DIGITALEDUCATIONREVIEW

Assessing the Second-Level Digital Divide in Austria: A Representative Study on Demographic Differences in Digital Competences

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ABSTRACT

The second-level digital divide concerns individual levels of digital competences and demographic indicators of digital gaps. In this paper, we have analysed empirical data that allow a thorough and differentiated look into the second-level digital divide with a rigorous methodological quantitative approach. We investigated the relationship between results from a self-assessment of one's own digital competences, and a knowledge test about digital tools among Austrian citizens (N=1109). The study explores second-level digital divides in gender, education level, age, first language, and length of time living in the country regarding respective competence levels and areas, referring to the Digital Competence Model for Austria - DigComp 2.2 AT. Results show that the digital gender divide is paramount across all competence areas, while the age divide remains strong when comparing under 18-year-olds with over 60-year-olds. Moreover, positive effects are related to education level and first language.

.KEYWORDS: Digital competences areas; digital divide; Austria; knowledge test; self-assessment; second-level divide

1 INTRODUCTION

Studies have indicated the presence of a digital divide ever since the World Wide Web was introduced to the public and gained momentum with further developments in digital technologies. The digital divide was initially associated with unequal access to technology, and pointed broadly to the dichotomous distinction and inequality between persons who did and persons who did not have access to the internet or digital devices. Dewan and Riggins (2005) noted that much of the research on this early digital divide focuses on first-level inequality effects, that is, on who has direct access to information and communication technologies (ICTs). Core studies (Büchi et al., 2016; Chakraborty and Bosman, 2005; Deursen and Dijk, 2013; Dewan and Riggins, 2005; Harden, 2020; OECD, 2021) point to the fact that some demographics are predominantly excluded from having access to digital technologies and can therefore not benefit from further ICT innovations. Those who are technologically, sociologically, and/or economically disadvantaged also often do not have access to digital media, creating a divide between them and those with access, and those for whom digital media is an integral part of their daily life.

In further development of the distinction between persons with access and persons without (permanent) access to the internet or digital devices, studies have shown a digital divide on another level. Deursen & van Dijk (2013) point to the fact that being in possession of a digital device does not necessarily mean that it is (continuously) used. Another aspect is addressed here, namely the use of and the mode of using these technologies. They therefore argue for an extension of the concept and establish empirical findings regarding a second-level digital divide, which appears as different modes of use within the group of users of digital devices. These different modes can be attributed to different levels of digital competence. The digital divide has thus shifted from inequalities relating to physical and material access to inequalities in digital competences and use of computer technology. The diversity of uses hence results in new and more complex issues beyond the question of access. The position within the second-level digital divide is strongly dependent on sociodemographic background. Results show that sociodemographic factors alone account for up to half of the variance in usage of computer technologies in countries with high digital penetration, with age being the strongest predictor (Büchi et al., 2016), and barriers to use are even higher among older and less privileged individuals.

Furthermore, research on the digital divide has evolved from examining access (first level), competences and use (second level), into examining tangible beneficial outcomes (third level) of competent use. Initial findings by Deursen and Helsper (2015) show that people with higher social status derive a greater advantage from digital engagement than people with lower status. Thus, existing inequalities are exacerbated as a third-level digital divide within the group with access to the internet and who use technology competently.

A mixed-method study (Schmölz et al., 2020) with a focus on crucial barriers that lead to digital divides revealed a fourth-level digital divide, which pertains to organisational requirements and support for the access to and competent use of digital technologies. Quantitative data analysis showed that organisations are lacking in their support and help regarding daily and weekly working routines of individual access to and use of digital technologies. Indeed, some organisations have increased their demands on individual workers. Advances in digital technologies, combined with this lack of support can thus lead to people facing heavier workloads and more work requirements on an everyday scale. Individuals felt these aspects are those that cause the most severe barriers. Support for access and use of digital technologies and for adequate handling of organizational requirements were largely lacking. This was also underlined in qualitative statements. Individuals reported increased time requirements and tedious online group work.

Levels of the Digital Divide	
First Level	Access to technologies
Second Level	Mode of use and competences
Third Level	Benefices of competent use
Fourth Level	Organisational requirement and support

Table 1 Different Levels of the Digital Divide (Schmoelz, Geppert & Barberi, 2020)

Due to the COVID-19 pandemic and its concomitant restrictions that shifted many activities from the analogue to the digital sphere, several aspects and negative consequences of the digital divide as well as the need to reduce it became even more obvious (Borda, Grishchenko & Kowalczyk-Rolczynska, 2022; Early & Hernandez, 2021; Lai & Widmar, 2020; Li, 2022; Liu & Fan, 2022; Nguyen et al. 2020; Nguyen, Hargittai & Marler, 2021; Deursen, 2020). In general, there is quite some research on the empirical differentiation between different levels of the digital divide regarding access, competent use, benefits as well as organizational requirements and support for individuals.

Regarding gender aspects, for instance, previous findings suggest that men show more favourable attitudes towards technology use than women, especially regarding their self-confidence concerning the ability to learn and use technology effectively (self-efficacy) (Cai et al., 2017). In contrasts to this stand the results of ICILS 2018 (Fraillon et al., 2020): in 10 of 13 countries, female participants achieved significantly higher results than their male counterparts when it came to Computer and Information Literacy, whereas males tended to perform better in Computational Thinking. The latter difference, however, was only significant in two countries. Since ICILS merely considers pupils in secondary schools (8th grade), these differing results might be related to the distinct groups of participants. This supports an overall finding regarding the digital gender divide, which became evident in numerous studies around the world (Alozie and Akpan-Obong, 2017; Kuroda, 2019; Larsson and Viitaoja, 2019; Marzano and Lubkina, 2019; Mathrani et al., 2020; Suresh, 2016). Hilbert (2011) describes in his literature review that researchers, especially in the 1990s, had the explanatory model that women were “latecomers” in the media world, whereby technology was connoted as male-dominated. This ultimately led to the opinion that men are more interested in technology, while women are described as technophobic. While media use has increased since the beginning of the new millennium, women seem to use the new media less frequently and less intensively, indicating that there is a persistent gender divide that is not only related to technological, but also non-technological barriers, such as “inadequate economic resources, lack of education and training and sociocultural assumptions about women’s roles and place in society and the labour market” (Davaki, 2018: 10). Based on a meta-study with data sets from twelve Latin American and 13 African countries, Hilbert (2011) concluded that

the reasons why women have less access to ICT and use it less depend on their circumstances regarding employment, education, and income. Mitigating these variables shows that women are even more active users than men.

Furthermore, the digital age divide is investigated in various studies. On the basis of two empirical studies, Rainer, Cloots & Misoch (2020) point out that older employees are often seen as more reserved towards the acquisition of digital competences and thus the digital age divide could also be viewed as a socially-constructed phenomenon. If one considers the effect of self-fulfilling prophecies, which ultimately also go hand in hand with a lack of support for the group that is considered to be less gifted, this approach seems understandable (Rosenthal and Jacobs, 1968). Going into a different direction, Porat et al. (2018) provide evidence that high-school students overestimate their digital competences as compared to their actual performance. Calvani, Fini, Ranieri & Picci (2012) were also able to show the result that younger people rate themselves well in terms of their media skills. They found that 14 to 16-year-olds were very good when it came to technical know-how, but they lagged behind expectations when it came to critical reflection and socio-ethical dimensions. Young persons who grew up with digital media are therefore only superior in some areas as compared with those who experienced the growth of digital and social media throughout their lifespan. Ikrath & Speckmayr (2016) come to a similar conclusion based on a study of 500 Viennese teenagers aged 15-19 years. They suggest that the digital divide does not run between groups of different ages, genders or immigrational backgrounds, but that it is rather connected to economic and educational inequalities. Friemel (2016) describes that this grey divide will change over the years, as those who are currently working and (have to) use media technologies there will then grow into this age group.

However, there is an overall research gap regarding further differentiation of the second-level-divide towards the analysis of different competence areas as well as the difference between self-assessment and knowledge. In Austria, only one study has been conducted, which uses analysis of secondary data and highlights that higher socio-economic background is positively related to digital problem solving, and being female is negatively correlated (Zilian and Zilian, 2020). In this study, however, we have analysed primary empirical data with a rigorous methodological quantitative approach that allows for a thorough and differentiated view of the second-level digital divide. We show

- how self-assessment of one's own digital competences relates to knowledge about digital tools and
- whether there are second-level digital divides according to gender, education level, age, first language, and duration of living in a country
- on different competence levels as well as in different competence areas.

Regarding different competence areas, we have utilized the "Digital Competence Model for Austria - DigComp 2.2 AT" (BMDW, 2018; Swertz, 2019), which was derived from the European Reference Framework for Digital Competencies (Carretero et al., 2017; European Commission and Directorate-General for Employment, 2018). The Digital Competence Model is used to classify and compare digital competencies. It has been the basis for research on digital literacy needs (Evangelinos & Holley, 2016) and attitudes (Evangelinos and Holley, 2015), on social work practise (Zhu and Andersen, 2021), as well as practices and policies in different educational areas, such as primary and secondary education (Guitert et al., 2021; Hatlevik et al., 2015), vocational education and training (Burns et al., 2020), adult education (Fröhlich et al., 2019) and higher education (Zhao et al., 2021). Moreover, the European Reference Framework for Digital Competencies is used in labour markets studies (Kluzer et al., 2020) and to some the model even constitutes a foundational digital literacy for all (Murphy, 2018).

As for the DigComp 2.2 AT model, stakeholder interviews and qualitative content analysis (Svecnik et al., 2018) revealed the need for an additional dimension covering basics and access to digital media as well as for complementing the European Framework with mentions of critical thinking and the ability, motivation, and volition for continuing learning in the IT/digital media field. The digital competence model for Austria adds the competence area 0 to the European Reference Framework for Digital Competencies, which thereby defines digital competencies in six areas and eight competence levels according to the European Qualification Framework (EQF). There are 5 competence areas:

- Competence area 0: Subject area "Basics and Access" contains statements on the basic use of digital technologies, such as the operation of devices or information search.
- Competence area 1: Subject area "Handling Information and Data" includes statements on the ability to assess the value of certain information and how it can be linked.
- Competence area 2: Statements relating to the media-supported interaction with individuals or a group of people fall into the subject area "Communication and Collaboration". The statements particularly relate to skills in collaborations via digital media.
- Competence area 3: Statements in the subject area "Digital Content Creation" relate to the competence to create digital texts and images, the combination of several digital contents, and the ability to programme.
- Competence area 4: Statements in this subject area cover "Safety". Creating secure passwords, securing files, observing copyrights, or recognizing phishing emails are competencies that should be recorded in it.
- Competence area 5: The area "Problem Solving and Continuing Learning" deals with the question of whether people can find and implement solutions to technical problems and actively develop new skills for dealing with digital applications.

Adding to research on the European Reference Framework for Digital Competences, this representative study furthers research on the second-level divide with special regard to the grey divide and the digital gender divide as well as to education level, age, first language and duration of living in a country.

2 RESEARCH METHODS & INSTRUMENTS

2.1 Measurements

Over the course of 1 ½ years, an assessment instrument was developed consisting of self-assessment and knowledge-based questions along a multimethod empirical procedure, in order to investigate digital competences in the context of the digital divide discourse. The development, although starting with recourse to partially older items, coincided with the Covid crisis in Austria. In concrete terms, some field tests of the items took place already

during the first lockdown in spring 2020, the review of the items by expert panels followed in early 2021 with some Covid-related restrictions still in force. The main data collection took place in April 2021 under renewed lockdowns in some regions.

For the identification of operational definitions, the DigComp 2.2 AT with its six competence areas served as a theoretical basis. The instruments were developed in an iterative process of expert-based item creation and evaluation activities as well as repetitive statistical analyses involving various social groups at a larger scale, towards the improvement of its psychometric properties (Schwarz and et al., 2023). Referring to psychometric practice, the increase of the content quality of the instruments was realized through alternating sequences between item analyses and item iterations. Item analyses were used to identify unproductive or weak items in order to revise or discard them. Over the course of this process, some items were discarded, others revised, and new ones were generated.

Extensive psychometric analysis of the final instruments (self-assessment, knowledge test) revealed satisfactorily discriminating items with sufficient reliability. Moreover, consistent correlations with related constructs indicates validity of the instruments. The procedure for elaborating items and subsequent psychometric analysis is described in detail in (publication under preparation).

2.1.1. Self-assessment

The development of the self-assessment questionnaire took place in 2020 with the aim of developing concrete data collection procedures and measurement instruments for the assessment of digital competences based on the DigComp 2.2 AT. A four-step process was implemented to achieve this goal. For the operational definitions, the DigComp 2.2 AT (BMDW, 2018) was used as a theoretical starting point. The six competence areas were used as dimensions. Self-assessment items were developed for each competence area, based on an existing online questionnaire provided by fit4internet, a non-profit association that aims to raise digital competences. First, feedback from different experts on the existing questionnaire was collected, with consideration of the DigComp 2.2 AT. The set of items was firstly validated in a quantitative pre-test using a small sample (N=138). After initial revision, the instrument was re-analyzed in a field test using a comprehensive sample (N=1976). Appropriate recommendations for the specification and instruction were formulated and relevant recommendations for the adaptation of the instrument were derived. The version of the instrument used in this study comprised a total of 31 self-assessment items, which covered questions addressing the six competence areas.

In the self-assessment, each statement is assessed by ticking one out of seven options (1 for “I cannot do this”; 2 for “I can only do this with support”; 3 for “I can do this partly on my own”; 4 for “I can usually do this alone”; 5 for “I can always do this alone”; 6 for I am on expert on this” and 7 for “I could teach this to others”).

2.1.2. Knowledge Test

Subsequent to the iterative item analyses and selection procedure described above, there was a multiple-choice instrument consisting of 87 knowledge-based questions related to the six competence areas, each comprising between three and five answering options.

2.1.3. Sample description

Participants were recruited via a representative online panel of people living in Austria. In addition, due to the limited accessibility of individuals of lower competence levels via the online panel, a subset of participants was recruited for paper-pencil surveys. People with lower education levels (ISCED 1, 2) were invited to an Austrian job placement institution center to perform the assessment in paper-pencil form. The final sample comprises a total of 1109 people, 576 of them female (51.9 %), 519 male (46.8 %), and five people who did not specify their gender. Another nine people provided no information about their gender.

72 percent of the survey participants have German as their first language, and 82 percent were born in Austria or Germany. Another larger group is made up of Turkish-speaking people (6 %) or people with Serbian as their first language (4 %).

84,3 percent (N = 609) have lived in Austria for up to 10 years, another 10,5 percent have been to Austria between eleven and 20 years, and 5,1 per cent have lived in Austria for over 20 years.

In relation to the number of books in the household as a proxy for cultural capital (e.g., Sieben & Lechner, 2019; OECD, 2010, 2011, 2012), it can be stated that a fifth own more than 200 books, but the percentage distribution across the individual levels is quite balanced.

The respondents were asked to indicate which school education they had already completed at the time of the survey (table 2). Some people (2.5 %) had successfully completed primary school, another 31 percent had completed middle- and high school (ISCED 2). The proportionately largest group with 422 respondents (39 %) is ISCED 3. 16 percent have at least a bachelor's degree or equivalent (ISCED 6-8).

ISCED level completed so far	count	percent
Primary school (ISCED-Level 1)	28	2,5%
Lower grades in school, middle school, high school (ISCED Level 2)	342	30,8%
Upper level in school, Matura, apprenticeship, vocational school (ISCED Level 3)	433	39,0%
Courses at universities or technical colleges (ISCED Level 4)	25	2,3%
Higher vocational school (ISCED Level 5)	96	8,7%
Bachelor degree or equivalent (ISCED Level 6)	56	5,0%
Master, PhD, Diploma, or equivalent (ISCED Level 7/8)	122	11,0%
No clear assignment possible	7	0,6%
Total	1109	100%

Table 2: ISCED level completed so far

Many of the respondents are still in training (23 %), which is also related to the ISCED levels. The proportionally largest sectors represented are retail (13 %) and the media, IT, and consulting sectors (12 %). 81 people work in health and social services, or had their previous job in that field, a further 69 people work in education and training as well as in tourism, gastronomy, art, and leisure. Very

few respondents can be found in the land sectors, forestry, fishing, or energy and water supply.

56 percent of respondents use digital applications and devices several times a day, and a further fifth use them daily. 61 people stated that they used digital applications less than once a week while at work (see table 3).

Use of digital devices / applications during work in the past year	count	percent
Several times a day	626	56,4%
Daily	202	18,2%
Several times a week	107	9,6%
Once a week	18	1,6%
Less frequently	61	5,5%
I do not know	95	8,6%
Total	1109	100%

Table 3: Use of digital devices / applications during work in the past year

3 ANALYSIS & RESULTS ON THE SECOND-LEVEL DIVIDE

The DigCert averages (percentage of correctly solved items) show a total score of 45.48% in Austria. The averages in regard to the six different competence areas are presented in table 4.

Competence area	**Mean (%)**
0	52.44
1	44.40
2	46.09
3	38.46
4	50.09
5	39.50

Table 4: Averages of the DigCert competence areas.

Furthermore, a step-by-step multiple regression analysis was calculated to investigate the influence of the variables of interest regarding both self-assessment and knowledge test (see table 5). The models for self-assessment of digital competences indicate that women report having lower digital competences than men. Analysis reveals a positive effect in terms of ISCED levels, where a higher ISCED level comes along with higher ratings in self-assessed digital competences. As to age, there was a negative effect. Self-assessment respondents age 18 or younger show scores very similar to 19-to-35-year olds, while respondents over the age of 36, and those over 60 show significantly lower ratings in their digital competence assessment than the under-18s. Here, self-assessment of digital competences also decreases with age. In addition, people with a non-German first language have lower self-assessed digital skills in the fifth model, which includes years of living in Austria in the analysis.

In a next step, the analysis was calculated for the knowledge test. Here, a gender effect was evident. Women were able to solve significantly fewer knowledge items correctly than men. The effect of the ISCED levels is also significant. The higher the level of education, the more items could be solved correctly, which becomes evident the moment age is included in the analysis. As concerns age, increasing age has a positive effect on the number of items solved in the knowledge test, with the 36 to 60-year olds having the highest parameter estimates and therefore the best results compared to the other age groups. This stands in great contrast to the self-assessment. People who did not speak German as their first language performed significantly worse in the knowledge test than people with German as their first language, and duration of living in Austria had a positive effect on the result.

Step	Predictor	Parameter estimator self-assessment			Parameter estimator knowledge test		
		B	SE	Sig.	B	SE	Sig.
1	constant	5,53	0,04	0,00	44,96	0,75	0,00
	female	-0,51	0,06	0,00	-10,38	1,04	0,00
	male (reference group)						
2	constant	4,83	0,19	0,00	29,22	2,69	0,00
	female	-0,48	0,06	0,00	-9,81	0,85	0,00
	male (reference group)						
	ISCED 1 (reference group)						
	ISCED 2	0,68	0,19	0,00	3,76	2,74	0,17
	ISCED 3	0,58	0,19	0,00	16,62	2,71	0,00
	ISCED 4	0,66	0,27	0,01	23,65	3,86	0,00
	ISCED 5	0,73	0,21	0,00	24,33	2,99	0,00
	ISCED 6	1,05	0,22	0,00	32,87	3,22	0,00
	ISCED 7/8	1,09	0,20	0,00	31,09	2,92	0,00
3	constant	4,96	0,19	0,00	23,44	2,76	0,00
	female	-0,49	0,06	0,00	-9,76	0,82	0,00
	male (reference group)						
	ISCED 1 (reference group)						
	ISCED 2	0,59	0,19	0,00	6,29	2,68	0,02
	ISCED 3	0,76	0,19	0,00	14,75	2,67	0,00
	ISCED 4	0,87	0,26	0,00	20,91	3,78	0,00
	ISCED 5	0,90	0,20	0,00	21,22	2,95	0,00

	ISCED 6	1,19	0,22	0,00	29,79	3,15	0,00
	ISCED 7/8	1,30	0,20	0,00	27,48	2,89	0,00
	Under 18 years old (reference group)						
	19 to 35 years old	-0,04	0,08	0,61	7,33	1,19	0,00
	36 to 60 years old	-0,36	0,10	0,00	10,92	1,37	0,00
	60+	-0,85	0,12	0,00	5,33	1,78	0,00
4	constant	4,92	0,20	0,00	18,07	2,67	0,00
	female	-0,48	0,06	0,00	-8,71	0,79	0,00
	male (reference group)						
	ISCED 1 (reference group)						
	ISCED 2	0,60	0,19	0,00	7,11	2,56	0,01
	ISCED 3	0,74	0,19	0,00	12,96	2,54	0,00
	ISCED 4	0,86	0,26	0,00	18,91	3,60	0,00
	ISCED 5	0,88	0,21	0,00	18,29	2,82	0,00
	ISCED 6	1,17	0,22	0,00	27,35	3,01	0,00
	ISCED 7/8	1,28	0,20	0,00	24,86	2,76	0,00
	Under 18 years old (reference group)						
	19 to 35 years old	-0,05	0,08	0,55	6,42	1,13	0,00
	36 to 60 years old	-0,38	0,10	0,00	8,25	1,33	0,00
	60+	-0,88	0,13	0,00	2,14	1,72	0,21
	German	0,08	0,07	0,27	10,56	0,99	0,00
	Other first language (reference group)						
5	constant	4,88	0,32	0,00	30,84	4,50	0,00
	female	-0,45	0,06	0,00	-9,47	0,90	0,00
	male (reference group)						
	ISCED 1 (reference group)						
	ISCED 2	0,56	0,27	0,04	1,78	3,77	0,64
	ISCED 3	1,02	0,27	0,00	7,36	3,73	0,05
	ISCED 4	0,85	0,33	0,01	10,55	4,62	0,02
	ISCED 5	1,12	0,28	0,00	11,23	3,95	0,00
	ISCED 6	1,33	0,29	0,00	18,75	4,01	0,00
	ISCED 7/8	1,44	0,28	0,00	16,60	3,87	0,00
	Under 18 years old (reference group)						
	19 to 35 years old	-0,38	0,14	0,01	4,37	1,92	0,02
	36 to 60 years old	-0,74	0,15	0,00	3,06	2,11	0,15
	60+	-1,35	0,17	0,00	-5,18	2,35	0,03
	German	0,42	0,11	0,00	17,46	1,48	0,00
	Other first language (reference group)						
	Less than 10 years in Austria						
	11 to 20 years in Austria	0,45	0,12	0,00	1,22	1,66	0,46
	More than 20 years in Austria (reference group)	0,07	0,15	0,62	5,89	2,10	0,01

Table 5: Results from the stepwise regression analysis of self-assessment & knowledge test. At each step of the analysis more predictors are added to the model.

In a next step, the results are subjected to a more in-depth analysis (see table 6). The parameter estimates of a multivariate analysis of variance are presented below. First, the self-assessment is again focused – here in all competence areas and later in the results of the knowledge test.

The analysis shows that female persons rate their digital competences lower than male respondents, which is true for all competence areas. The B-values show that the largest divide between males and females occur in the area of problem-solving, with B = -0,55.

The divide concerning ISCED-levels also occurs in all competence areas. When it comes to digital competencies, the higher the ISCED level, the higher the self-esteem. Regarding the area of "0. Basis and Access", there is, however, no difference between persons in ISCED levels 1, 2, and 4. Here, these persons show similar lower self-assessment ratings compared to persons with higher formal education degrees. There is also no significant advantage for persons in ISCED 2 when it comes to competence ratings in the area of "4. Safety", compared to persons at ISCED level 1.

The age divide appears in all areas with self-assessed digital competences decreasing with age. Exceptions can be seen in the areas of "1. Handling Information and Data" as well as "2. Communication and Collaboration" with a significant divide between the under 18-year-olds to 35-year-olds, and the groups

over 36 years old. The younger age group (under 35) has higher ratings in their abilities to deal with information and communicate and collaborate with others better than the group over 36 years of age.

There is a significant divide when it comes to language. People with German as their first language report significantly higher digital competences than people with any other first language. The largest difference with B = .62 occurred in the competence area of “5. Problem Solving and Continuing Learning”.

Interestingly, people with a shorter duration of stay in Austria (less than 10 years) showed significant differences in the self-assessment compared to people with medium duration (11 to 20 years), but not to those with long duration (more than 20 years

Parameter estimator self-assessment	Competence areas total			Basics and Access			Handling information and data			Communication and collaboration			Creation of digital content			Safety			Problem solving and further learning		
	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.
constant	4,80	0,28	0,00	5,42	0,30	0,00	4,69	0,30	0,00	4,99	0,32	0,00	4,43	0,39	0,00	4,86	0,33	0,00	4,44	0,36	0,00
female	-0,45	0,06	0,00	-0,46	0,07	0,00	-0,37	0,07	0,00	-0,38	0,07	0,00	-0,46	0,09	0,00	-0,48	0,08	0,00	-0,55	0,08	0,00
male (reference group)																					
ISCED 1 (reference group)																					
ISCED 2	0,56	0,27	0,04	0,22	0,29	0,44	0,75	0,28	0,01	0,59	0,31	0,06	0,83	0,37	0,03	0,42	0,32	0,18	0,58	0,34	0,09
ISCED 3	1,02	0,27	0,00	0,60	0,29	0,04	1,18	0,28	0,00	0,91	0,31	0,00	1,29	0,37	0,00	1,05	0,31	0,00	1,07	0,34	0,00
ISCED 4	0,85	0,33	0,01	0,39	0,35	0,27	1,13	0,35	0,00	0,71	0,38	0,06	0,87	0,46	0,06	1,02	0,39	0,01	0,96	0,42	0,02
ISCED 5	1,12	0,28	0,00	0,66	0,30	0,03	1,31	0,30	0,00	1,02	0,32	0,00	1,39	0,39	0,00	1,05	0,33	0,00	1,27	0,36	0,00
ISCED 6	1,33	0,29	0,00	0,72	0,31	0,02	1,52	0,30	0,00	1,21	0,33	0,00	1,75	0,40	0,00	1,31	0,34	0,00	1,49	0,37	0,00
ISCED 7/8	1,44	0,28	0,00	0,89	0,30	0,00	1,65	0,29	0,00	1,30	0,32	0,00	1,81	0,38	0,00	1,45	0,33	0,00	1,54	0,35	0,00
Under 18 years old (reference group)																					
19 to 35 years old	-0,38	0,14	0,01	-0,33	0,15	0,02	-0,23	0,14	0,10	-0,26	0,16	0,10	-0,52	0,19	0,01	-0,37	0,16	0,02	-0,53	0,18	0,00
36 to 60 years old	-0,74	0,15	0,00	-0,68	0,16	0,00	-0,52	0,16	0,00	-0,57	0,17	0,00	-0,96	0,21	0,00	-0,71	0,18	0,00	-0,99	0,19	0,00
60+	-1,35	0,17	0,00	-1,26	0,18	0,00	-0,98	0,18	0,00	-1,30	0,19	0,00	-1,57	0,23	0,00	-1,31	0,20	0,00	-1,65	0,22	0,00
German	0,42	0,11	0,00	0,47	0,11	0,00	0,57	0,11	0,00	0,29	0,12	0,02	0,28	0,15	0,05	0,29	0,12	0,02	0,62	0,14	0,00
Other first language (reference group)																					
Less than 10 years in Austria (reference group)																					

11 to 20 years in Austria	0,45	0,12	0,00	0,32	0,13	0,01	0,51	0,12	0,00	0,37	0,14	0,01	0,58	0,16	0,00	0,34	0,14	0,01	0,61	0,15	0,00
More than 20 years in Austria	0,07	0,15	0,62	0,03	0,16	0,86	0,12	0,16	0,46	0,07	0,17	0,67	0,11	0,21	0,59	-0,03	0,18	0,87	0,14	0,19	0,45

Table 6: Analysis of self-assessment including all areas

The analysis of the knowledge test (see table 7) showed a gender effect in general and in all areas of competence. The greatest differences were found in the areas of “0. Basics and Access” (B = -13.3), “1. Handling of Information and Data” (B = -12.9, an area in which women showed slightly higher ratings) and “5. Problem Solving and Continuing Learning” (B = -12.7).

As far as educational qualifications are concerned, ISCED level 1 (primary education) is the reference group. In all areas, there is clear evidence that persons at ISCED 6 (bachelor’s degree or equivalent) as well as ISCED 7/8 (master’s or PhD degree) have the highest values in the knowledge test and differ significantly from persons at ISCED 1. When it comes to the percentage of correctly answered questions in area “1. Handling Information and Data” there is a clear divide between persons with and without a tertiary education degree. It becomes evident that higher education is an advantage in solving these items. The same is true for the competence area “5. Safety”. In all other areas there is a significant increase in solved answers along with the ISCED levels.

3.1.1. Competence areas

Parameter estimator knowledge test	% correctly answered questions			% correctly answered questions in basics and access			% correctly answered questions in handling information and data			% correctly answered questions in communication and collaboration			% % correctly answered questions in creation of digital content			% correctly answered questions in safety			% correctly answered questions in problem solving and further learning		
	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.
constant	24,95	3,93	0,00	35,54	5,47	0,00	28,32	5,81	0,00	25,45	5,55	0,00	26,55	4,58	0,00	34,29	5,56	0,00	19,03	6,07	0,00
female	-9,47	0,90	0,00	-13,27	1,25	0,00	-12,93	1,33	0,00	-7,42	1,27	0,00	-7,93	1,04	0,00	-9,42	1,27	0,00	-12,74	1,39	0,00
male (reference group)																					
ISCED 1 (reference group)																					
ISCED 2	1,78	3,77	0,64	1,13	5,24	0,83	0,06	5,56	0,99	7,10	5,32	0,18	0,47	4,38	0,91	-3,33	5,32	0,53	7,79	5,82	0,18
ISCED 3	7,36	3,73	0,05	8,30	5,19	0,11	6,17	5,51	0,26	11,41	5,27	0,03	8,20	4,34	0,06	4,17	5,27	0,43	12,87	5,76	0,03
ISCED 4	10,55	4,62	0,02	13,18	6,43	0,04	7,31	6,83	0,28	17,79	6,52	0,01	9,92	5,38	0,07	7,68	6,53	0,24	17,07	7,13	0,02

ISCED 5	11,23	3,95	0,00	11,30	5,50	0,04	8,93	5,84	0,13	16,02	5,58	0,00	13,46	4,60	0,00	9,36	5,59	0,09	19,16	6,10	0,00
ISCED 6	18,75	4,01	0,00	21,28	5,58	0,00	18,21	5,92	0,00	24,70	5,66	0,00	22,13	4,67	0,00	15,41	5,67	0,01	27,93	6,19	0,00
ISCED 7/8	16,60	3,87	0,00	18,74	5,39	0,00	18,72	5,72	0,00	22,35	5,47	0,00	18,75	4,50	0,00	13,16	5,47	0,02	26,13	5,98	0,00
Under 18 years old (reference group)																					
19 to 35 years old	4,37	1,92	0,02	5,46	2,67	0,04	8,31	2,83	0,00	4,12	2,70	0,13	1,89	2,23	0,40	3,92	2,71	0,15	5,89	2,96	0,05
36 to 60 years old	3,06	2,11	0,15	6,53	2,94	0,03	6,92	3,12	0,03	-0,71	2,98	0,81	0,87	2,46	0,72	5,63	2,99	0,06	1,45	3,26	0,66
60+	-5,18	2,35	0,03	-3,04	3,28	0,35	-6,16	3,48	0,08	-10,80	3,32	0,00	-4,75	2,74	0,08	-1,51	3,33	0,65	-10,49	3,63	0,00
German	17,46	1,48	0,00	21,31	2,06	0,00	21,14	2,19	0,00	20,62	2,09	0,00	13,08	1,73	0,00	24,26	2,10	0,00	19,77	2,29	0,00
Other first language (reference group)																					
Less than 10 years in Austria (reference group)																					
11 to 20 years in Austria	1,22	1,66	0,46	1,40	2,31	0,54	5,28	2,45	0,03	-1,49	2,34	0,53	-0,81	1,93	0,68	2,57	2,34	0,27	1,02	2,56	0,69
More than 20 years in Austria	5,89	2,10	0,01	5,76	2,92	0,05	7,12	3,10	0,02	5,67	2,96	0,06	5,08	2,44	0,04	10,76	2,97	0,00	5,55	3,24	0,09

Table 7: Analysis of knowledge test including all areas

Age grouping is interesting. The reference group of under 18 showed the highest ratings in self-assessment in their digital competences. It turned out, however, that there is a tendency towards higher ratings in competence assessment up to the age of 60 years. These differences, however, are not all statistically significant. Compared to the 19- to 35-year-olds, there are significant differences in the overall questions answered, and the areas "0. Basics and Access" with the older group showing higher competences. In reference to 36- to 60-year-olds there are significant differences in the areas "0. Basics and Access", "1. Handling Information and Data" as well as "4. Safety", where the persons in the older age group did better in the test than the under 18-year-olds. Generally, over 60-year-olds do worse in the knowledge test than under 18-year-olds do, however, this digital age divide is not significant in all competence areas. In the areas of "1. Handling Information and Data", "2. Digital Content Creation", and "4. Safety" the under 18-year-olds and the over 60-year-olds do not show significant differences in the knowledge test.

There is a language effect with participants having German as their first language gaining better results in all areas of the knowledge test.

Persons who had lived in Austria for less than ten years did not gain as good results as persons who had lived in Austria for a longer period, however, there is only a difference in "1. Handling Information and Data" compared to persons living in Austria for up to 20 years. In all competence areas, except for "2. Communication and Collaboration" as well as "5. Problem solving and Continuing Learning", persons living in Austria for more than 20 years show better test results than persons who had lived in Austria for less than ten years. This may also be confounded with age and first language.

3.1.2. Relationship between self-assessment and knowledge test

Finally, the relationship between the self-assessment and the knowledge test (without taking gender, ISCED level, or age into account, see table 8) show highest correlations in the area "1. Handling Information and Data" (r = .415 **) – here people were able to self-assess particularly well, with the lowest correlations occurring in the area "3. Digital Content Creation (r = .226).

Knowledge test	**Self-Assessment**		
% correctly answered questions	Competence areas total	Spearman Correlation	.384**
		Sig. (2-tailed)	,000
		N	1109
% correctly answered questions in basics and access	basics and access	Spearman Correlation	.350**
		Sig. (2-tailed)	,000
		N	1109
% correctly answered questions in handling	handling information and data	Spearman Correlation	.415**
		Sig. (2-tailed)	,000
		N	1109
% correctly answered questions in communication and collaboration	communication and collaboration	Spearman Correlation	.261**
		Sig. (2-tailed)	,000
		N	1109
% correctly answered questions in creation of digital content	creation of digital content	Spearman Correlation	.226**
		Sig. (2-tailed)	,000
		N	1109
% correctly answered questions in safety	safety	Spearman Correlation	.262**
		Sig. (2-tailed)	,000
		N	1109
% correctly answered questions in problem solving and further learning	problem solving and further learning	Spearman Correlation	.340**
		Sig. (2-tailed)	,000
		N	1109

Table 8: relationship between self-assessment and knowledge test

4 DISCUSSION

In this study we investigated how self-assessment of digital competences relates to knowledge about digital tools and whether there are digital divides that depend on gender, education level, age, first language, and duration of living in Austria.

Analyses reveal a digital divide depending on gender, with male respondents showing higher scores in both self-assessment and knowledge test in general, and in all areas of competence. Results on self-assessment are in line with previous findings that men show more favourable attitudes towards technology use than women, especially in regard of their self-confidence concerning the ability to learn and use technology effectively (self-efficacy) (Cai et al., 2017). Regarding knowledge-test results and gender, our findings differ from those in ICILS 2018 (Fraillon et al., 2020), where female participants achieved significantly higher results than their male counterparts when it came to Computer and Information Literacy, and males tended to perform better in Computational Thinking. Yet our findings show that female participants score lower than male ones in self-assessment and knowledge test. Following Hilbert (2011), this might depend on their circumstances regarding employment, education, and income, resulting in less access to and less usage of ICT.

A digital divide was also found for the reported level of education. People assess their knowledge depending on their level of education, which in turn corresponds to their results in the knowledge test. People having a certification from a higher vocational school (ISCED 5) or a university or technical college degree (ISCED 4) form just as much of a unit in terms of their

competences as those with at least a bachelor's degree (ISCED 6, 7/8). This could be seen as an indicator that progressive institutional schooling can contribute to digital competence formation.

Notably, results in the knowledge test might somehow be related to test-wiseness: more highly educated people might have handled such test settings and types of items in the past, compared to respondents with lower levels of education, and may have an advantage due to their familiarity with the question formats. This has shown to contribute to a better performance in multiple-choice tests (Thoma and Köller, 2018). Since digital media contain a good deal of written information and the knowledge test in particular is written, it is highly plausible that reading competence also plays a significant role in the current assessment of digital competences. As test items were displayed in German only, German native speakers were clearly advantaged in completing the knowledge test and the self-assessment.

The analyses show very clearly that the digital age divide exists primarily in people's self-assessment. Under 18-year-olds rated their digital skills significantly higher than all other age groups, with an almost linear decrease in accordance with a rise in age. In the knowledge test, however, there were mainly differences between the very young respondents, the under 18-year-olds, and the 60+-age group. This result supports previous evidence that the under 18-year-olds tend to overestimate their digital competences as compared to their actual performance level (Calvani, Fini, Ranieri & Picci, 2012; Ikrath & Speckmayr, 2016; Porat et al., 2018). The other knowledge test results, contrasting with the self-assessments, but in line with results concerning ISCED levels, showed that digital competences increased with age. The over 60-year-olds did worse than the under 18-year-olds, but not in all competence areas. There was no difference between the groups in the areas “1. Handling Information and Data”, “3. Digital Content Creation” and “4. Safety”. As Friemel (2016) suggests, this grey divide will change over the years, as those who are currently working and (have to) use media technologies there will then grow into this age group. Nevertheless, given the current findings, it is relevant to support this age group so that they have a realistic picture of their knowledge. Ultimately, trust in competences is also a key factor in continuing to deal with the topic. As shown above, there is a highly significant correlation between digital competences in the knowledge test and the self-assessment, which indicates that motivational and volitional aspects play a role that should not be underestimated.

Similarly, respondents in our study with a first language other than German did not have high values in terms of self-assessment, and thus might have a more realistic assessment of their own abilities, given that their knowledge tests indicated a significantly lower percentage of solved questions compared to respondents whose first language was German. Research – particularly in the United States – suggests that cultural affiliation and/or the first language play a role in the acquisition of digital competences and, above all, in access to digital media. This research also shows that there is often confusion regarding educational status (Chakraborty and Bosman, 2005; Fairlie, 2004; Hoffmann et al., 2001; Jackson et al., 2008; Pimienta, 2009). This may, however, relate to the methodological limitation that both the self-assessment and the knowledge test were provided in German only and that the tests were not too difficult in terms of content but in terms of language.

5 CONCLUSION & OUTLOOK

This research builds on numerous seminal studies regarding different levels of the digital divide and on the differences between individuals, organizations, and states. We have identified a research gap based on recent studies on the second level divide showing differences in the mode of use of digital technologies and differences in the proficiency in digital competences, but no research has investigated different competence areas in relation to gender, education level, age, first language, and duration of living in a country. Therefore, we present novel results on different competence levels as well as in different competence areas and the relevance of socioeconomic variables. Regarding different competence areas, we have utilized the "Digital Competence Model for Austria - DigComp 2.2 AT" (BMDW, 2018; Swertz, 2019), which was derived from the European Reference Framework for Digital Competencies (Carretero et al., 2017; European Commission and Directorate-General for Employment, 2018). Moreover, we have shown how the self-assessment of one’s own digital competences relates to knowledge about digital tools.

Overall, the analysis has shown a gender effect in digital competence knowledge assessment. Women were able to solve significantly fewer tasks correctly than men. Regarding the different competence areas, the analysis showed a gender effect in general and in all areas of competence, but the greatest differences were found in the areas of basics and access, handling of information and data, and problem solving and further learning. The persistence of gender segregation in educational and occupational fields contributes decisively to the spread of gender-stereotypic beliefs about a “natural fit” of women in careers in more expressive and human-centered fields and of men in technical and math-intensive fields (Makarova, Aeschlimann & Herzog, 2019). Therefore, focus need to be put on including digital competences in curricula, training content and equipment in different vocational training pathways, especially on female dominated educational trainings like salesperson, hairdresser, nurse, etc.

The effect of the education levels (ISCED) is also significant. The higher the education level, the more questions could be solved correctly. As far as educational qualifications are concerned, the results show an almost linear increase with ISCED levels. There are, however, no differences between ISCED 6 (bachelor degree or equivalent) and ISCED levels 7/8 (masters or doctorate or equivalent). Therefore, lower ISCED level need to be prioritised in future interventions and provides. Research has shown that digital games may foster inclusion (Kremser et al., 2023; Kremsner et al., 2022; Schmoelz et al., 2017)

As concerns age, increasing age has a positive effect on the number of items solved in the knowledge test. This stands in utmost contrast to the self-assessment. This approach has been shown especially fruitful when differentiating between overall findings that e.g., affirm or contest the notion of “digital natives”. This study falsified both extreme standpoints: digital natives are inherently better versed in technology (Prensky, 2001) and digital natives are a myth (Kirschner and De Bruyckere, 2017). The analysis illustrates that under 18-year-olds showed the highest ratings in their digital competences. It turned out, however, that there is a tendency towards increased competence up to the age of 60. Compared to the 19- to 35-year-olds, there are significant differences in the overall questions answered, and the older group showing higher competencies in the areas of basics and access. In reference to 36- to 60-year-olds there are significant differences in the areas of

basics and access, handling information and data, as well as safety: persons in the older age group did better in the test than the under 18-year-olds. Generally, over 60-year-olds did worse in the digital skills test than the under 18-year-olds. However, this digital age divide is not significant in all competence areas. In the areas of handling data and information, creation of digital content, and safety the under 18-year-olds and the over 60-year-olds show no differences in knowledgePeople who did not speak German as their first language performed significantly worse in the knowledge test than people with German as their first language, and the time that people had spent in Austria had a positive effect on the result. Persons who had lived in Austria for less than ten years did not gain as good results as persons who lived in Austria for a longer period of time. However, there is only a difference in the area of handling information and data compared to persons living in Austria for up to 20 years. In all competence areas, with the exception of communication and collaboration as well as problem solving and further learning, persons living in Austria for more than 20 years show higher test results than persons who have lived in Austria for less than ten years. This may also be confounded with age and first language. Furthermore, people with German as their first language performed significantly better than people with a non-German first language. The range of differences was between 13 percent of solved questions in the area of creation of digital content and 21 percent in the area basics and access as well as handling information and data. Especially in safety and also in the area of dealing with information and communication, people who had lived in Austria for more than 20 years score significantly higher than people who had lived in Austria for less than 10 years. This seems to be mainly a language issue.

These results give a novel insight into digital competences and diversity dimensions, however, digital agency – a concept that includes competences, awareness and action needs to be more closely addressed in a intersectional manner to provide evidence for diversity-sensitive methods and guidelines for future interventions and provisions on dealing and creating digital technologies (Freund et al., 2023). Moreover, future research needs to contrast these findings from Austria and needs to provide further insights from different countries regarding the correlation between digital competence areas and socio-economic variables. Regarding the wider normative context of digital humanism (Barberi et al., 2021; Doueihi, 2011; Nida-Rümelin and Weidenfeld, 2018; Schmoelz, 2020, 2022; Werthner et al., 2022) these results allow differentiated developments and policy measures fostering core humanistic values and limits as well as inclusion and co-creativity in shaping future technologies, and media in society.

Acknowledgments

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AVALUACIÓ DE LA BRETXA DIGITAL DE SEGON NIVELL A ÀUSTRIA: UN ESTUDI REPRESENTATIU DE LES DIFERÈNCIES DEMOGRÀFIQUES EN COMPETÈNCIES DIGITALS

La bretxa digital de segon nivell afecta els nivells individuals de competències digitals i els indicadors demogràfics de les diferències digitals. En aquest treball hem analitzat dades empíriques que permeten una mirada exhaustiva i diferenciada de la bretxa digital de segon nivell amb un enfocament metodològic quantitatiu rigorós. Hem investigat la relació entre els resultats d'una autoavaluació de les competències digitals pròpies i una prova de coneixements sobre eines digitals entre ciutadans austríacs (N=1109). L'estudi explora les bretxes digitals de segon nivell quant a gènere, nivell educatiu, edat, llengua materna i temps de residència al país en relació amb els respectius nivells i àrees de competència, en referència al Model de Competència Digital per a Àustria - DigComp 2.2 AT. Els resultats mostren que la bretxa digital de gènere és primordial a totes les àrees de competència, mentre que la bretxa d'edat continua sent forta quan es comparen els menors de 18 anys amb els més grans de 60 anys. A més, els efectes positius estan relacionats amb el nivell educatiu i la llengua materna.

PARAULES CLAU: àrees de competències digitals; bretxa digital; Àustria; prova de coneixements; autoavaluació; bretxa de segon nivell

EVALUACIÓN DE LA BRECHA DIGITAL DE SEGUNDO NIVEL EN AUSTRIA: UN ESTUDIO REPRESENTATIVO DE LAS DIFERENCIAS DEMOGRÁFICAS EN COMPETENCIAS DIGITALES

La brecha digital de segundo nivel afecta a los niveles individuales de competencias digitales y a los indicadores demográficos de las diferencias digitales. En este trabajo hemos analizado datos empíricos que permiten una mirada exhaustiva y diferenciada de la brecha digital de segundo nivel con un riguroso enfoque metodológico cuantitativo. Hemos investigado la relación entre los resultados de una autoevaluación de las propias competencias digitales y una prueba de conocimientos sobre herramientas digitales entre ciudadanos austriacos (N=1109). El estudio explora las brechas digitales de segundo nivel en cuanto a género, nivel educativo, edad, lengua materna y tiempo de residencia en el país en relación con los respectivos niveles y áreas de competencia, en referencia al Modelo de Competencia Digital para Austria - DigComp 2.2 AT. Los resultados muestran que la brecha digital de género es primordial en todas las áreas de competencia, mientras que la brecha de edad sigue siendo fuerte cuando se comparan los menores de 18 años con los mayores de 60 años. Además, los efectos positivos están relacionados con el nivel educativo y la lengua materna.

PALABRAS CLAVE: áreas de competencias digitales; brecha digital; Austria; prueba de conocimientos; autoevaluación; brecha de segundo nivel