to manage digital stress, workload and distraction. We could all learn to use digital tools with more concern for each other and for the wider world.

Digital skills for work are all of your digital capabilities as they support you in your chosen work. Most workplaces have their own digital systems and practices: what matters is that you are able to learn them. Digital employability also covers seeking and securing work and using your digital access to progress in your chosen career, whether by upgrading your qualifications or by networking and showcasing your achievements.