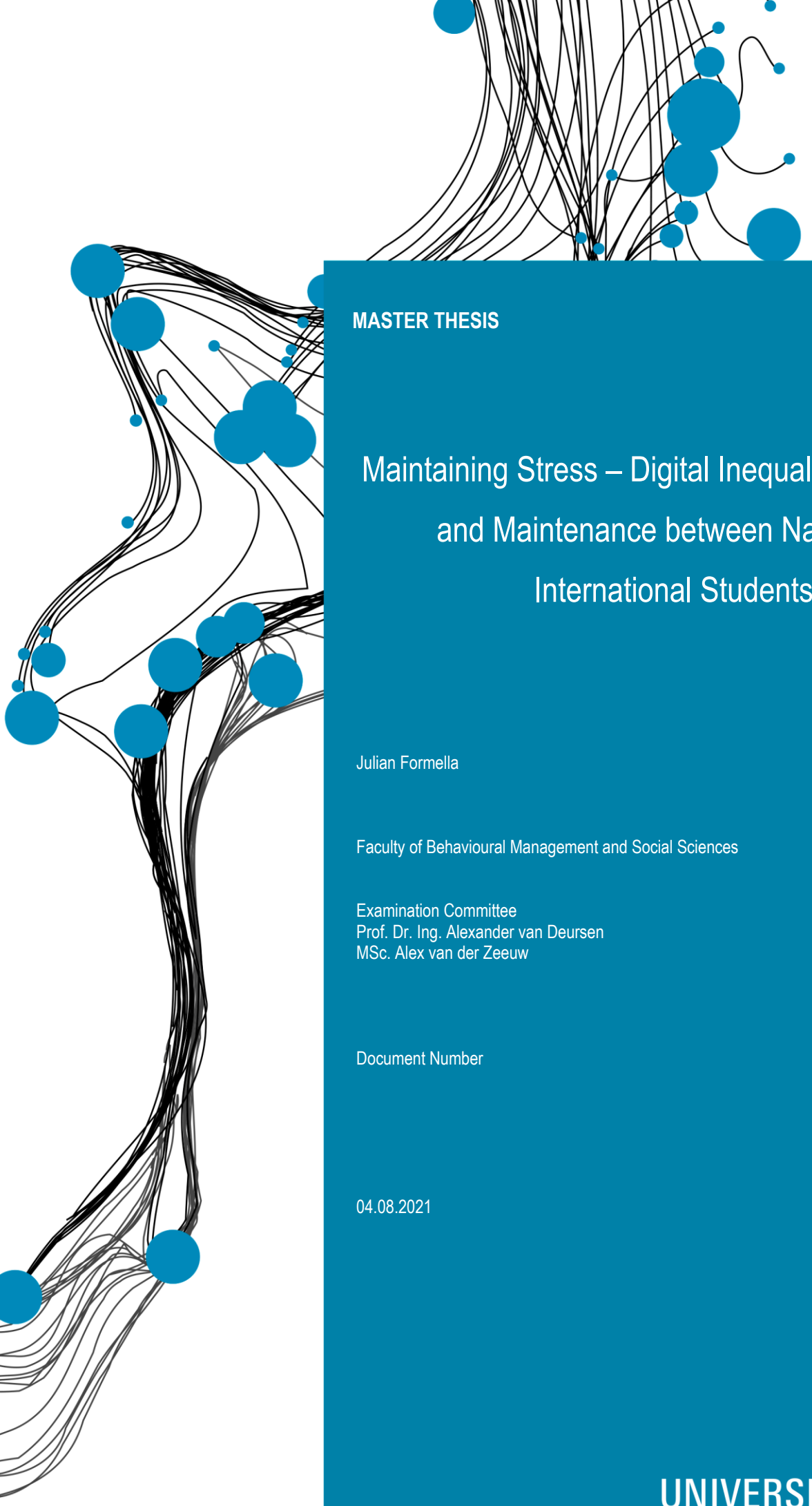

MASTER THESIS

Maintaining Stress – Digital Inequalities in Access and Maintenance between Native and International Students.

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Abstract

Laptops, tablets, and other devices are an integral part of university students ‘everyday life. Which is accompanied by the digitalization of educational infrastructure (Vega-Hernández et al., 2018). However, this integration does not always produce benefits, especially for already marginalized students. Accessing and maintaining devices is still a problematic endeavor for some students, with often dramatic consequences (Petro et al., 2020). Thus, the current study investigated inequalities between native and international students in accessing and maintaining study devices, as well as the consequences of them. Combining both qualitative and quantitative data, from interviews and a path model, hypotheses were tested. Results revealed the complex practices employed by students when maintaining their study devices. Moreover, the important and recursive role of students' technology attitudes was revealed. Last, suggestions both towards future research and programs to reduce the investigated inequalities were made.

1. Introduction

Embodied within modern education, laptops, tablets, and other devices are indispensable for university students (Vega-Hernández et al., 2018). However, accessing and maintaining such devices is a more complex endeavor and not all students benefit from a digitalized learning environment (Xu & Xu, 2019). Existing (digital) inequalities do not disappear when entering university. Instead, they can torment many, already disadvantaged, students (Gonzales et al., 2020).

When investigating the appropriation of technologies, it is oftentimes assumed that individuals only use a technology if they are motivated to do so. Hence, those who hold more favorable attitudes towards the devices at hand are more likely to engage with them (van Dijk, 2005, p. 39; van Deursen & van Dijk, 2015). Nevertheless, attitudes can be expected to play a different role at universities, as students cannot opt-out from using digital devices. Rather than influencing the motivation to appropriate a certain technology, they can be expected to affect how technology is maintained (Gonzales, 2016).

Moreover, universities do not consist of one homogenous group of people, but a variety of native and international students, from distinct fields and backgrounds, whose differences are also the origin of many inequalities (Junco et al., 2010). Especially those studying abroad are faced with a variety of specific issues. They often rely either on scholarships or must pay higher tuition fees, limiting their economic resources (Chapman & Sinning, 2014; Huberts, 2017). Additionally, cultural differences make it hard for some to connect with native students and create supporting social ties, limiting their social network and resources (Rienties et al., 2012, 2015).

However, both economic and social resources shape how students access and maintain their study devices (van Deursen & van Dijk, 2019). Students, who cannot afford modern devices, as they tend to be rather expensive, often rely on used, lower quality equipment with less processing power (Reisdorf et al., 2020). Moreover, if a device breaks, such students continue to work with damaged and impaired technology, as even fixing one's own device requires both practical knowledge and money (Faith, 2018; Gonzales et al., 2020). Hence, students with limited financial means may use their social network to tackle such issues, by sharing or obtaining used devices (Ball et al., 2019). However, if a student lives in a foreign country with few friends and no direct connection to family members, thereby lacking the necessary social support, this option may not be available, leaving no other choice than to continue using a defective device.

Additionally, the lack of social and economic resources is the origin of a vicious cycle of sequential digital and academic inequalities (Robinson, 2009; van Deursen et al., 2017). Initiated by the universal agent of separation -money- and exacerbated by the absence of compensatory means to deal with technological impairments and breakdowns, students' academic performance suffers (Petro et al., 2020; Reisdorf et al., 2020). Furthermore, such negative experiences can result in an increased amount of stress, which compounds the existing struggles (Reisdorf et al., 2020).

Therefore, the current research aims at unraveling the digital inequalities separating native and international students' access to and maintenance of their study devices, as well as the consequence of such disparities. Moreover, filling theoretical gaps, the influence of motivational factors, namely the attitude towards technology, will be assessed in a setting where an individual is bound to use technological devices. Making use of a mixed-methods approach, both qualitative and quantitative data will be used to gain detailed insights into the current field of investigation, as well as to saturate these accounts with a structured model. Last, implications for both future research and measures to reduce such inequalities will be given. All this shall be done by answering the following research question:

RQ: What are the causes and consequences of study device-related access and maintenances issues for university students?

Specifically, the differences between native students, with a potentially stronger social network, and international students, who instead are expected to rely on economic means, will be investigated. Thus, answering the following sub-question:

SQ1: Do international students have more difficulties accessing and maintaining their study devices than native students?

These two resources, economic and social, are also expected to play a different role for these two types of students, but also to be detrimental assets when dealing with technical issues. Hence, the next sub-question will be answered:

SQ2: Does the available social support, as well as the economic capital of a student influence the access to, and maintenance of their study device?

Last, filling theoretical gaps, the motivational access of students, in a setting where usage is mandatory, as digital devices are required to partake in all studies nowadays, will be investigated. This is done by answering the following sub-question:

SQ3: Is the access to and maintenance of a study device influenced by students' attitudes held towards technologies?

2. Theoretical Framework

2.1 Outcomes of digital inequalities at universities

As "technology" is often deemed to be essential for a prosperous society and a neutral good, universities frequently try to facilitate access to study devices, be it through subsidizations or offering them free of charge in their libraries (Petro et al., 2020). However, digital inequalities cannot be solved with such simple means, as they neglect the "complex and mutually evolving relationship" between technology, its users, and the structures at hand (Halford & Savage, 2010). Even subsidized devices are not free, and libraries have strict opening schedules, offer a limited number of devices, and must be traveled to in the first place (Ball et al., 2019; Petro et al., 2020).

Trying to achieve material access many students are then bereaved of the crumbs they have left, be it money or time. This leads to a higher propensity of those affected to express negative emotions, such as anxiety and stress (Ball et al., 2019; Reisdorf & Groselj, 2017; Slechtova, 2015). Such "emotional costs" are a common experience for students from lower social strata, who lack the needed ability and quality of access to operate a certain technology (Huang et al., 2015). However, these students are oftentimes familiar with such costs, as families of lower social strata are more likely to experience a limited material access, for example being unable to pay for internet subscriptions and owning fewer devices overall (Ignatov & Robinson, 2017).

Furthermore, emotional costs do not only influence the propensity to use a certain technology, but the usage itself. They inhibit students from learning the skills they are already lacking, as such negative emotions greatly reduce the academic achievement of students (Ball et al., 2019). Moreover, they can have a negative effect on students' well-being, causing and being related to depression and other psychological impairments (Haldorsen et al., 2014). Consequently, emotional costs are at the center of a vicious cycle of sequential inequalities (Cazan et al., 2016; Shields, 2001). Therefore, it will be expected, that students who properly access and maintain their study devices have overall higher GPAs than those who do not. Moreover, properly accessing and maintaining devices result in a lower level of stress.

H1a: Maintenance of study devices contributes positively to the GPA.
H1b: Access to study devices contributes positively to the GPA.
H2a: Maintenance of study devices contributes negatively to stress levels.
H2b: Access of study devices contributes negatively to stress levels.

2.2 Motivational Access & Field of Study

A factor that is deemed to play an important role in the maintenance of devices is the student's attitude towards technologies in general. Such attitudes are shaped by prior experiences with technologies, influencing the way how students perceive and interact with them. Consequently, those who had more exposure to technologies, as well as quality material access, also express more favorable attitudes towards them (Cazan et al., 2016; Huang et al., 2015; Reisdorf & Groselj, 2017).

In an "open" setting such attitudes would fall under the term "motivational access" which, as Van Dijk (2005, p. 28) puts it, is the "preliminary condition" of all other phases of internet and technology usage, influencing how technologies are being handled. This does not only include the range and frequency of usage but also its maintenance. Again, such practices then shape the attitude of the agent, either positively or negatively (Gonzales 2016; Sam et al., 2005; van Laar et al., 2019).

However, as stated earlier, students themselves do not have the choice to not use digital devices. Nonetheless, they may choose how much they want to engage with technology by picking a certain field of study. Here, it has been shown, that those who are part of natural sciences, programs that are often portrayed as technical, modern, and digital, do in general hold more positive attitudes than those who are part of social sciences (Adebowale et al., 2009; Sensales & Greenfield, 1995). Hence it is expected that a positive attitude towards technology leads to better maintenance of study devices. Furthermore, this attitude is deemed to be predicted by a student's field of study.

H3: Natural science students are more likely to hold positive attitudes towards technologies in general.
H4: Attitude towards technologies in general contributes positively to maintenance.

2.3 International students & Economic Capital

Fundamental to the current issue are the resources available to each student, be they economic or social. Financially disadvantaged students often use slower, lower-quality devices, and have difficulties when it comes to replacing them if they are completely broken, which leads them to experience continuous technological issues, so-called "dependable instability" (Petro et al., 2020). Their counterparts own expensive devices, which tend to break less often, while also possessing a higher amount of processing power, making it easier to handle demanding tasks. The same holds for the ownership of peripheral devices, such as a second laptop, screens, or tablets; wealthier students are more likely to own them, and thus can work more efficiently (Gonzales et al., 2020; van Deursen & van Dijk, 2019).

However, for international students, economic capital may not be as much of an issue. Past research on student migration has shown that young people from wealthy families are the ones most likely to study abroad (Herz et al., 2019). Hence, it is expected that those who are financially advantaged achieve higher quality access. Moreover, international students are expected to have a larger economic capital than native students.

H5: International students possess a larger economic capital.
H6: Economic capital positively contributes to access.

On the contrary, individuals, who lack economic capital, may use their social network, such as friends or family, to solve technological issues. However, this is only the case if a strong social network, with available sources of support, exists (Helsper & van Deursen, 2017). International students, who are more likely to struggle with establishing a wider and stronger social network, often due to complex cultural differences, may not have access to this range and quality of social support (Rienties et al., 2015). Therefore, they then need to rely on their financial capital to maintain study devices. Nevertheless, students, who lack both means for solving technical issues, are the ones to suffer the most. Thus, it is expected, that native students have a stronger social network and are thus more likely to make use of the sources of social support when dealing with technical issues. Additionally, making use of one's social support sources is expected to lead to better maintenance of devices.

H7: Social support contributes positively to maintenance.

H8: Native students are more likely to use social support sources to deal with technical issues.

2.4 Conceptual Model

Figure 1 shows the conceptual model, based on the theoretical framework.

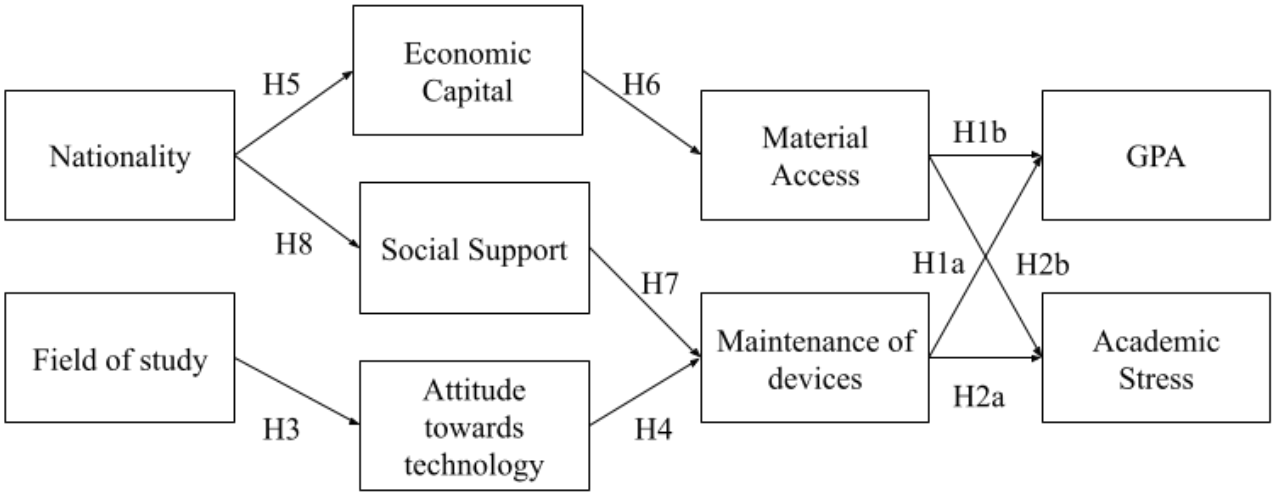

Fig. 1. Model of the theoretical framework.

3. Methods

3.1 Study design

The current research consisted of both a qualitative, as well as quantitative part, thus adopting a mixed-method approach (Zohrabi, 2013). First, following the so-called "cognitive interviewing" concept, several interviews were conducted to gain information next to existing literature. Based on these two sources a questionnaire was constructed, which was also used for hypothesis testing (Willis et al., 2005).

In total 17 interviews were conducted with 17 different students. Participants were recruited through the researcher's social network or social media. Participants were studying in Germany or the Netherlands, as either native or international students. Each interview lasted around 15 minutes and was conducted in German or English, using video-call software. Interviews were transcribed using a designated software, Amberscript, and used quotes have been translated by the researcher. The average interviewee age was 24 years. 70% identified as female. 76% were following a social science degree and 42% were international students.

Interviews were semi-structured, being based around four different themes, giving participants enough space to offer and outline their personal experiences (Newcomer et al., 2015). These themes were: students' attitudes towards technology, their domestic experience with technologies, asking about their first contact with technologies in high school or earlier, study devices, getting insight into which devices were seen as most important for one's studies, as well as access and maintenance-related issues, what consequences they had for the student's coursework and how they dealt with them.

The final survey was completed by 241 students, 74% identified as female and 1% as non-binary/third gender. The mean age of the sample was 22 years. The majority, 90% of the sample, were following a social science degree. Moreover, 68% of the sample were international students. A summary of interview and survey demographics can be found in Table 1.

Table 1

Demographics of interviews and survey

Demographic	Interviews	Survey
N	17	241
Age	23 (SD = 2.36)	22 (SD = 3.16)
Female	70%	74%
Social science	76%	90%
International	42%	68%

3.2 Measures

The predictor of students' attitudes, their field of study, was determined by one dichotomous item, where participants could self-select if they were following a natural or social science degree. Determining if participants were native to the country they were studying in, or foreign students, two multiple-choice items were used. First, students were asked about their nationality, then in which country they were studying. Answers were either coded as "native" or "international", based on the congruence of both items.

For the current study, a prior validated six-item scale assessed the general technology attitudes of students (Reisdorf & Groselj, 2017). These items, all worded negatively, were measured on a 5-point Likert scale, ranging from "Strongly agree" to "Strongly disagree". An example question is: "I do not trust technologies, because they fail when you need them the most." For the final model 4 items of this 6-item-scale were used, to improve internal reliability, the other items were discarded. Used items can be found in Appendix A.

Measures of students' available monetary means tend to be a difficult endeavor, as they often receive financial support from a variety of sources, that are not easy to assess, such as their parents, governmental grants, or loans (Petro et al., 2020). Therefore, student's economic capital was assessed by asking them how much money they have available to spend monthly, creating a continuous variable.

The access to devices does not only concern the kind or number of devices owned but also the quality of them (Robinson, 2009). Thus, student's material access was measured utilizing 6 text-box items. Students indicated how much they spent for each of their owned devices, the rationale being, that both quality and quantity of devices correlate with a higher amount spent. These measures were then combined into a single, continuous variable, measuring the total amount spent on devices.

Compressing the complex process of maintenance into a single variable, two items used by Gonzales et al., (2020), were adapted and split into 3 items. Participants indicated how quickly they thought to be able to fix technical issues with hardware, software, and those at home, on a 5-point scale. Here, answers ranged from "I couldn't afford to replace it at any point in the foreseeable future" to "About 1 day". An overview of the material access and maintenance variables can be found in Appendix B.

Based on the concept of actual support sources, the latter was assessed with one item (Helsper & van Deursen, 2017). Students were asked to indicate how likely they were to contact 7 different sources of social support when being faced with a technological issue. The likeliness was measured on a 7-point Likert scale, with options ranging from "Extremely

likely" to "Extremely unlikely". Examples include: "my family", "my friends" or "people on the internet".

Academic achievement was measured using the students' most recent GPA, which they entered in a text-box item. Emotional costs were reduced to the experience of stress and measured with the "perception of academic stress scale" (PAS) (Bedewy & Gabriel, 2015). This scale consists of 18 items, split into three thematic blocks of stresses related to academic expectations, faculty work, and examinations, as well as students' academic self-perceptions. Answers were entered on a 5-point scale, ranging from "strongly agree" to "strongly disagree". After an initial factor and reliability analysis, 5 items of this scale were used in the analysis of the final model, as a measure of academic stress. An example is: "I am unable to catch up if getting behind the work." The used items can be found in Appendix C.

3.3 Data analysis

The hypotheses were tested using Amos 20.0. Variables were analyzed employing item parceling, reducing many items into composite scales (Bandalos & Finney, 2001; Hau & Marsh, 2004). The model achieved a proper fit, after path adjustment, using the χ^2, the ratio of χ^2 to its degree of freedom (χ^2/df), the standardized root mean residual (SRMR), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA) indices (Schreiber et al., 2006).

4. Results

4.1 Path model

The results of the model fit is: χ^2 = 20,24; χ^2/df = 1,125; SRMR = .00; TLI = .95; RMSEA = .02 (90% confidence interval [CI] = .00, .06). Figure 2 shows the final path model and standardized coefficients. Table 2 shows the correlation matrix.

Table 2

Correlation Matrix.

	1	2	3	4	5	6	7	8	9
1. Nationality	-	-	-	*.05*	*.04*	-	-	.20	-
2. Field of Study		-	*-.02*	.15	-	-	-	-	-
3. Attitude			-	-	-	-.20	.22	.17	-
4. Economic Capital				-	-	*-.01*	-	.13	-
5. Social Support					-	-	-.16	-	.16
6. Material Access						-	-	*-.03*	-
7. Maintenance							-	-	-
8. GPA								-	-
9. Stress								-.27	-

Note: numbers displayed are significant at $p > 0.05$ level, numbers in italics are not significant.

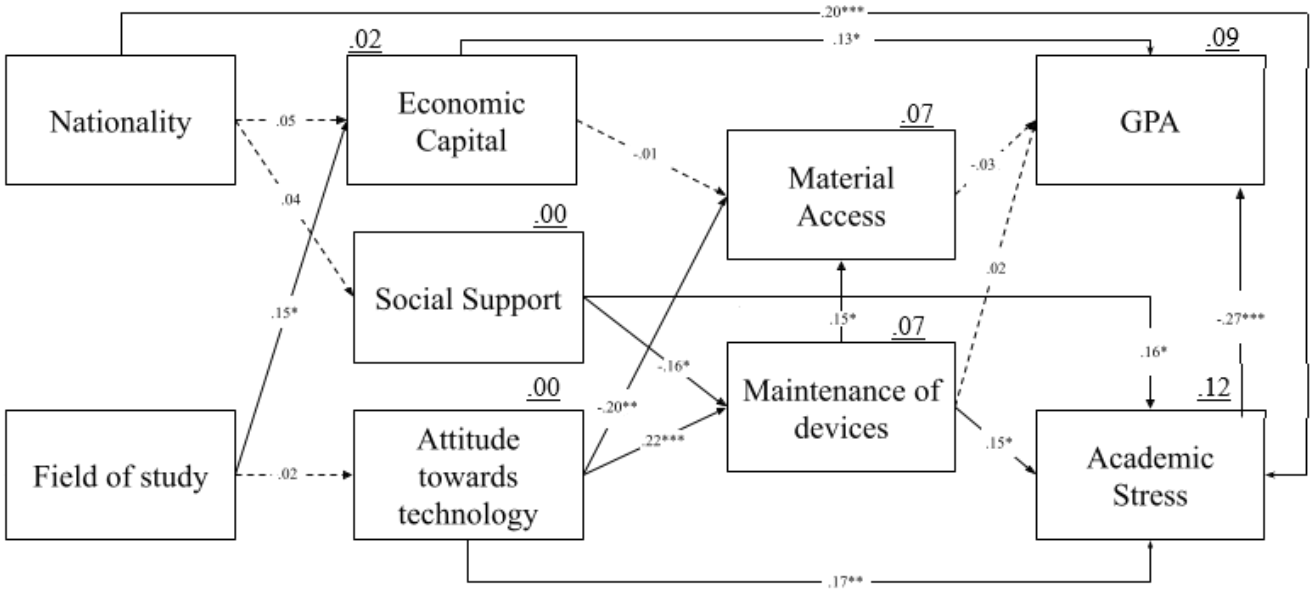

Fig. 2. Results for the research model with path coefficients. Note: *p < .05; **p < .01; ***p < 0.001 level. The dotted lines are non-significant paths.

4.2 Overview of the hypotheses

In the end, 3 out of the 8 initial hypotheses were supported. Table 3 displays all significant effects between the variables, as well as the unexpected effects, which appeared after adjusting the model fit.

Hypotheses 1a and 1b are not supported. There is no significant negative, or positive, the influence of either material access or maintenance on GPA. However, supporting Hyp. 2a maintenance has a positive, direct influence on academic stress. Access however does not influence stress, rejecting Hyp. 2b. Nonetheless, stress itself has a direct negative influence on GPA.

While Hyp. 3 is not supported, as the field of study has no influence on the attitude towards technology, Hyp. 4 is supported as a (negative) attitude towards technology has a direct, positive influence on maintenance. Moreover, attitude has a positive influence on stress, which is partially mediated by maintenance. Demonstrating this stressfulness of facing technical issues, we consider the example of a student whose Wi-Fi connection broke down, as she was finishing up a report. While she tried to deal with this issue by herself, only her landlord, who was on vacation, had access to the router:

> When it comes to the W-Lan, it is so frustrating and annoying, because all my work needs it. I already spent all my (mobile) data and we contact our landlord every time. (...) I feel a little bit powerless (...) I would really like to do something it just doesn't work. (...) You just can't do anything.
>
> A, female

Additionally, attitude has a negative influence on material access, which is again partially mediated by maintenance. Maintenance by itself has a positive direct influence on access. To illustrate this, we consider the example of a student, who discovered the versatility of technologies during her studies, holding a favorable attitude towards them. Using her laptop for more than 4 years, she decided, after half a year of consideration, stressful situations, a broken battery, and a defective hard drive, that she needed a better laptop, hoping to avoid technical problems and improve performance. Here, within the interaction of a positive attitude with a prolonged period of technical issues, the pronounced effect of the former can be seen:

> (...) so I wanted to invest into a laptop, that would be useful for more than three years maybe, (...) and then, of course, I wanted one that would be a bit better.
>
> B, female

Contrary to expectations there is no influence of nationality on economic capital, hence Hyp. 5 is not supported. Furthermore, Hyp. 6 is also not supported as economic capital does not affect material access. However, there exists a positive direct influence of the field of study on economic capital. Furthermore, economic capital has a positive direct influence on students' GPA. Moreover, Nationality has no influence on social support, thus Hyp. 7 is not supported. Nonetheless, nationality does have a positive direct influence on academic stress.

Social support has a negative direct influence on maintenance, supporting Hyp. 8. Apart from being influenced, maintenance serves as the partial mediator for the positive effect that social support has on stress. Furthermore, stress completely mediates the negative effect of social support on GPA. Last, maintenance serves as a complete mediator for the positive effect of social support on access. Indeed, the maintenance practices of students, using their available sources of social support, often were complex, effortful, and even described as stressful directly. An example here is the case of a student whose laptop broke as

she had to finish a group report. Due to high repair costs, she found an alternative solution to continue working:

> I was really far behind because I just couldn't work. It just didn't work. (...) then I worked together with my group a lot, not on my own laptop, but theirs.
>
> C, female

However, when being asked whether she thought that this had a negative influence on her grade, she denied it and highlighted the importance of solving her issues through social support, in this case, teaching staff:

> It (technical issues) never really had an influence on my grades. I just communicated it, that there was a problem and sent it when it was done. Otherwise, I didn't have that many (technical) issues.
>
> C, female

Table 3

Significant direct, indirect, and total effects for the path model.

Link	Direct effect β	Indirect effect β	Total effect β	Validation
H1a. Maintenance - GPA	-	-	-	Rejected
H1b. Access - GPA	-	-	-	Rejected
H2a. Maintenance – Stress	.15	-	.15	Supported
H2b. Access – Stress	-	-	-	Rejected
Stress - GPA	-.27	-	-.27	-
H3. Field of study – Attitude	-	-	-	Rejected

H4. Attitude - Maintenance	.22	-	.22	Supported
Attitude- Maintenance- Stress	.17	.03	.20	-
Attitude - Maintenance – Access	-.20	-.03	-.23	-
H5. Nationality – Economic capital	-	-	-	Rejected
H6. Economic capital –Access	-	-	-	Rejected
H7. Social support - Maintenance	-.16	-	-.16	Supported
H8. Nationality – Social support	-	-	-.16	Rejected
Nationality - Stress	.20	-	.20	-
Social Support – Maintenance - Stress	.16	-.02	.14	-
Social Support – Maintenance - Access	-	.02	.02	-
Social Support – Stress - GPA	-	-.04	-.04	-

Note: effects are significant at p > 0.05 level.

5. Discussion

Contrary to binary assumptions, that define material access to technology as an either-or scenario, the current study adds onto opposing literature, painting a more complex picture. Even those who are “connected” differ in their motivation and quality of access, while maintaining access is an intricated endeavor by itself (van Deursen & van Dijk, 2019). Filling these gaps, a setting was investigated, namely that of the university, where access to digital devices is considered a supposition.

Combining both quantitative and qualitative data it was possible to outline and detail the complex relationship between students and their study devices. Moreover, differentiating between native and international students the role of external and internal influences was delineated. This included the influence of economic and social resources available, as well as the attitudes towards technology. Last, the outcomes of these processes on students' academic performance and well-being were assessed.

Although there was no evidence for the influence of both access and maintenance on students' GPAs, a prolonged expectation of maintenance did lead to a higher level of stress. Indeed, most interviewees highlighted the stressfulness connected with the maintenance of an impaired device. This process was often described as a prolonged sequence of ever-increasing difficulty. Beginning with minor technical complaints, students' devices often suffered as time went on, climaxing in total breakdowns, requiring a full repair or replacement. Such emotional experiences were amplified when they occurred during already stressful times, such as exam periods or close to the deadline of an assignment. This latter connection was also reflected in the negative influence of stress on students' GPAs, highlighting the "emotional costs" associated with technology maintenance (Ball et al., 2019).

Another factor that influenced the maintenance of devices was the attitude held towards technology. Here, it was revealed, that those who evaluated technology as more positive, expected to fix their issues quicker. Surprisingly, in the interviews, this confidence was only reflected in word, but not in commotion. Students, both those with positive and those with more negative attitudes, took a similar amount of time when they experienced technical difficulties. However, those with more favorable attitudes, were more likely, after the occurrence of severe impairments and breakdowns, to buy more expensive devices, which they expected would last longer. Thus, we may conclude that attitudes do in fact play a significant role in the maintenance of study devices, and when accessing such technologies, especially after a complete breakdown (Gonzales, 2016).

Surprisingly, a negative attitude towards technology was associated with a higher level of stress. Drawing on the concept of the “hidden curriculum” of digitalized education, which those fulfill who possess the needed technical skills and knowledge, the experience of negative emotions may be a reaction of those who do not (Darvin, 2019; Giroux & Penna, 1983). However, as the collected data does not provide sufficient insight into this phenomenon it would be of great interest to investigate it in future research. Furthermore, the lack of evidence for the proxy measure of students' attitude, namely their field of study, may be related to the missing representativeness of those following a natural science program. However, another reason may have been the rather broad conceptualization of both social and natural science, and future research may investigate a smaller range of studies, comparing those where only basic technology is used with those where advanced computing is being executed.

Another surprising result was the missing influence of economic capital on both access and maintenance. This contradicts existing literature on digital access inequalities, which emphasizes that students with more money available tend to not only own more, but also more expensive devices (for example: Gonzales et al., 2020). Nevertheless, it became apparent in the interviews, and past studies have shown, that students often do not pay "directly" for devices, subscriptions, and repairs, but instead rely on external financial sources, for example, parents or loans (Oosterbeek & van den Broek, 2009). Thus, the influence of economic resources on ownership, and even maintenance, may only become fully visible when the aspects of financial autonomy and dependency, and related issues, are included (Petro et al., 2020).

Notably, however, students with a higher economic capital were obtaining higher GPAs. This manifestation can be explained by the higher probability that such students stem from higher educated, wealthier families, thus domestic situations that encourage academic achievement (Battle & Lewis, 2002). This is not only reflected in academic performance but also overall representation in higher education (Inspectie van het Onderwijs, 2021, p.183; Middendorff et al., 2017, p. 11-12). Therefore, the lack of significant economic influences may also explain the strong attitudinal influence on both access and maintenance in the current path model. A volatile finding, however, when compared to the more complex composition of students’ economic capitals.

Despite these findings, what did influence the access to, and the maintenance of devices was the social support available to students. Undeniably, students, when dealing with technical issues, used the internet, their friends, and their family to get help or obtain

replacement devices (Courtois & Verdegem, 2016). Nevertheless, even this way of maintaining technology came with a price. Albeit not a monetary one, but an emotional one instead (Petro et al., 2020). Relying on others' help was always connected to occurrences of stress and temporal expenditures. For example, students needed to abide by their friends' schedules to use their devices or had to use old, second-hand devices while their own was being repaired.

Concerning the initially assumed differences between native and international students, it must be said, that none were proven to be true. International students expressed neither a reduced likelihood to make use of their social support sources, nor did they possess a larger economic capital. However, they did experience a higher level of stress in general. Albeit that existing literature differs in identifying the causes for these differences, some highlighting cultural conflicts, lack of integration or social support (see for example: Franco et al., 2019; Rienties et al., 2012), these students nonetheless, if they are faced with the same technical issues as native students, experience an even higher amount of stress and related negative outcomes.

Answering the initial research question, it can thus be concluded, that the causes for access and maintenance issues are "natural" as they are mainly caused by technical decay. However, the causes for related digital inequalities are differences in available social support, as students refrain from solving minor and even major issues by replacement or repair but instead rely on the internet, their friends, or family to deal with technical issues. Moreover, students with a more positive attitude towards technology, are more confident when dealing with such issues, and see it as worthwhile to invest in more expensive technology. The consequences of such inequalities are complex, rarely resulting in noticeable perceived influences on the students' academic performances, but instead are manifested in the experience of stress, which then impairs academic performance, a hidden cycle so to say.

Those who experience the negative side of such outcomes are not only students with a weak social network or negative attitudes, but also international students, who may not differ as much on the resources available to them but are already experiencing an increased amount of stress already. This not only results in a lower academic performance but also an overall lower well-being. Therefore, those who suffer most do not only maintain their devices but instead maintain the detrimental outcomes associated with flawed material access, drifting further into the vicious cycle of digital inequalities, as can be seen in the problematic implementation of remote learning during times of a global pandemic (Gunter et al., 2020; Pischetola et al., 2021).

5.1 Limitations & Implications

The current study is not without flaws, but they must be addressed to improve upon them in future studies. The measures of both GPA and economic capital may only be interpreted as proxy measures. Some students refrained from stating their current GPA, which led to the exclusion of them from the analysis. Moreover, as the study was cross-national grades were re-calculated into the Dutch 10-point system, which may have led to skewed results. Similar tendencies were seen for economic capital, as some students did not know how much money they had available monthly, while some refused to state their income. However, comparing the average income of the sample to that of a governmental inquiry, numbers did not differ much (van der Werf et al., 2017, p.22)

While the first issue may be solved by making use of university databases, to obtain a direct and precise measure of students' GPAs, the second issue is more persistent. As outlined before, students obtain their income from a variety of sources. Moreover, the source of income may also differ in autonomy, for example taking up a loan creates different dependencies than asking one's parents for money (Petro et al., 2020). Thus, future research may also define economic capital not only based on its volume but also based on dependency and related problems.

While the current study was able to hint at the complexity of maintenance practices employed by students, future studies would enrichen this field of study by investigating the following influential factors more in-depth. First, students adapted themselves and their environment to experienced issues dynamically, creating stable choreographies. Indeed, humans are rather creative when it comes to the adoption of new technologies, for example, the IoT, to existing social and material structures (van der Zeeuw et al., 2020). Future studies may then investigate such choreographies using qualitative data, so that not only the issues connected to such practices are highlighted, for example having to sit next to an electrical outlet because of a broken battery, but that the positive aspects of such practices are being used to design programs that adapt organically to the circumstance of those left behind.

Next, the importance of time became apparent during the interviews. Not only did it matter when an issue occurred, but also for how long. Therefore, future studies should make use of longitudinal designs, an approach that would also deem helpful to investigate chorographical practices, so that temporal influences become more visible. With this, researchers would be able to investigate the temporal changes of held attitudes, further delineating the sequential and circular aspects of digital inequalities.

Offering solutions for the existing digital inequalities, universities must expand their means of reducing such inequalities beyond subsidiary programs for devices, public devices, or helpdesks. Instead of offering only such superficial, and often exclusionary measures, help programs must adapt dynamically to the already existing practices of students. This would entail the adoption of a perspective, in which the device is not the detrimental factor, but the relational entanglement between all actors in the university setting and even outside of it, being reflected in the high frequency of technical issues experienced at home (Hultin, 2019). Such help programs would then need to aim at the different parts of the "vicious cycle" of digital inequalities, which are intertwined with other existing social inequalities.

Therefore, the successful application of the proposed help program involves the participation of a variety of experts, such as counselors or technicians, who must work together. Instead of dealing with the negative outcomes superficially, for example stress, by offering counseling alone, universities must be open to structural changes. In the end it is not only "technology" that is being embedded into the digitalized scape of education, but also the many issues that come with it.

References

Adebowale, O. F., Adediwura, A. A., & Bada, T. A. (2009). Correlates of computer attitude among secondary school students in Lagos State, Nigeria. *International Journal of Computing and ICT Research*, *3*(2), 20-30.

Ball, C., Huang, K. T., Rikard, R. V., & Cotten, S. R. (2019). The emotional costs of computers: An expectancy-value theory analysis of predominantly low-socioeconomic status minority students' STEM attitudes. *Information, Communication & Society*, *22*(1), 105-128.

Bandalos, D. L., & Finney, S. J. (2001). Item parceling issues in structural equation modeling In Marcoulides GA & Schumacker RE (Eds.), New developments and techniques in structural equation modeling (pp. 269–296).

Battle, J., & Lewis, M. (2002). The increasing significance of class: The relative effects of race and socioeconomic status on academic achievement. *Journal of poverty*, *6*(2), 21-35.

Bedewy, D., & Gabriel, A. (2015). Examining perceptions of academic stress and its sources among university students: The Perception of Academic Stress Scale. *Health psychology open*, *2*(2), 2055102915596714.

Cazan, A. M., Cocoradă, E., & Maican, C. I. (2016). Computer anxiety and attitudes towards the computer and the internet with Romanian high-school and university students. *Computers in Human Behavior*, *55*, 258-267.

Chapman, B., & Sinning, M. (2014). Student loan reforms for German higher education: financing tuition fees. *Education Economics*, *22*(6), 569-588.

Courtois, C., & Verdegem, P. (2016). With a little help from my friends: An analysis of the role of social support in digital inequalities. *New media & society*, *18*(8), 1508-1527.

Darvin, R. (2019). Youth, Technology, and the Hidden Curriculum of the 21st Century. *Youth and Globalization*, *1*(2), 210-229.

Ignatow, G., & Robinson, L. (2017). Pierre Bourdieu: theorizing the digital. *Information, Communication & Society*, *20*(7), 950-966.

Faith, B. (2018). Maintenance affordances and structural inequalities: Mobile phone use by low-income women in the United Kingdom.

Franco, M., Hsiao, Y. S., Gnilka, P. B., & Ashby, J. S. (2019). Acculturative stress, social support, and career outcome expectations among international students. *International Journal for Educational and Vocational Guidance*, *19*(2), 275-291.

Giroux, H., & Penna, A. (1983). Social education in the classroom: The dynamics of the hidden curriculum. In H. Giroux & D. Purpel (Eds.), The hidden curriculum and moral education (Vol. 7, pp. 100–121). Berkeley, CA: McCutchan Publishing Corporation. https://doi.org/10.1080/00933104.1979.10506048.

Gonzales, A. (2016). The contemporary US digital divide: from initial access to technology maintenance. *Information, Communication & Society*, *19*(2), 234-248.

Gonzales, A. L., McCrory Calarco, J., & Lynch, T. (2020). Technology problems and student achievement gaps: A validation and extension of the technology maintenance construct. *Communication Research*, *47*(5), 750-770.

Gunter, A., Raghuram, P., Breines, M. R., & Prinsloo, P. (2020). Distance education as socio-material assemblage: Place, distribution, and aggregation. *Population, Space and Place*, *26*(3), e2320.

Halford, S., & Savage, M. (2010). Reconceptualizing digital social inequality. *Information, Communication & Society*, *13*(7), 937-955.

Haldorsen, H., Bak, N. H., Dissing, A., & Petersson, B. (2014). Stress and symptoms of depression among medical students at the University of Copenhagen. *Scandinavian journal of public health*, *42*(1), 89-95.

Hau, K. T., & Marsh, H. W. (2004). The use of item parcels in structural equation modelling: Non-normal data and small sample sizes. *British Journal of Mathematical and Statistical Psychology*, *57*(2), 327-351.

Helsper, E. J., & van Deursen, A. J. (2017). Do the rich get digitally richer? Quantity and quality of support for digital engagement. *Information, Communication & Society*, *20*(5), 700-714.

Herz, A., Díaz-Chorne, L., Díaz-Catalán, C., Altissimo, A., & Carignani, S. S. (2019). Are you mobile, too? The role played by social networks in the intention to move abroad among youth in Europe. *Migration Letters*, *16*(1), 93-104.

Huang, K. T., Robinson, L., & Cotten, S. R. (2015). Mind the emotional gap: The impact of emotional costs on student learning outcomes. In *Communication and information technologies annual*. Emerald Group Publishing Limited.

Huberts, D. (2017). Update: Incoming student mobility in Dutch higher education 2016-17. *Den Haag: EP-Nuffic*.

Hultin, L. (2019). On becoming a sociomaterial researcher: Exploring epistemological practices grounded in a relational, performative ontology. *Information and Organization*, *29*(2), 91-104.

Inspectie van het Onderwijs. (2021). *De Staat van het Onderwijs*.

Junco, R., Merson, D., & Salter, D. W. (2010). The effect of gender, ethnicity, and income on college students' use of communication technologies. *Cyberpsychology, Behavior, and Social Networking*, *13*(6), 619-627.

Middendorff, E., Apolinarski, B., Becker, K., Bornkessel, P., Brandt, T., Heißenberg, S., & Poskowsky, J. (2017). Die wirtschaftliche und soziale Lage der Studierenden in Deutschland 2016. 21. *Sozialerhebung des Deutschen Studentenwerks–durchgeführt vom Deutschen Zentrum für Hochschul-und Wissenschaftsforschung, Bundesministerium für Bildung und Forschung (BMBF). Zugriff am*, *2*, 2018.

Newcomer, K. E., Hatry, H. P., & Wholey, J. S. (2015). Conducting semi-structured interviews. *Handbook of practical program evaluation*, *492*.

Oosterbeek, H., & van den Broek, A. (2009). An empirical analysis of borrowing behaviour of higher education students in the Netherlands. *Economics of education review*, *28*(2), 170-177.

Petro, G., Gonzales, A., & Calarco, J. (2020). " Out of Luck": Socio-Economic Differences in Student Coping Responses to Technology Problems. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-10).

Pischetola, M., de Miranda, L. V. T., & Albuquerque, P. (2021). The invisible made visible through technologies' agency: a sociomaterial inquiry on emergency remote teaching in higher education. *Learning, Media and Technology*, 1-14.

Reisdorf, B. C., & Groselj, D. (2017). Internet (non-) use types and motivational access: Implications for digital inequalities research. *New Media & Society*, *19*(8), 1157-1176.

Reisdorf, B. C., Triwibowo, W., & Yankelevich, A. (2020). Laptop or Bust: How Lack of Technology Affects Student Achievement. *American Behavioral Scientist*, 0002764220919145.

Rienties, B., Beausaert, S., Grohnert, T., Niemantsverdriet, S., & Kommers, P. (2012). Understanding academic performance of international students: The role of ethnicity, academic and social integration. *Higher education*, *63*(6), 685-700.

Rienties, B., Johan, N., & Jindal-Snape, D. (2015). A dynamic analysis of social capital-building of international and UK students. *British Journal of Sociology of Education*, *36*(8), 1212-1235.

Robinson, L. (2009). A taste for the necessary: A Bourdieuian approach to digital inequality. *Information, Communication & Society*, *12*(4), 488-507.

Sam, H. K., Othman, A. E. A., & Nordin, Z. S. (2005). Computer self-efficacy, computer anxiety, and attitudes toward the Internet: A study among undergraduates in Unimas. *Journal of Educational Technology & Society*, *8*(4), 205-219.

Scheerder, A. J., van Deursen, A. J., & van Dijk, J. A. (2019). Negative outcomes of Internet use: A qualitative analysis in the homes of families with different educational backgrounds. *The Information Society*, *35*(5), 286-298.

Scheerder, A., van Deursen, A., & van Dijk, J. (2017). Determinants of Internet skills, uses and outcomes. A systematic review of the second-and third-level digital divide. *Telematics and informatics*, *34*(8), 1607-1624.

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of educational research*, *99*(6), 323-338.

Sensales, G., & Greenfield, P. M. (1995). Attitudes toward computers, science, and technology: A cross-cultural comparison between students in Rome and Los Angeles. *Journal of cross-cultural Psychology*, *26*(3), 229-242.

Shields, N. (2001). Stress, active coping, and academic performance among persisting and nonpersisting college students. *Journal of Applied Biobehavioral Research*, *6*(2), 65-81.

Slechtova, P. (2015). Attitudes of undergraduate students to the use of ICT in education. *Procedia-Social and Behavioral Sciences*, *171*, 1128-1134.

Van der Werf, M., Schonewille, G., & Stoof, R. (2017). Studentenonderzoek 2017: Achtergrondstudie bij de handreiking Student & Financiën. *Nationaal Instituut voor Budgetvoorlichting: the Netherlands*.

Van der Zeeuw, A., van Deursen, A. J., & Jansen, G. (2020). How to apply IoT skills at home: Inequalities in cultural repertoires and its interdependency chains. *Poetics*, *83*, 101486.

Van Deursen, A. J., & van Dijk, J. A. (2015). Toward a multifaceted model of Internet access for understanding digital divides: An empirical investigation. *The Information Society*, *31*(5), 379-391.

Van Deursen, A. J., & van Dijk, J. A. (2019). The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *new media & society*, *21*(2), 354-375.

Van Deursen, A. J., Courtois, C., & van Dijk, J. A. (2014). Internet skills, sources of support, and benefiting from Internet use. *International journal of human-computer interaction*, *30*(4), 278-290.

Van Deursen, A. J., Helsper, E., Eynon, R., & van Dijk, J. A. (2017). The compoundness and sequentiality of digital inequality. *International Journal of Communication*, *11*, 452-473.

Van Dijk, J. A. G. M. (2005). The deepening divide: Inequality in the information society (pp. 39-46). London, UK: Sage.

Van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2019). Determinants of 21st-century digital skills: A large-scale survey among working professionals. *Computers in human behavior*, *100*, 93-104.

Vega-Hernández, M. C., Patino-Alonso, M. C., & Galindo-Villardón, M. P. (2018). Multivariate characterization of university students using the ICT for learning. *Computers & Education*, *121*, 124-130.

Willis, G., Lawrence, D., Thompson, F., Kudela, M., Levin, K., & Miller, K. (2005). The use of cognitive interviewing to evaluate translated survey questions: lessons learned. In *Conference of the Federal Committee on Statistical Methodology, Arlington, VA*.

Xu, D., & Xu, Y. (2019). The Promises and Limits of Online Higher Education: Understanding How Distance Education Affects Access, Cost, and Quality. *American Enterprise Institute*.

Zohrabi, M. (2013). Mixed Method Research: Instruments, Validity, Reliability and Reporting Findings. *Theory & practice in language studies*, *3*(2).

Appendix A: General technology attitudes

Table 4

General Technology Attitudes (Reisdorf, & Groselij, 2017)

	N	Minimum	Maximum	Mean	Std. Deviation
I do not trust technologies, because they fail when you need them the most	241	1	7	2.65	1.31
I get nervous using technologies, because I might break something	241	1	7	2.55	1.47
Often it is easier to do things without using technologies	241	1	7	3.34	1.36
I find it difficult to keep up to date with new technology	241	1	7	3.29	1.66
Cronbach's Alpha	0.68				

Appendix B: Material Access & Maintenance

Table 5

Device ownership

	N	Percentage
Laptop	240	100
Desktop Computer	46	19
Smartphone	240	100
Tablet	100	41
Printer	120	50
(Additional) screen	70	29
Other device(s),	32	13

Note: The last option was a text-box entry, where participants listed additional devices, they owned. It was not included in the final measure, as statements included mainly gaming consoles and were seen as unimportant.

Table 6

Frequency occurrence of technical issues

	Hardware	Software	At home
Never	65	28	11
Weekly	3	10	32
Monthly	2	15	32
Quarterly	9	28	17
Yearly	21	19	8

Note: N = 241, percentages displayed.

Appendix C: Academic Stress items

Table 7

Academic Stress (Bedewy, & Gabriel, 2015)

	N	Minimum	Maximum	Mean	Std. Deviation
Teachers have unrealistic expectations of me.	241	1	5	2.39	1.01
I am unable to catch up if getting behind the work.	241	1	5	2.61	1.10
Examination times are very stressful to me.	241	1	5	3.83	1.06
I believe that the amount of workload and assignments is excessive.	241	1	5	3.05	.98
Chronbach's Alpha	0.77				