General technological competency and usage in public administration education: An evaluation study considering on-the-job trainings and home studies

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Abstract
According to the UN's E-Government Development Index (EGDI 2020), which distinguishes between rating classes V1/V2/V3, it is part of Rating Class V3. When it comes to the digital maturity of Germany's public administration the weaknesses have become blatantly obvious during the pandemic. Civil servants' digital skills are one of the core prerequisites for digitalization in the public sector. Therefore, these skills need to play a key role in public administration education to prepare future civil servants for e-government. Since the first step towards digital skills is general technological competency, we are studying the level of general technological competency among public administration students. Whereas other studies focus on the information technology gap in public administration or on pedagogical aspects of technological skills, our study evaluates public administration students´general technological competency and usage. To do so we reflect different evaluation models and base our survey upon the EILAB´s digital competency profiler (DCP) measuring digital readiness of individuals and groups. The case studied is a Public Administration University of Applied Sciences. The survey results show that e-learning (home studies) phases during the COVID-19 pandemic have contributed little to students´ technological competency and usage. On the contrary, competency and usage during on-the-job training phases in public organizations clearly differ to the off-the-job training phases at the University. Hence, the findings reveal a general technological competency and usage gap between the public administration education and the duties in public administration. Finally, the implications of general technological competency and usage in public administration education are presented and critically reflection based on the chosen EILAB model.

Keywords: digital skills, public administration education, e-government, digital readiness

1. Introduction
When it comes to digitization and digitalization, Germany is one of the worst performing countries in Europe. According to the EU's Digital Economy and Society Index, Germany ranks 11th out of 29 in terms of digitalization. Basic digital skills and basic software skills are widespread in the country but the shortage of ICT professionals persists [1]. Furthermore, according to the UN's E-Government Development Index, which distinguishes between rating classes V1/V2/V3, it is part of Rating Class V3 [2]. Until the introduction of the Online Access Act (OZG) in 2017 the administrative digitization in Germany had been then rather sluggish and the implementation of the Online Access Act is lagging behind [3]. But with outbreak of the COVID-19 pandemic, administrative digitization has acquired a new urgency.

When it comes to the digital maturity of Germany's public administration the weaknesses have become extremely obvious during the pandemic. The common diffusion of online services in the citizens´ everyday life has changed expectations regarding governments. These expectations concern the participation and engagement possibilities as well as with the efficiency of public administration. The adoption of solutions using ICT in government - to improve citizen´s well-being - is expected even more by citizens since the COVID-19 pandemic and the catastrophic flooding in western Europe in July 2021 [4].

Whereas other studies focus on the gap in information technology in public administration training [5] or on pedagogical aspects of technological skills [6], our study evaluates public administration students´ general technological competency and usage. For the digital transformation in the public administration sector, civil servants training in their digital competences needs to be reflected in the system within the public administration education [7] as they are a prerequisite of digital transformation [8]. Digital competencies should play a key role in public administration education preparing future civil servants for this modernization of the administration. Therefore, the study evaluates public administration students´ general technological competency and usage (GTCU). Digital competency is determined by "the confident and frequent use of digital technology" ([9]: 58). We see competency as a set of "theoretical and practical knowledge, skills and values that can be readily called upon and put into action in a situation and context that is different from prior situations." [10]

Our case study is a Public Administration University of Applied Sciences in which we take e-learning (home studies) phases during the COVID-19 pandemic into account as well as on-the-job-training phases. After presenting the research framework and the methods, we then present the empirical results and discuss them.

2. Research framework

The European Union suggests the European reference framework - DigComp - for educational institutions as the instrument for assessing and improving digital skills. DigComp is used as a reference for many digital skills initiatives at European level. It has defined 8 proficiency levels along 3 dimensions: complexity of tasks, autonomy and cognitive domain [11]. Moreover, 5 competence areas are identified: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. ICT competency is a part of digital competencies [12]. We see ICT competency as the basic competency since technological process and procedural innovations are essential for the digital transformation [13]. For us, the two first competence areas of the European reference framework – **information and data literacy** and **communication and collaboration literacy** are the most basic precondition for digital transformation.

To measure general technological competency and usage we base our survey upon the EILAB´s digital competency profiler (DCP) which measures digital readiness of individuals and groups. According to [10] the **frequency of use** of digital technology widens the skills by managing different situations and finding different solutions. Hence, the competency grows with the frequency of its use. Therefore, we find it interesting to look at the movement of the teaching from presence to online during the COVID-19

pandemic. The **confidence of use** is collected in data through the self-assessment of once own ability to perform a task (ibid.). Moreover, the authors (ibid.) distinguish four orders of competency as a precondition for the use of technology effectively and efficiently. The four orders are: the technical order of competency, the social order of competency, the informational order of competency, and the epistemological order of competency. Firstly, the **technical order of competency** describes the capacity of interaction with the technology to use it. Secondly, the **social order of competency** regains the ability gained from the reflection communication experiences with others. Thirdly, the **informational order of competency**: Skills drawn from reflection by documentary collection experiences including treatment methods i.e. aggregation. Fourthly, the **epistemological order of competency**: a branch of knowledge using digital tools for a definite domain, for example, information processing tasks.

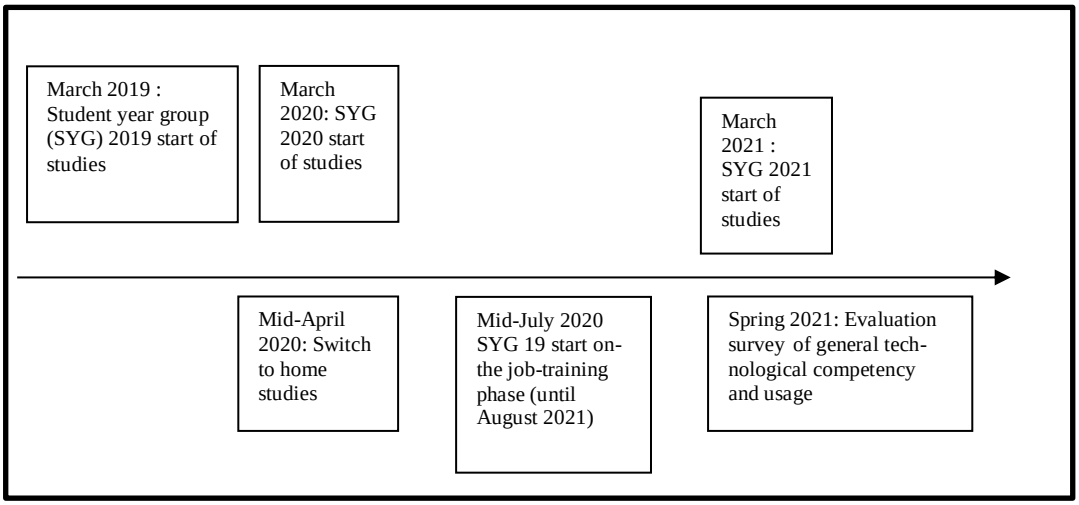
Employees can fail to demonstrate a skill required for a task for two reasons. Either (i) the employee does not have the competence or (ii) the employee does have the ability or skill privately but does not apply it to the professional task. In case (i) there is a lack of competence acquisition. In case (ii) there is a lack of application of competencies. In both cases, one can observe the failure or the inability to complete the task. Nonetheless we cannot directly deduce from this whether the acquisition of the competencies or the application of the competencies is missing. But employees can successfully develop their digital competency depending on how the acceptance of digital skills development is promoted in a workplace [14]. Hence, we assume that on-the-job-training phases can have an impact on the students´ GTCU self-assessment.

3. Method

We surveyed students enrolled in a dual bachelor's degree programme in Public Management were examined. The students are organized in years and are designated by the year of the beginning of their studies. The following age groups were examined: 2019, 2020 and 2021. The online survey to record general technological competency and usage took place in spring 2021. The on-the-job trainings are for the 2019 student group: 15.07.2020 - 31.08.2021, for the 2020 student group: 15.07.2021 - 31.08.2022, and for the 2021student group : 15.07.2022 - 31.08.2023. The switch from studying face to face to home studies as a measure to contain the Covid-19 pandemic was implemented Mid-April 2020. This means that the students had their lectures online at home.

The student year groups were – until our evaluation – exposed differently to contexts in which ICT usage is required. The timeline below shows that at the moment of the survey of general technological competency and usage, 2019 student year group has had only a few weeks of home studies as they have been mostly in their on-the-job-training phase. In contrast to this, year group 2020 and 2021 almost exclusively studied at home We therefore assume that the survey of general technological competency and usage is different between student year groups.

Figure 1: Timeline: student year groups and its specific ICT-context



Source: Own figure

The present study is an **exploratory study** in which we compare student year groups 2019, 2020, and 2021 based on a quantitative survey. The cases are characterized with different contexts that might have influence on general technological competency and usage. This is not a study based on a causal model and therefore cannot offer statistical correlations. Nevertheless, the results allow conclusions on students' general technological competency and usage in different contexts.

According to the research framework described above, our study relies on [9] and his presentation of the of the Digital Competency Profiler (DCP). The survey was somewhat modified by leaving out an item on programming to automate certain processes as we focus on the general technological competency for public administration students. "Programming" is part of a competence area of the European Union framework "digital content creation" – on which we do not focus (see research framework and [15]). Hence, we considered the following dimensions and items :

Table 2: General technological competency and usage - dimensions and categories

Dimension	Item	Number of item
D1 Technical Competency	To create/edit electronic documents (word processing, presentations, spreadsheets)	1
	To create/edit audio recordings (podcasts, voice memos)	2
	To create/edit multimedia items (photographs, movies, slideshows)	3
	To manage any of my accounts (email, bank, phone, video chat service, TV/movie service, etc.)	4
	To manage or operate other devices (home entertainment system, thermostats, lights, etc.)	5
D2: Social Competency	To communicate with others using text chat or text messaging (SMS, etc.)	6
	To communicate with others using audio (Skype, phone)	7
	To communicate with others using video (Facetime, Skype)	8
	To communicate with others using e-mail.	9
	To use social networking systems (Facebook, Google+, LinkedIn, Twitter, etc.)	10
	To use collaboration/shared document tools (Google Drive, Dropbox, etc.)	11
	To share my works and ideas publicly (blogs [Wordpress], photo sharing [Flickr, Picasa], Pinterest, etc.)	12
D3: Informational Competency	To access digital maps (MapQuest, GoogleMaps) or a GPS (TomTom, Garmin, etc.) to find my way or to get directions.	13
	To search for journal articles on the Web.	14
	To search for short videos (YouTube) on the Internet.	15
	To search for and download movies from the Internet.	16
	To search for and download music from the Internet.	17
	To search for and download books (text and/or audio) from the Internet.	18
	To use an aggregator to automatically collect and organize documents (news aggregators, data feeds, RSS feeds, media aggregators etc.).	19
D4: Epistemological Competency	To use and share a calendar/personal agenda.	20
	To create and use concept maps, flowcharts, sitemaps or algorithms.	21
	To create, modify and use plans or other diagrams.	22
	To sort large amounts of data.	23
	To produce graphs from numerical data.	24
	To do complex calculations.	25

Source: Based on [9]

The students could choose one item from five to measure their confidence of usage: (1) do not know how to use it, (2) not confident, require assistance to use it, (3) confident, can solve some problems, (4) quite confident, can use it with no assistance, and (5) very confident, can teach others how to use it. The response options for their frequency of usage were : (1) Never, (2) A few times a year, (3) A few times a month, (4) A few times a week, (5) Daily. We also collected data about the usage of their device: (1) A Computer (desktop, laptop, etc.), (2) A Mobile device (smart phone, tablet, etc.), (3) Other (smart TV, gaming

console, wearables, etc). (ibid.:61). For the 2019 student year group, we distinguished between the frequency of usage three areas of learning: private life, studies, and on-the-job-training. The response rates per student year group were as follows:

Table 1. Response rate

Student year group	Number of students	Number of responses	Response rate
2019 Student year group	350	84	24 %
2020 Student year group	349	70	20 %
2021 Student year group	345	126	36,5 %

Source: Own data

In the following sections,we sum up the core results of the survey.

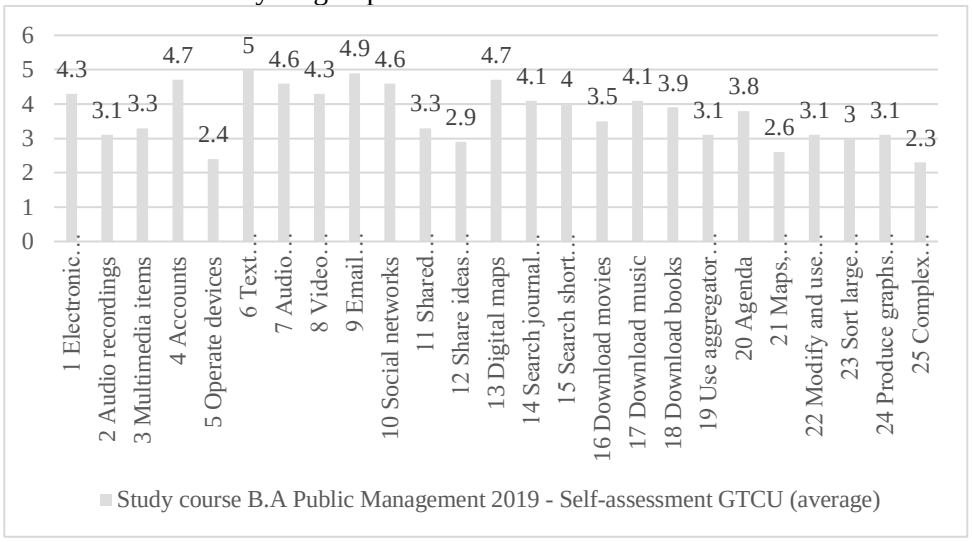
4. Results

Our case studied has two particularities. Firstly, the programme is dual which means the studies consist of two parts:on-the-job and off-the-job trainings. Secondly the study programme was characterized by the switch from face to face studying to home studies. We present the results firstly, as per year group of students admitted to higher education institutes (chronologically from 2019 until 2021) and secondly, compare the results of the groups.

4.1 2019 students year group

The 2019 students year group started their study programme in March 2019 – just before they stopped their courses at University for the on-the-job training phase from mid-July 2020 until the end of August 2021. This group experienced only eight weeks of home studies due to the COVID-19 pandemic.

Figure 2: GTCU Student year group 2019

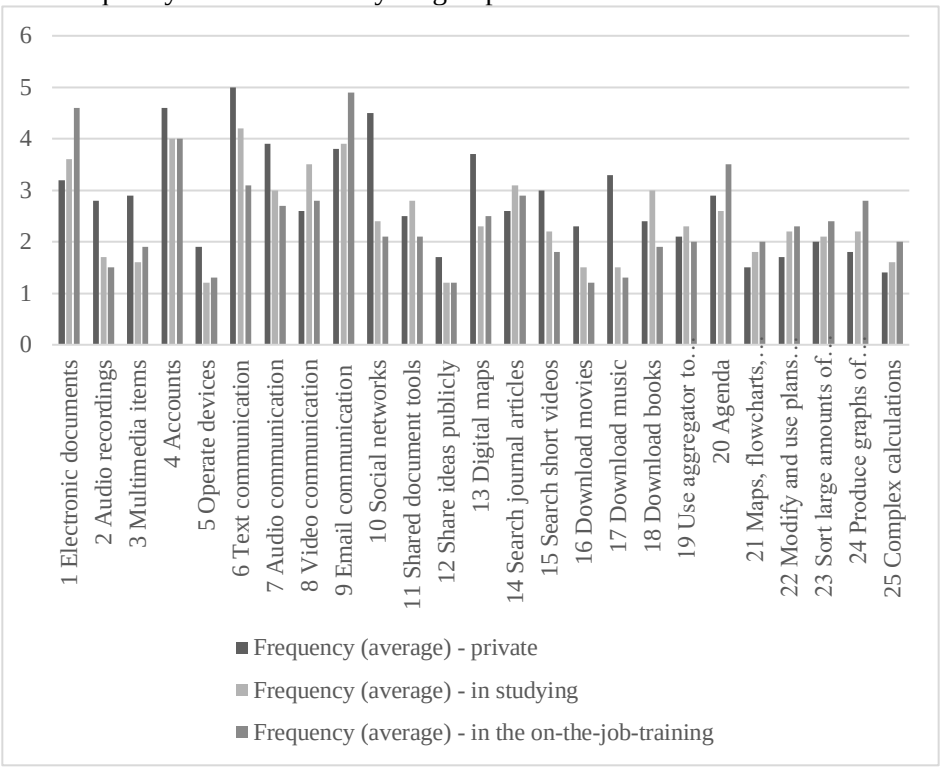


Source: Own data

The results of the **technological competency** concerning the different items (items 1 to 5) are assessed very differently. Respondents assess their ability to create **electronic documents** and to **manage accounts** higher than to create audio recordings, multimedia items to manage other devices. Compared to this technological competency, the self-assessed capacity of the **social competency** aspects (items 6 to 12) are **generally higher**. Within the social competency, **sharing tools and sharing ideas rank lower**. Concerning the **informational competency** (items 13 to 19) the **access to digital maps** are outstandingly **highly** assessed. The **epistemological competency** (items 20 to 25) is assessed the lowest of all.

Interestingly, the epistemological competency shows the most consistent differences between the frequency in private life usage, and in on-the job-trainings: The use of a personal agenda, diagrams, the production of graphs, the management of data, the conception of maps, flowcharts, sitemaps or algorithms, and doing calculations is much more frequent on the job than during studies or in private life. The frequency of the other competency blocks is less consistent. Not surprisingly, the frequent use of electronic documents and the email communication on the job is higher than in private life or studies. The following graph shows the frequency averages.

Figure 3: Frequency of use - student year group 2019



Source: Own data

4.2 2020 student year group

This group of students started their study programme in March 2020 – one year before the COVID-19 pandemic. The on-the-job-training phase had not yet started before the survey was done.

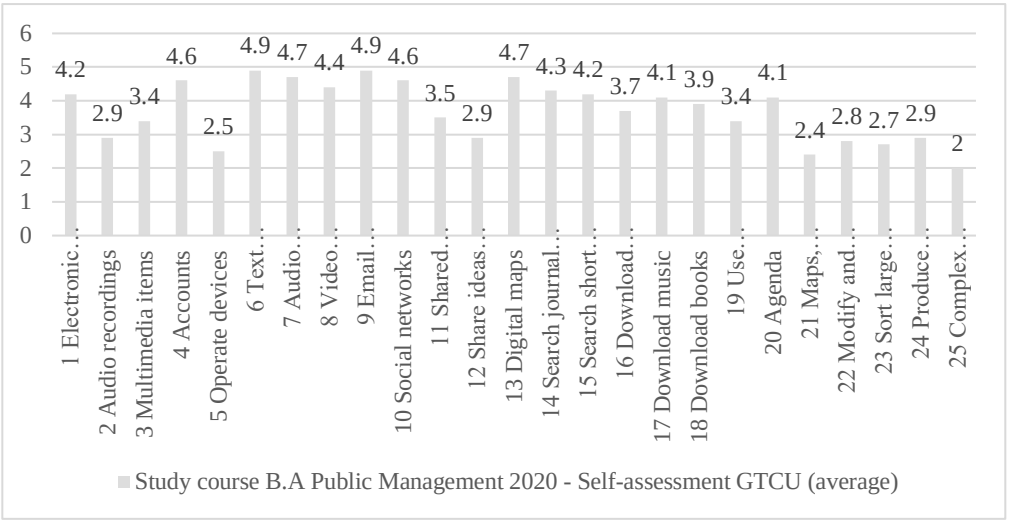


Figure 4: GTCU Student year group 2020

Source: Own data

Technological competency is assessed low in audio recordings and operating devices. Everything except **sharing tools and sharing ideas ranks lower**, the **social competency** and the **informational competency like for example searching short videos or journals are generally rather high.** The **epistemological competency** (items 20 to 25) is mostly assessed the lowest of all.

4.3 2021 student year group

The group of students who started the study programme in March 2021 and had only a few weeks of (home) studies before responding to the survey. As the following figure shows, the **technological competency** is evaluated low in audio recordings and operating devices. Except **sharing tools and sharing ideas**, the **social competency** and the **informational competency are generally rather high.** The **epistemological competency** (items 20 to 25) is assessed the lowest of all.

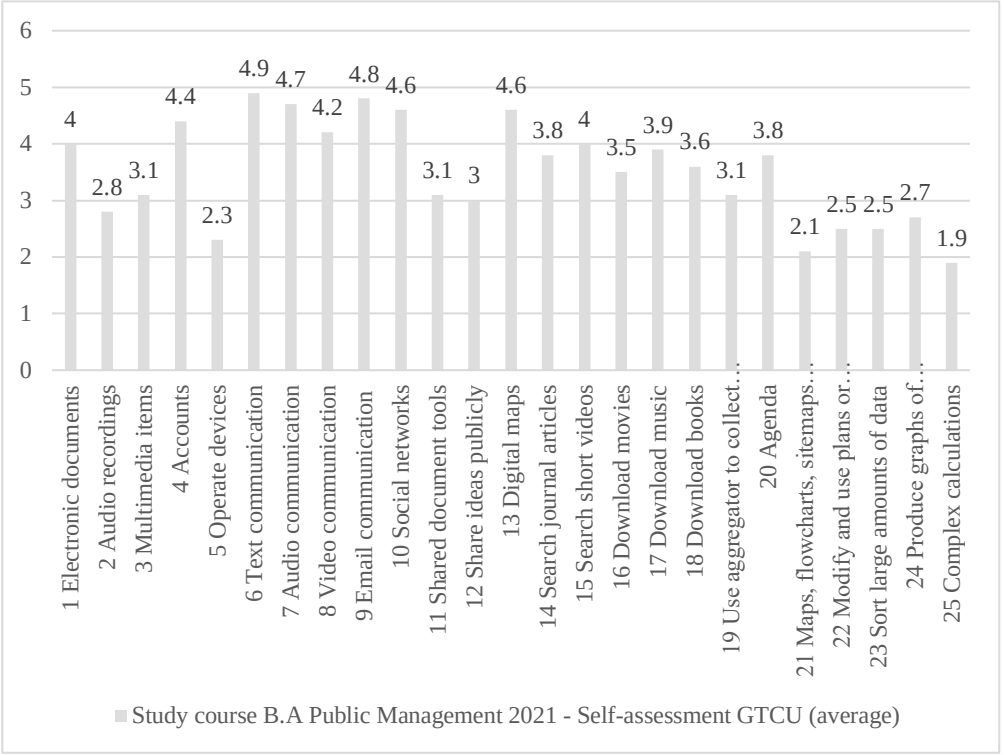


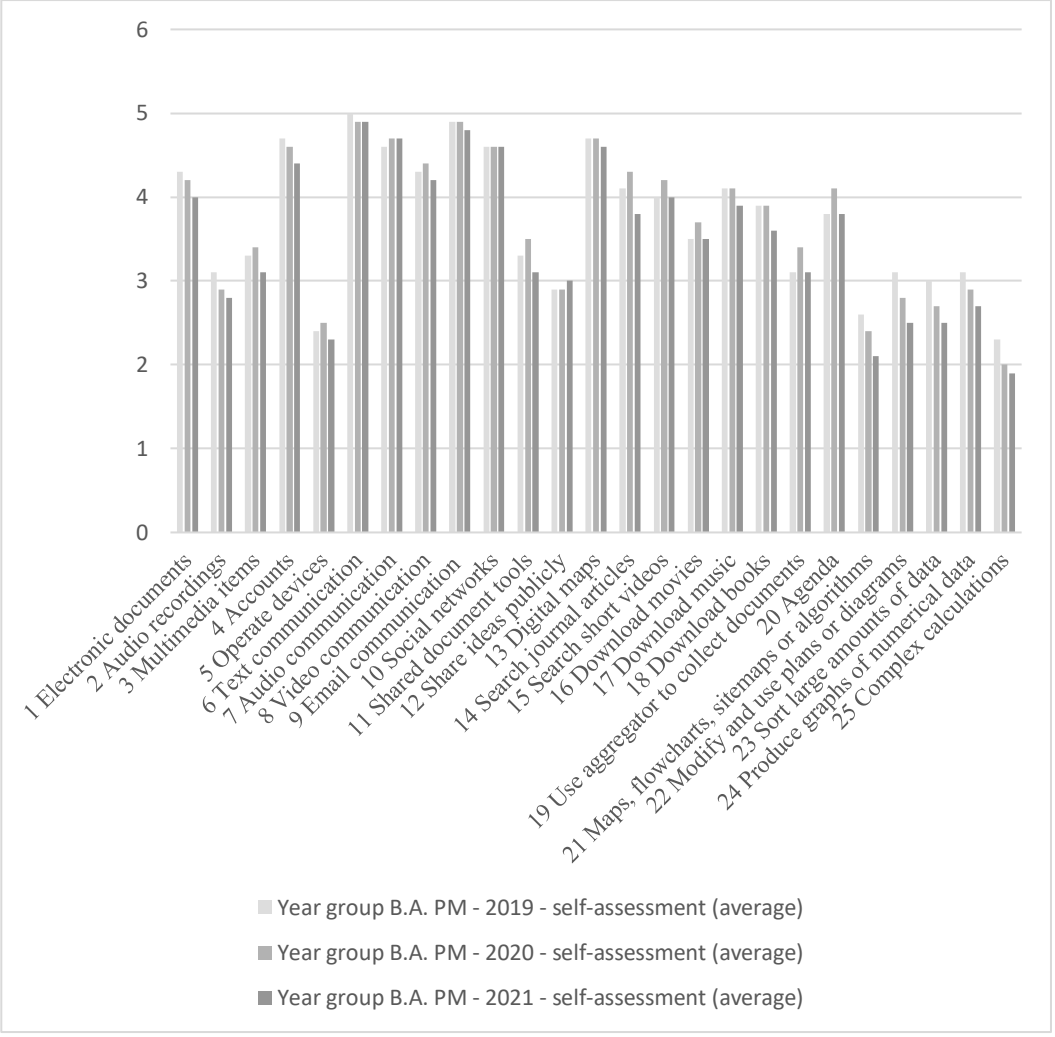
Figure 5: GTCU Student year group 2021

Source: Own data

4.4. The student year groups compared

As the summary figure below shows the general technological competency and usage profile of the three student year groups are very similar. Nevertheless, we see that year group 2019´s **shows the highest epistemological competency,** followed by 2020-year group and finally 2021-year group. The same gradation (first 2019-group, second 2020-group, third 2021-group) can be observed for electronic documents, accounts, and email communication.Surely of interest, 2020-year group – who studied more than one year at home when the survey was done – shows the strongest ability in the following categories: multimedia items, operating devices, video communication, shared document tools, search journal articles and short videos, using aggregator to collect documents, and personal agenda.

Figure 6: GTCU - Comparison of student year groups 2019, 2020, and 2021



Source: Own data

Discussion

As the results show, the epistemological competency is the most frequently used competency on the job of a public servant (see results group 2019). The use of a personal agenda, diagrams, the production of graphs, the management of data, the conception of maps, flowcharts, sitemaps or algorithms are highly regarded. In contrast to that, the epistemological competency is evaluated the lowest when it comes to self-assessment. We therefore state that its usage should play a greater part in the education of future civil servants.

Moreover, the comparison allows the conclusion that on-the-job-trainings are an important function for the development of general technological competency and usage. Further there are indications that show that home studying supports the information competency e.g. searching journal articles and short videos. Looking at digital transformation of public administration as a process, civil servants competency is in a continuous state of development so that the application of innovation can be assured [16]. Therefore, we need more knowledge and constant information about the competence requirements for digitizing and digitalizing public administration as for example the systematic empirical analysis of job advertisements in public administration [13]. Furthermore, we need mechanisms as, for example, more dialogue options between the public sector and public administration education institutions. This guarantees that digital competence requirements can be considered.

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