

TOYS FOR THE BOYS, TOOLS FOR THE GIRLS? GENDER AND MEDIA USAGE PATTERNS IN HIGHER EDUCATION

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ABSTRACT

Since the introduction of digital media the fear of women being left out of the virtual world is expressed in various contexts. With the aim to establish if these gender differences still exist and, if they do, what form they take this paper investigates the use of digital media by male and female higher education students. 1,327 students enrolled at German higher education institutions completed an online questionnaire concerning the digital devices that they own or have access to, and their usage of media and e-learning tools and services for their learning. Using multivariate analysis, the study indicates that male students show higher acceptance values for more general web tools higher than female students, but when it comes to e-learning related tools women show higher acceptance values for a lot more different tools and services than men. The findings indicate that differences in media usage patterns between male and female students are not a question of having access, but of the attitude toward and the reasons for using digital media, and that the mentioned fear of women being left out did not come true.

Keywords: Gender differences, Media usage behaviour, Digital technology, Digital media, Higher education

INTRODUCTION

Digital media are omnipresent in almost every aspect of society and decisively shape the everyday life of information and knowledge societies. Politicians, as well as educators, demand that students at every educational level become proficient in digital media, as digital literacy is considered an indispensable condition for participating in (continuing) education, professional development and communication (BMWi, BMI & BMVI, 2014; Stalder, 2016; Adams Becker et al., 2017).

Today, student access to the necessary technologies is taken for granted. There has been a rapid proliferation of mobile devices and Internet connectivity throughout Western industrialized societies (bpb, 2016), and university campuses are usually well equipped with freely accessible information and communication technologies, including wireless LAN in student rooms in dormitories (Lehmann, 1999; Glenn & D'Agostino, 2008; Roberge & Gagnon, 2014; Jisc & EDUCAUSE, 2015). The importance of technology is high for Open and Distance Learning in general and for e-learning in particular (Bates, 1995; DeVolder 1996; Conole 2014). Computers and the Internet are used in universities for administrative purposes (e.g. registration, updating information, submitting assignments and receiving feedback), for teaching (e.g. streaming lectures, providing supplementary study material, experiments and tests), for research (e.g. searching library catalogues, Internet searches, online surveys), and for communication and collaboration (e.g. chats, guided discussions, study groups, video-conferences). Zawacki-Richter (2012) states that e-learning established itself within German higher education institutions from the beginning of the 21st century, with e-learning implemented in addition to traditional teaching and learning formats. But, due to the high density of campus-based universities, distance education still plays a minor role in the German-speaking area (Zawacki-Richter, 2012).

To ensure a meaningful application of digital media it is not enough to gear the development toward the technically feasible, but rather to challenge their pedagogical implementation into formal teaching

and learning processes (Zawacki-Richter, 2015). The knowledge of media usage patterns and perceived usefulness by higher education students is vital, in order to inform the media selection and digital alignment of universities.

Digital media offer more flexible learning opportunities that are independent of time and space, thus expanding access to higher and continuing education (Vollmeyer & Imhof, 2007). With the advent of electronic media and information and communication technologies there was increasing concern about the greater affinity and access of men to technology and the possibility of women being left out of the virtual world (Broos, 2005; Cooper, 2006; Vollmeyer & Imhof, 2007). This trend is also confirmed by a representative study in Germany which concludes that the digital divide between gender and age groups has not been overcome so far and requires great attention (Initiative D21, 2017). Thus, the aim of this paper is to explore the current patterns of student media use and the extent to which gender differences persist and, if they do, what form they take. This can then lead to suggestions for strategic media development to improve the use of digital media at higher education institutions.

GENDER AND DIGITAL MEDIA

Following Bourdieu (1997), gender-specific differences in the media usage of women and men can be explained with a different habitus of women and men. The habitus is determined by social experiences encompassing the socialisation. In the context of media use, social experiences can be influenced by stereotypical gender attributions, for example, that technology and science have traditionally been seen as male domains all but inaccessible to women, especially as developers (Kramarae, 2001). Furthermore, technology is often associated with masculinity and the under-representation or invisibility of women explained within terms of a masculine culture (Wajcman, 1991). Following a traditional gender attribution, men claim technology as their field of knowledge and try to maintain their dominance (Luca, 2010). Complementing the stereotypical gender attribution, students' private lives have to be taken into account. The still existing gendered division of labour, results in women having more domestic and childcare responsibilities than men which means that women, who often also hold a job outside the home, have to meet multiple commitments (von Prummer, 2008). Hence, women have less time for studying in general and getting used to using digital media for studying in particular.

Gender is discussed and shown to be a pivotal principle of order for media usage differences in various contexts for a long period of time, though research into gender issues in e-learning has yielded divergent results concerning the participation of women in e-learning:

On the one hand, gender differences in the use of digital media seem to have all but disappeared, as women and men have equal access to the new media and Internet. In a study of media usage of students at an English distance teaching university, Price (2006) comes to the conclusion that women "may outperform their male counterparts online" and "do not have reduced computer and Internet access compared with men" (p. 357). A survey of business students at four German-speaking (3 German, 1 Swiss) universities by Remmele & Holthaus (2013) finds that e-learning usage patterns of women and men in higher education have become similar. Fallows (2005) states that for the U.S. population women somewhat outnumber men in access to the Internet, but she also points out that access does not equal the amount of time spent and ways in which it is used.

On the other hand, women have been found to have less access and less inclination to utilise digital media, or they use it for different purposes than their more technology-oriented male peers. A survey of the German resident population 14+ years old (Initiative D21, 2017) shows that more men (86 %) than women (77 %) use the Internet. A similar relation applies for the use of the mobile Internet (m 69 %, w 59 %). When it comes to knowledge of digital terminology, men also outperform women by far (Initiative D21, 2017). In a Belgian survey Broos (2005) finds "significant gender differences regarding attitudes toward new communications technology, extent of computer use, and self-perceived computer experience favouring males" (p. 29). Similar to the results of the Initiative D21 survey (2017), men spend more time using a computer, are less anxious about and have a more positive attitude toward digital media than women (Broos, 2005). Moreover, differences in the way of use of social network sites, that are considered to play an active role in peoples' daily lives (Smith & Anderson, 2018; Initiative D21, 2017; Albert et al., 2015), are

observed for male and female students. Park, Kee & Valenzuela (2009) show that “female students [...] are more likely to use the Facebook Groups for obtaining information” (p. 731) than male students. Looking at four different usage purposes Mazman & Usluel (2011) showed that Facebook is more often used for ‘maintaining existing relationships’, ‘academic usage’ and ‘following agenda’ by women, while men use it more often for ‘making new relationships’.

For new students at higher education institutions in Switzerland, Martin (2012) proves a correlation between gender and software skills in the use of digital media. Women evaluate their software skills significantly lower than men and have a more negative attitude toward digital media (Martin, 2012). For German higher education students Kleimann et al. (2005) also find gender specific differences in the evaluation of the students’ skills. Only for emails the same amount of males and females (98 %) consider themselves to possess good skills. In all other dimensions, for example the Internet (m 96 %, w 92 %), word processing (m 88 %, w 81 %) or graphics software (m 29 %, w 16 %), men have a better appreciation of their own skill levels than women (Kleimann et al., 2005). Beyond this, Fallows (2005) finds for the U.S. population that women are less interested in technology, try less hard- and software applications, are less self-confident in their operating skills but care more about the risks of using digital media than men. Furthermore, she states that “men use the web for more kinds of entertainment and recreation than women do” (Fallows, 2005, p. iv). The presented findings are often summed up in the catch-phrase “tools for the girls, toys for the boys” which signals a different attitude with consequences for the equitable design and delivery of e-learning elements (Kirkup, 1992; Cooper, 2006; Kelan, 2007; Wyatt, 2015).

RESEARCH QUESTIONS

Aim of the Study

Considering prior research, it can be assumed that gender differences are not a matter of access but rather a matter of the quality of the use of digital media. This paper presents a secondary analysis of survey data on student media use in German tertiary education in 2015 . The primary focus of this paper is on the persistence of gender differences in access, attitudes and usage of digital media for learning in higher education. A detailed analysis of all possible influence variables is beyond the scope of this article, however given that media usage is a complex and individually structured action influenced by cognitive characteristics, personality and external factors, the variables age and time budget are also considered. Having a limited time budget is an indicator for structural private life differences and follows the assumption that students who have a job and/or childcare responsibilities, which are said to often be women (von Prummer, 2008), are disadvantaged in creating an efficient learning environment.

In this regard, the purpose of this paper is to address the following research questions:

- What kind of digital devices do higher education students own or have access to and how long do they use the Internet?
- What are the differences between female and male higher education students regarding their attitude toward technology usage?
- How does digital media usage behaviour and acceptance of female and male higher education students differ?

METHOD

Instrument and Sample

The online questionnaire used was developed based on the dimensions of Johnsson-Smaragdi (1994) and Bonfadelli’s (1993) model of media usage: (1) environment (media and learning environment), (2) socialisation (education and media relevant sociodemographic dimensions), (3) behaviour (media usage and learning behaviour) and (4) personality (education and media relevant dispositions). The items and scales focus on access to media and mobile devices, study-related media usage, students’ attitudes toward technology, the use of social networks (for learning), the compatibility of studying and working, as well as demographic variables. In total, 51 media, tools and services were classified according to the media typology

of Grosch and Gidion (2011): printed and digital text media (n = 2), general web tools and services (n = 22) and e-learning tools and services (n = 27) (Zawacki-Richter, 2015; Zawacki-Richter et al., 2015). Table 8 provides an overview of the various media, tools and services. For each of those tools the participants are asked how often they use them for studying (Likert-Scale: 5 = almost every day; 4 = a few times a week; 3 = between once a week and once a month; 2 = less than once a month; 1 = never) and how useful they are for academic purposes (Likert-Scale: 5 = very useful - 1 = not useful at all). Furthermore, participants were asked to indicate how often digital teaching and learning approaches are used at their university (Likert-Scale: 5 = very often - 1 = not at all). Cases where “I’m not familiar with that” or “I don’t know” were chosen, are defined as missing values.

Data Collection

To collect the data, a mailing list of the project leaders and coordinators of the BMBF [German Federal Ministry of Education and Research]-program “Offene Hochschulen” [“Open Universities”] was used. Key contact people distributed the online questionnaire via the homepage and university learning management systems (LMS). Participation was voluntary and self-recruited. On this way a considerable amount of German higher education students has been contacted.

Sample

Between April and June 2015 1,327 students enrolled at German higher education institutions completed the online questionnaire concerning their media usage behaviour. 62 % of the participants were female, 39 % were male. The average age was 27 years (n = 1,299; SD = 7.9), the total range was between 17 and 69 years of age. Including the current semester, the students had studied 5.5 semesters (n = 1,303; SD = 3.86) on average. With 31 semesters, a 46-year-old man was enrolled for the longest period of time. 69 % of the students were enrolled in on campus programs, 11 % in blended-learning programs, 5 % in fully online programs and 14 % in integrated vocational programs.

Data Analysis

In addition to descriptive analyses and contingency tables a number of 2 (gender) x 2 (age) x 2 (time budget) ANOVAs were conducted to investigate differences in the media usage behaviour. To take the premises of the ANOVA (Huber et al., 2014) into account, a sample of n = 100 was drawn for the calculations. Partial eta-squared (η^2) (small: $.01 \leq \eta^2 < .059$; medium: $.059 \leq \eta^2 < .138$; large: $\eta^2 \geq .138$) and Cramer’s V (small: $.1 \leq \text{Cramer’s } V < .3$; medium: $.3 \leq \text{Cramer’s } V < .5$; large: $\text{Cramer’s } V \geq .5$) were used to calculate effect size (Cohen, 1969). For each scale in the study, the Cronbach’s Alpha internal consistency coefficients (α) was calculated to assess reliability (Streiner, 2003).

According to the research question(s) the focus of the following data analyses is on gender as an explanatory variable for media usage. Given that (study-related) media usage is a multi-dimensional phenomenon, age and time budget are other variables taken into account. For this purpose, the sample is grouped into younger and older students. Huber et al. (2014) suggest the median as a dividing line between younger and older students. Consequently, the group of younger students is younger than 24 years and the group of older students is 24 years and older. The variable time budget divides the sample into students with a normal and a limited time budget. Having a limited time budget means that the students work more than 19 hours a week or have at least one child. Here it is assumed that students who work more than 19 hours a week or who have an own child or children have a limited time budget for their studies.

Limitations

The presented survey does not claim to obtain a perfectly randomized sample of the German higher education student population. The selection of the participating higher education institutions was based on the members of the BMBF-program “Offene Hochschulen” and with including the FernUniversität in

Hagen, a German single-mode distance teaching university, it might be biased toward distance or online learning students. Furthermore, the sample within the participating higher education institutions might not be randomized, because the reference to the questionnaire was published through the learning management system. Thus, more technophilic students might have participated more frequently. However, the mentioned biases apply equally for all survey participants.

The way in which the frequency of use of media, tools and services for studying was conducted has to be critically examined, too. Using a named five-point Likert scale the data has ordinal scale level. For research pragmatic reasons (using an endpoint named scale allows a large margin of interpretation for the participants and also a named scale with equal intervals (hours, days, weeks etc.) is not meaningful enough) the variable frequency of use is considered as metric in the presented study as it is believed that the intervals between the scale values are interpreted homogeneous.

Lastly, it has to be mentioned that the mostly small effect sizes (η^2 and Cramer V) of the statistically significant results indicate that the practical relevance has to be interpreted with caution and critically examined.

FINDINGS

Table 1 shows that the proportion of female and male students differs concerning the type of study program ($\chi^2(3, n = 1,283) = 17.38, p = .001$). Women tend to study more often in online programs than men and men tend to study more often in integrated vocational study programs.

Table 1. Type of study program by gender

	on campus programs	blended learning programs	fully online programs	integrated vocational study programs
female students	69.2 %	11.9 %	6.7 %	12.3 %
male students	69.5 %	10.0 %	2.6 %	17.9 %

On average the students were employed for 12 hours per week ($n = 1,286$; $SD = 13.94$). There is no significant difference for the amount of hours for female and male students work per week ($t(946.05) = .823, p = .411$).

14 % of the respondents had children ($n = 1,302$). Table 2 shows, that separated by gender the proportion of female students with children is almost twice than that of male students ($\chi^2(1, n = 1,280) = 14.46, p = .00$).

Table 2. “Do you have children?” by gender

	yes	no
female students	16.4 %	83.6 %
male students	8.9 %	91.1 %

34 % ($n = 1,280$) of the students can be considered as having a limited time budget for their studies. Table 3 shows, that the proportion of students having a limited time budget differs significantly regarding gender ($\chi^2(1, n = 1,259) = 7.62, p = .006$), with more female students having a limited time budget for their studies than male students.

Table 3. Time budget by gender

	limited time budget	normal time budget
female students	37.0 %	63.0 %
male students	29.4 %	70.6 %

Access to Electronic Devices and Digital Media

There is no significant difference between the number of devices female and male students own ($t(945.95) = -1.823, p = .069$). On average students own five ($SD = 1.56$) different electronic devices. One-third of each group owns six or more digital devices (see table 4).

Table 4. Number of devices owned by female and male students

female students			male students			
cum. %	%	n	number	n	%	cum. %
0	0	0	0	1	0,2	0.2
0	0	0	1	2	0.4	0.6
4.4	4.4	35	2	24	4.8	5.4
16.5	12.1	97	3	59	11.8	17.3
37.3	20.8	167	4	85	17.1	34.3
61.5	24.2	194	5	116	23.3	57.6
85.3	23.7	190	6	106	21.3	78.9
95.1	9.9	79	7	66	13.3	92.2
99.6	4.5	36	8	23	4.6	96.8
100	0.4	3	9	14	2.8	99.6
	0	0	10	2	0.4	100
	100	801	total	498	100	

Table 5 shows that there is a significant correlation with small effect sizes between gender and ownership of desktop PCs, smartphones and MP3 players. 57 % of male students own a desktop PC, whilst only 32 % of the female students do. The percentage of men owning a smartphone (95 %) is also higher than the percentage of women (88 %). MP3 players are more often owned by female (67 %) than by male (57 %) students. Because of the small effect sizes, the findings shall not be over-interpreted.

Table 5. Device owned by female and male students

ownership	female	male	total	n	χ^2	Cramer's V
desktop PC	31.7 %	57.2 %	41.6 %	1239	87.61, $p = .00$.25
printer	76.9 %	74.1 %	75.9 %	1289	1.31, $p = .25$	
scanner	66.0 %	62.3 %	64.6 %	1268	1.78, $p = .18$	
notebook / laptop	93.1 %	89.6 %	91.8 %	1288	4.89, $p = .03$.06
netbook	15.4 %	17.8 %	16.4 %	1113	1.12, $p = .29$	
tablet PC	36.1 %	44.2 %	39.2 %	1208	7.85, $p = .01$.08
e-book reader	20.4 %	16.4 %	18.8 %	1152	2.90, $p = .09$	
smartphone with Internet access	88.1 %	94.6 %	90.6 %	1275	15.06, $p = .00$.11
self-phone without Internet access	24.8 %	25.9 %	25.2 %	1138	0.18, $p = .67$	
MP3 player	67.0 %	56.8 %	63.1 %	1225	12.97, $p = .00$.10

Overall, 99 % of the surveyed students have Internet access at home, meaning there is full coverage of Internet access for German HE students. Furthermore, there is no correlation between the access of female and male students ($X^2(1, n = 1,268) = .58, p = .45$). However, there is a significant difference between the number of hours females and males are using the Internet actively per day. Male students reported being online for 4.84 hours a day, whilst female students are online for 3.78 hours ($t(840.1) = -7.1, p = .00$).

Uses of Mobile Devices for Learning

Students were also asked how they use their mobile devices (e.g. mobile phone, tablet PC) for learning (see figure 1). On a list of 20 items with yes or no answers, students report the highest degree of usage for doing Internet searches outside the classroom (80 %) and accessing the learning management system (74 %). Only rarely were mobile phones and tablets used for location-based services (6 %), for writing papers and assignments (10 %) and for sending text messages to teachers (13 %).

The differences between female and male respondents range from +8.3 % to -13.9 %. Significantly more female students use their mobile digital device to post texts and pictures (+8.3 %; $X^2(1, n = 1,156) = 7.92, p = .005$), to buy books (+7.6 %; $X^2(1, n = 1,156) = 7.7, p = .006$), to access social networks (+7.1 %; $X^2(1, n = 1,156) = 6.24, p = .012$), to use library services (+7.0 %; $X^2(1, n = 1,156) = 5.43, p = .02$), and to take pictures (+6.8 %; $X^2(1, n = 1,156) = 6.01, p = .014$). Only listening to music whilst learning (-13.9 %; $X^2(1, n = 1,156) = 25.69, p = .000$) and sending text messages to teachers (-3.9; $X^2(1, n = 1,156) = 3.88, p = .049$) is used significantly more by male students.

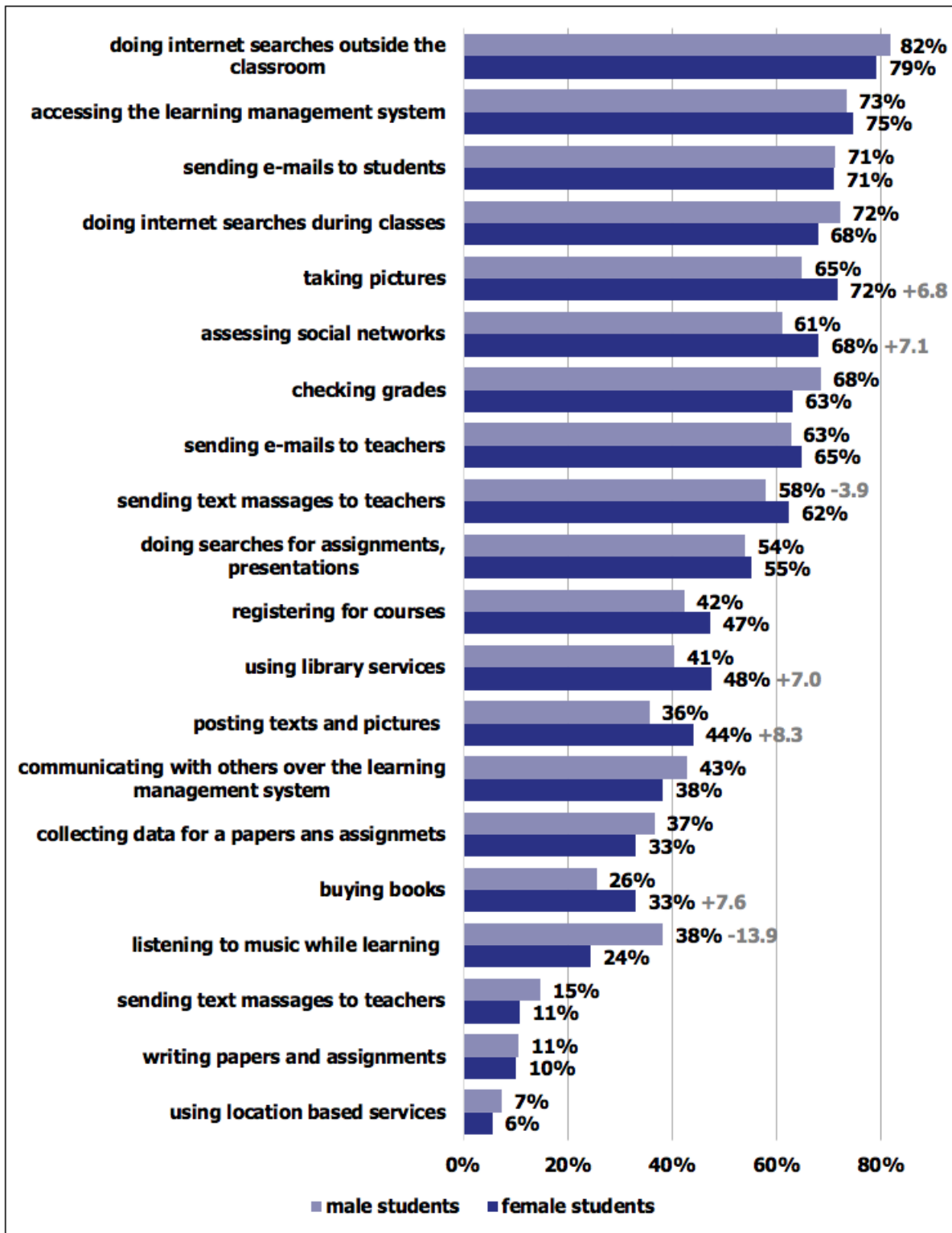


Figure 1. Use of mobile devices for learning by female and male students

Students' Attitudes Toward Technology and Acceptance of Media, Tools and Services

To measure the students' general acceptance of technology, the Technology Usage Inventory (TUI) developed by Kothgassner et al. (2013) was used. "Here user acceptance is defined as the demonstrable willingness within a user group to employ IT [information technology] for the task it is designed to support" (Dillon & Morris, 1996, p. 4). The TUI intends to measure technology-specific and psychological factors that

contribute to the actual use of technology. It consists of the following seven scales: “curiosity”, “anxiety”, “interest”, “usability”, “usefulness”, “scepticism” and “accessibility”. The scale “immersion” was excluded a priori because it only can be conducted for technologies that are designed to cause immersion (e.g. TV, virtual simulations) (Kothgassner et al., 2013). According to Kothgassner et al. (2013) the validity of the scales is also given for other technologies, thus the items were adapted to the research subject “digital media for learning” for the present study. Other than expected, a principal component analysis (with varimax rotation) of all items of the TUI does not suggest to retain seven but five factors (explained variance 63.5 %; KMO = .908; scale reliability between $\alpha = .88$ and $\alpha = .71$).

The scale “usefulness” represents whether students consider the use of digital media as useful for learning and whether it supports their daily lives. The scale “interest and curiosity” represents the general interest in (new) technology as well as their curiosity about study-related digital media in particular. The scale “anxiety” represents whether students feel overburdened and anxious to make mistakes while using a variety of technical devices. The scale “scepticism” represents whether students think that digital media are risky, dangerous or disadvantageous for their studies. The scale “accessibility” represents how students perceive the accessibility of media for studying regarding financial aspects and the ease of accessibility. High values always mean a high correspondence with the statement of the scale.

Table 6. Students’ general acceptance of technology (TUI) by gender

	gender	<i>n</i>	<i>MV</i>	<i>SD</i>	<i>T</i>	<i>df</i>	sig.
usefulness	female	790	5.39	1.52	-0.62	1276	.54
	male	488	5.44	1.52			
interest and curiosity	female	797	3.22	1.46	-9.84	1290	.00*
	male	495	4.03	1.39			
anxiety	female	791	2.81	1.67	6.07	1147.1	.00*
	male	495	2.27	1.47			
scepticism	female	792	4.07	1.53	0.02	1280	.98
	male	490	4.06	1.57			
accessibility	female	792	3.77	1.39	-5.97	1282	.00*
	male	492	4.25	1.43			

* $p < .01$ (2-tailed)

Table 6 shows the differences of female and male students on the described scales. Males have a significantly higher interest and curiosity in (new) technology in general and study-related digital media. They are also more likely to think that digital media for studying is accessible to anyone. In contrast, female students are significantly more anxious to make mistakes while using technology than men.

In addition to the definition of acceptance already introduced, media acceptance can also be understood as a two-dimensional indicator for the quality of media use (Grosch, 2014). According to this understanding, the acceptance values ((Value usage frequency + Value perceived usefulness) / 2) for the 51 media, tools and services, result from the averaged ratings of the frequency of media use at university and the perceived usefulness of (= satisfaction with the) media for academic purposes. The differences regarding the acceptance of media tools and services among female compared to male students are depicted in table 7.

Table 7. Acceptance of media tools and services in comparison

Type of medium	Significantly higher acceptance among female students	Significantly higher acceptance among male students
text media	printed texts**	electronic texts (e.g. e-books, PDFs)**
general web tools and services	social networks**	Skype (conference call)* Skype (1:1 call)* search engines** micro blogging (e.g. Twitter)* cloud computing** wikis** etherpads* videos (e.g. on YouTube)** music (e.g. iTunes)** chat / instant messaging**
e-learning tools and services	online library services** file storage / file sharing (internal)* e-portfolios** multimedia software of the university** internal university forums / newsgroups** mailing lists for courses** virtual seminars / webinars (synchronous)** bibliographic software (e.g. Zotero)** MOOCs** computer terminals on campus** computer terminals outside of the university (e.g. at home, at work)** word processing software (e.g. Word, Pages)* statistical software (e.g. SPSS)** software for qualitative text analysis (e.g. MaxODA)**	file storage / file sharing (external, e.g. Dropbox)** spreadsheet software (e.g. Excel, Numbers)**

* $p < .05$ (2-tailed); ** $p < .01$ (2-tailed)

Table 8 lists the acceptance values of media, tools and services according to their ranking. It also shows the mean values separated for female and male students. Female as well as male students accept search engines (MV = 4.66), computers outside of the university (MV = 4.48) and external email accounts (MV = 4.35) the most. Geo tagging (MV = 1.21) and virtual worlds (MV = 1.19) are at the bottom of the list.

Table 8. Ranking according to acceptance of media, tools and services for learning in higher education

Rank		n	MV total	MV females	MV males
1	search engines (W)	1312	4.66	4.63	4.72
2	computer terminals outside of the university (E)	1245	4.48	4.57	4.36
3	email account (external) (W)	1312	4.35	4.36	4.33
4	Internet based learning platform (E)	1271	4.35	4.36	4.33
5	word processing software (E)	1281	4.29	4.32	4.24
6	printed texts (T)	1315	4.12	4.24	3.94
7	university email account (W)	1230	3.83	3.83	3.84
8	electronic texts (T)	1303	3.81	3.73	3.95
9	presentation software (E)	1264	3.79	3.78	3.80
10	spreadsheet software (E)	1225	3.64	3.56	3.79
11	online library services (E)	1242	3.62	3.74	3.42
12	emailing lists for courses (E)	1179	3.49	3.60	3.30
13	chat / instant messaging (W)	1108	3.40	3.28	3.58
14	wikis (W)	1121	3.36	3.12	3.69
15	file storage / file sharing (external) (E)	1143	3.36	3.22	3.57
16	computer terminals on campus (E)	1168	3.27	3.36	3.15
17	social networks (W)	1221	3.21	3.30	3.07
18	file storage / file sharing (internal) (E)	1026	3.17	3.23	3.09
19	videos (W)	1249	3.15	3.01	3.38
20	internal university forums / newsgroups (E)	1020	2.90	2.99	2.74
21	cloud computing (W)	776	2.82	2.55	3.10
22	statistical software (E)	752	2.68	2.79	2.50
23	bibliographic software (E)	578	2.64	2.74	2.47
24	online exams / tests (E)	854	2.62	2.65	2.57
25	forums / newsgroups (W)	1020	2.61	2.58	2.65
26	multimedia software of the university (E)	590	2.61	2.69	2.49
27	graphics software (E)	910	2.50	2.48	2.55
28	music (W)	1110	2.49	2.34	2.69
29	virtual seminars / webinars (synchronous) (E)	574	2.45	2.56	2.28
30	Skype (1:1 call) (W)	1058	2.33	2.28	2.41
31	multimedia learning software online (E)	553	2.33	2.40	2.26
32	e-portfolios (E)	452	2.32	2.43	2.13
33	software for qualitative text analysis (E)	494	2.30	2.44	2.11
34	lecture recordings (E)	715	2.16	2.18	2.13
35	podcasts / vodcasts (E)	715	2.16	2.18	2.13
36	Skype (conference call)	997	2.14	2.09	2.22
37	MOOCs (E)	247	2.12	2.36	1.84
38	presentation sharing (W)	587	2.05	2.08	2.03
39	audio software (E)	720	2.03	2.00	2.05
40	video software (E)	775	2.02	2.04	1.98
41	virtual labs (E)	385	2.00	1.99	1.98
42	business networks (W)	726	1.97	1.94	2.01
43	etherpads (W)	260	1.93	1.77	2.06
44	blogs (W)	902	1.90	1.89	1.89
45	simulations or learning games (E)	523	1.88	1.91	1.85
46	RSS feeds (W)	472	1.75	1.71	1.79
47	micro blogging (W)	950	1.45	1.40	1.51
48	photo communities (W)	738	1.41	1.43	1.39
49	social bookmarking (W)	360	1.40	1.44	1.35
50	geo tagging (W)	399	1.21	1.20	1.22
51	virtual worlds (W)	731	1.19	1.15	1.23

types of media (Grosch & Gidion, 2011): T = text media; W = general web tools and services; E = e-learning tools and services

To broaden this quite detailed examination of each media, tool or service, five sum scales were formed on the basis of principal component analysis of all items of the survey regarding the frequencies, digital teaching and learning approaches and benefits of the use of these multiple tools and services.

The scale “application of e-learning tools” ($\alpha = .90$) was established with 16 items regarding the frequency of use of multiple e-learning tools and services (e.g. virtual seminars, web-based training, multimedia learning software, e-portfolios, podcasts). A 2 (gender) x 2 (age) x 2 (time budget) ANOVA with this scale indicates a significant main effect of the time budget ($F(1, 521) = 7.36, p = .007, \eta^2 = .014$) and significant interactions of age and gender ($F(1, 521) = 5.13, p = .024, \eta^2 = .010$) (see figure 2) and age and time budget ($F(1, 521) = 4.29, p = .039, \eta^2 = .008$). But, with an effect size of $\eta^2 = .008$ the interaction of age and time budget is practically irrelevant. Students with a limited time budget use e-learning tools more often than students who have no limitations regarding their time for studying. Male students who are younger than 24 years use e-learning tools more often than females, however in contrast to females, their frequency of use slightly decreases with the group of older students. Females who are 24 years and older use e-learning tools more often than when they are younger than 24 years.

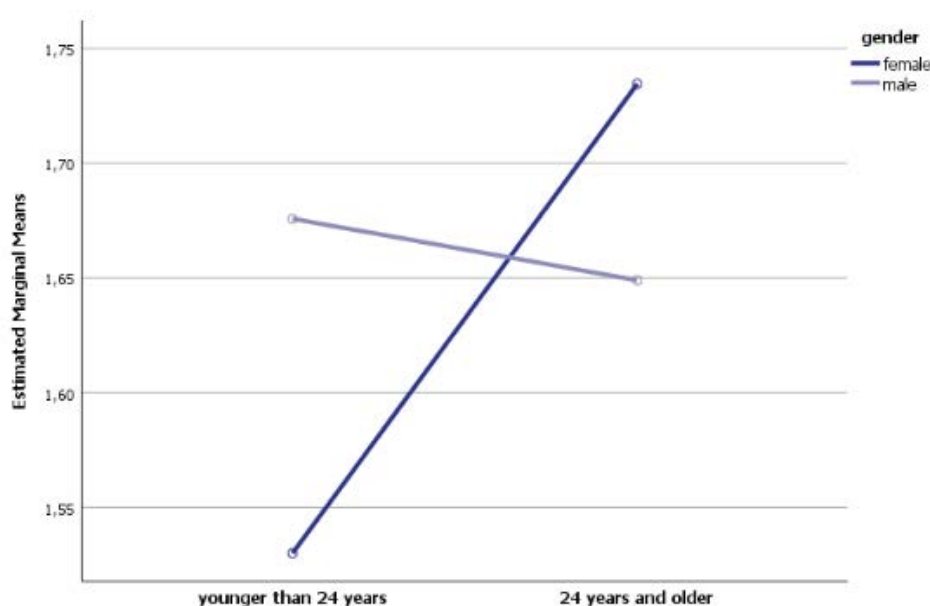


Figure 2. Interaction between age and gender

The scale “value of e-learning tools” ($\alpha = .93$) consists of 7 items regarding the perceived usefulness of e-learning tools and services (e.g. lecture recordings, virtual seminars) and 7 items regarding the importance of digital teaching and learning approaches (e.g. online exams and exercise, virtual internships and labs). A 2 x 2 x 2 ANOVA indicates significant differences for the all three main effects. Women ($F(1, 497) = 5.96, p = .015, \eta^2 = .012$) and students who are 24 years and older ($F(1, 497) = 5.99, p = .015, \eta^2 = .012$) value e-learning tools more than men and younger students. Moreover, students with a limited time budget attribute more importance to e-learning tools ($F(1, 497) = 4.10, p = .043, \eta^2 = .008$). However, the minimal effect size shows that this difference is not relevant.

The scale “usefulness of learning management systems” consists of seven items. Four of these items assess the perceived usefulness of e-learning tools and services. The other three items are related to the frequency of use. The conducted 2 x 2 x 2 ANOVA indicates significant differences for all three main effects and the interaction of age and time budget ($F(1, 497) = 12.76, p = .000, \eta^2 = .019$). In the group of older students the estimated means for “usefulness of learning management systems” are almost the same for students with a limited or normal time budget, whereas in the group of younger students those with a limited time budget show much lower values. Furthermore, learning management systems are more accepted by female students ($F(1, 647) = 15.13, p = .000, \eta^2 = .023$), by students who are 24 years and older ($F(1, 497) =$

8.57, $p = .004$, $\eta^2 = .013$) and by students who have no limitations regarding their time for studying ($F(1, 497) = 15.04$, $p = .000$, $\eta^2 = .023$).

The scale “usefulness of office software” ($\alpha = .77$) consists of five items regarding the frequency of use, as well as the perceived usefulness of office software such as word processing, presentation and spreadsheet software. A 2 x 2 x 2 ANOVA shows a significant main effect of the time budget and a significant interaction of gender and time budget (see figure 3). Students with a limited time budget indicate a higher usefulness of office software ($F(1, 658) = 18.87$, $p = .000$, $\eta^2 = .028$). The interaction of gender and time budget shows that students with a limited time budget value office software more than students with a normal time budget and this trend is more pronounced for male than female students.

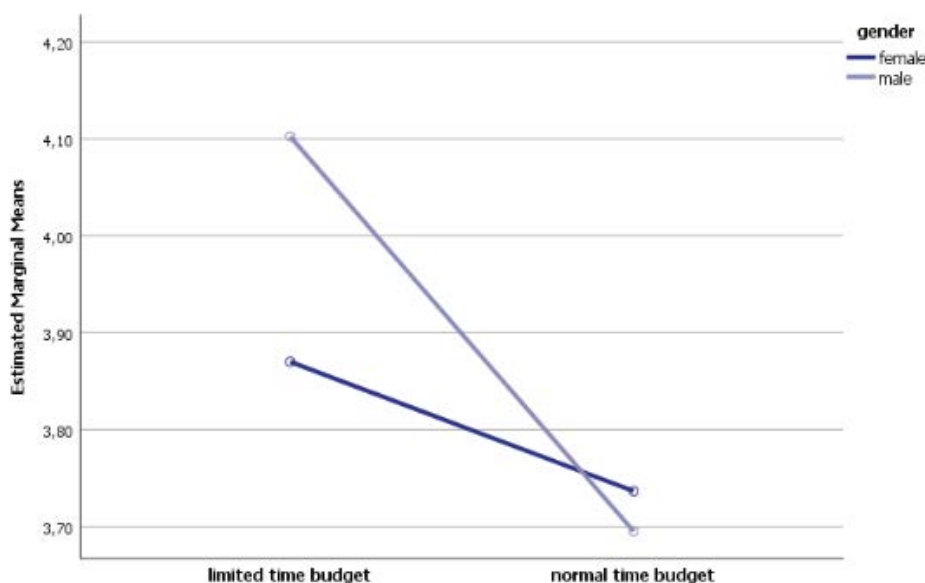


Figure 3. Interaction between time budget and gender

The scale “usefulness of computer applications of the university” ($\alpha = .69$) consisted of four items regarding the frequency of use as well as the perceived usefulness of computers on campus and the university email account. A 2 x 2 x 2 ANOVA with this scale indicated a significant main effect of gender ($F(1, 626) = 6.91$, $p = .009$, $\eta^2 = .011$) and time budget ($F(1, 626) = 36.14$, $p = .000$, $\eta^2 = .055$). Female students and students with a normal time budget indicated that computer applications of the university are more advantageous.

DISCUSSION

To begin with, it can be ascertained that female and male higher education students differ neither in the number of devices owned nor in having Internet access at home. In addition, full coverage of Internet access at home can be assumed for German higher education students. Thus, media usage patterns of men and women cannot be distinguished by access but there is a significant difference in the amount of time they spend on the Internet with men being online about one hour longer each day. In other words, it can be said that differences in media usage patterns between male and female students are not a question of having access, but of the attitude toward and the reasons for using digital media.

Despite the finding that more than 99 % of higher education students in the sample have Internet access at home, more male than female students agree that study-related media are accessible to anyone and male students are more interested and curious about (new) technology. Reversely female students are shown to be more anxious when it comes to using digital media. These findings correspond to the results of a current German Digitalisation Index (Initiative D21, 2017). In this study competence comprises the knowledge and understanding of technology related terms (e.g. cloud computing, Internet of things, e-health), the

handling of computer and Internet applications (e.g. doing web searches, posting in social networks), and the handling of the Internet in general (e.g. knowing if a search engine result is an advertisement). Even if the digital literacy is increasing in the overall population, women tend to perceive their digital expertise much smaller than men (Initiative D21, 2017). Having a first look at the acceptance of the used media tools and services as an indicator for the experienced quality of media points in the same direction (see table 7): Male students show higher acceptance values for electronic texts than female students, for printed texts it is exactly the opposite. Assuming that reading electronic texts requires using the Internet this finding corresponds to the finding that male students use the Internet longer than female students. Likewise, male students show higher acceptance values for more general web tools than female students, but when it comes to e-learning related tools women show higher acceptance values for a lot more different tools and services than men. E-learning tools and services are seen to be more useful and used more often by female students. It, therefore, can be concluded that male and female students have different attitudes toward learning with digital media which also could have consequences for the further development of digital teaching and learning formats.

At this point special attention should be paid to social networks being the only general web tool that is accepted significantly higher among female students. This indicates an activity in as well as a high perceived usefulness of social networks for female students and corresponds to the finding that Facebook is used for more different purposes more often by women (Mazman & Usluel, 2011).

The results indicate that the value that is attributed to e-learning tools and services by female students is related to circumstances in their private lives, for example the amount of time they are free to use for studying (von Prummer, 2008). Beyond, an overall examination of the conducted variance analyses shows that female students, students with a limited time budget as well as older students apply e-learning tools more often and also attribute more importance to e-learning tools. Also noteworthy is the finding that students with a limited time budget and especially women indicate a higher usefulness of office software like word processing and presentation software and that female students indicate a higher usefulness of computer applications of the university as well as of learning management systems.

Overall it seems that female students, who more often have a limited time budget for studying (see table 3), tend to use digital media as a tool for (e-)learning, as they provide more flexible learning opportunities. On the opposite male students focus on using more general web tool and services and value e-learning tools less than their female peers. This corresponds with the concept of habitual differences in the media usage of women and men (Bourdieu, 1997).

CONCLUSION AND FURTHER RESEARCH PERSPECTIVES

The aim of the present study was to explore the use of digital media by male and female higher education students. Furthermore, it was investigated if gender differences persist and, if they do, what form they take. The presented results indicate that since the advent of electronic media and information and communication technologies mentioned concerns about men being more technology savvy and women being left out of the virtual world did not come true. But women and men have a different attitude toward using digital media for studying as well as they have a different usage behaviour of digital tools. Accordingly, gender is still an important topic and has to be taken into account for designing digital learning environments in the context of higher education. In terms of suggestions for strategic media development and practical implication for improving the use of digital media at higher education institutions, the results can be summarized as follows.

More female than male students have a limited time budget for their studies (see table 3). Compared to male students, female students accept significantly and considerably more different e-learning tools and services (see table 7). Also, women value e-learning tools more than men. This target group in particular would benefit from the development of blended learning courses. In this way, a self-determined, locally and temporally flexible learning and the possibility of social interaction during presence phases can be didactically combined in a meaningful way. In the implementation of this concept it should be taken into account that women are more anxious to make mistakes while using technology (see table 6) and accept printed texts higher (see table 7) than men. Thus, it is critical to ensure a good mentoring as well as technical support for participants. Likewise, printed study materials should not be entirely abandoned.

Furthermore, mobile devices are increasingly popular and used by female and male students for learning in various ways (see figure 1). This leads to an increasing demand for a responsive design of learning environments, especially for those tools and services that are ranked high (see table 8).

Beyond gender-specific differences, age and the amount of time that students are free to spend for studying were considered. It has been shown that students' media use is affected by complex and numerous reasons. The present study is concerned solely with students' use of digital media and services and the added value to digital tools, but it is not possible to make an assertion about the effectiveness of students' media usage. In order to discover if higher education institutions should support male students to use e-learning tools or female students to use general web tools or if both sexes learn best the way they do, further research has to be done.

To build upon the presented results further quantitative research on the one hand and qualitative research on the other hand is recommended in order to deepen and broaden the understanding of students' media usage behaviour. Concerning further quantitative research apart from self-reported frequency of use and experienced usefulness the actual efficiency of using digital media as well as the performance of students should be examined. For this purpose, a pretest-posttest-design is recommended. Subsequent qualitative research can either deepen and illustrate the quantitative results and uncover explanation patterns that are not taken into account yet. Both approaches are aiming to broaden the possibilities of implementing digital media in formal teaching and learning processes, to explain contexts of justification and to provide new thought-provoking impulses.

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