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Doctoral Theses in the Digital Age – ICT use by Social Sciences PhD Students of The Maria Grzegorzewska University

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***Abstract*—The article is a result of a complementary advanced publication workshop accompanying the curriculum course exercises for PhD students, on the role of ICT in the research work of a scientist. To fulfill the extended course requirements the participants decided to write relevant paper, if possible, related to their individual research endeavors and their relations to the digital world. The paper consists of a collection of short chapters written by young researchers. They express their own views, based on early research experience, relevant generally to the inclusion of critical digital age components in their theses. The chapters are only moderately consulted by the tutor in the direction of finding a common denominator related to social sciences.**

***Keywords*—ICT; social sciences; PhD students; higher education; digital competencies; education and support for researchers; technology and researcher's skills balance**

I. Introduction

DIGITAL transformation in higher education [1] is one of the numerable processes involved in building a knowledge society [2]. ICT is an indispensable component of the research path of PhD students at each university humanistic and technical alike. At the Maria Grzegorzewska University in Warsaw the PhD students have several lectures, workshops and laboratories related to the ICT. ICT is a part of a broader area including digitization, virtualization, and cloud platforms [3], virtual reality [4] and on-line social presence [5], big data [6], smart/agile education [7], hybrid education [8],[9], Internet of Things/everything [10], etc. All these components effectively contribute to the knowledge organization [11], transformation of the higher education [12], build knowledge society [13], and post-knowledge society [14].

The basic competencies included in the course for PhD students include learning how to use a word processor to the extent that allows writing scientific texts and preparing them for publication; effectively collaborate online while writing a scientific text; use reference managers and search engines; obtaining knowledge of academic social networking sites; visualizing data; creating and managing notes; using programs for analyzing qualitative and quantitative data; obtaining data from open databases; preparing scientific posters. In addition to the knowledge and skills acquired during classes, PhD students independently develop in individually selected areas that can be used to deepen the subject of personal research exploration. This text presents thoughts, experiences, hopes and fears of PhD students regarding the use of information technologies in the work of novice scientists.

II. ICT competencies as a factor supporting the development of scientists and science

In the information society and the era of digital resources, it seems impossible to improve one's competences without considering information and communication technologies (ICT) and widely understood digital solutions. This applies to the situation in developed countries and to improving competences in the industry directly related to science. The text below concerns the connections between digital competences and competences to practice science in the light of research results. Should PhD students - in addition to improving their knowledge in their chosen field - also develop their digital skills? (In this study, the term of digital or technological skills includes skills related to the use and practical application of electronic programs, online platforms, and any tools requiring the use of a computer and/or the Internet).

Teachers with greater technological and pedagogical competences use them more often in their personal and professional spheres, and they also use technology to a greater extent when working with students [15]. The results of a subsequent study indicate that attitudes and beliefs toward technology have a greater impact on its use in educational practice by novice teachers. Experience in learning to use technology and competences to use it are less important, and the weakest factor is access to technology [16].

An Estonian study [17] analyzed the impact of teachers' attitudes towards digital technology, the regular use of ICT in everyday teaching and their perception of their own role in preparing children and adolescents for life in the digital era. The results showed a range from a skeptical approach where technologies are not an integral part of teaching practice to seeing ICT as a natural part of life. Despite the variety of digital tools used, most of the practices turned out to be monotonous and poorly stimulated students to actively use ICT.

Majority of students and teachers have a basic level of digital competence [18]. Higher education institutions are encouraged to develop students' and teachers' digital competences, develop learning strategies, and use appropriate tools. There is also a positive and statistically significant relationship between ICT competencies and higher-order thinking skills and teamwork competencies [19].

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Abstract, introduction, common denominators, and conclusions are written by M. W. R. Chapter II is written by A.S., chapter III by I. P., chapter IV by K. Ch.

Academics have an appropriate level of digital research skills [20], but this may vary depending on the level of transversal skills such as creativity and entrepreneurship. Experience also has a significant impact on the use of digital competences, including in XR technology, cryptocurrencies, and facial authentication systems.

Especially interesting, in the context of this article, are the results of a study from 2023 on the impact of digital technologies on the development of research competences of PhD students in philosophy [21]. The study included 118 participants from two Ukrainian universities, divided into 100 doctoral students (divided into two specialization groups: pedagogy, psychology, and social work - 60 people, journalism - 40 people) and 18 academic teachers. It was found that the use of various digital applications, such as iSpring Market - for conducting classes, Comindwork - for organizing research work, BBC Learning English - for learning specialized English and OpenLearning - cooperation with a research supervisor, contributed to increasing the level of knowledge (mainly in group 1) and develop independent learning skills (mainly in group 2).

Digital competences also include the ability to communicate with other scientists using virtual space. An effective altmetric indicator for active researchers is activity on the Research Gate website [22]. Using ICT skills to better manage time and improve organizational skills, as well as experience and confidence in using technology, may be significant in the work of PhD students. The challenge is the lack of sufficient training in research data management, research methods and data analysis.

In the context of expanding ICT knowledge and skills, it is also worth looking at learning as a general development process and specific aspects of doctoral students' learning. People with greater innate ability or better social background are more likely to invest in skill acquisition [23]. In turn, the factors influencing the differences in digital skills of doctoral students [24] include working under time pressure and at a high level of organization, which requires digital skills as well as access to appropriate hardware and software.

The above review shows that various studies are being conducted on the importance and use of digital technologies and competences in education and higher education. The benefits include the digitization of resources and access to knowledge, including scientific and specialist knowledge, as well as the creation of digital tools enabling efficient navigation of virtual reality. However, a perceived difficulty in the development of science is the failure to use available digital tools for scientific work.

The issue of basic competences necessary to acquire subsequent higher-level competences and the availability of such resources, without which the use of digital tools will be impossible in practice, remains poorly visible. It may therefore turn out that the lack of knowledge about available (digital) resources and the lack of ability to use them is a significant competence deficit of PhD students. At the same time, it would be an obstacle to the full use of their intellectual and creative potential for the good of science. Motivations (or lack thereof), reluctance to obtain information about ICT solutions and apply them in practice, conservative attitudes towards the way of scientific work and simple fears about the unknown virtual world are another psycho-social area that also seems to be poorly appreciated in terms of learning difficulties, including at doctoral level.

At the same time, there seems to be a lack of research illustrating the importance of the "digital competences" indicator. The impact on the effects of PhD students' work could be measured by "hard doctoral indicators", such as faster completion of doctoral studies (or completion on time), a greater number of publications, publications in higher-scoring journals or more effective obtaining of grants.

Similarly, research on the area of consequences experienced individually and reflected in the quality of life of a PhD student is similarly insufficient. In this case, the indicators examined would be, for example, time savings, lower stress levels, higher levels of satisfaction with learning and doing science, and greater creativity resulting from the use of digital tools.

The above reflection applies to empirical research. One may also wonder to what extent digital tools and competences are necessary also in practicing "theoretical" science (philosophy, theoretical sciences), in which the scientist's workshop focuses on in-depth self-reflection and is not based on conducted research. However, hypothetical indicators illustrating the quality of life of PhD students, resulting, for example, from saving time or using it more effectively, can be used in this area.

A review of research on the importance and use of information and communication technologies (ICT) and digital competences in education indicates that although the basic digital competences of students and academic teachers are generally satisfactory, there are still challenges related to the full, creative use of ICT tools in scientific practice. Research confirms that digital competences have a positive impact on the effectiveness of scientific work, including at the doctoral level. This results in the need for further research on the importance of digital competences for the scientific work and quality of life of PhD students, as well as the dissemination of knowledge in this area and support in the constructive use of digital tools.

III. ONLINE SURVEYS – COMPARISON OF POPULAR SURVEY CREATORS

Designing the survey is an important part of the research work. It includes the methods of collecting answers from respondents. It can be done in person (face to face) or online. In both cases, it is possible to use questionnaires or even conduct experiments. The experience of the pandemic in recent years has prompted or forced some researchers to adopt remote research [25].

The advantages of online research are low cost, convenience, and short time of conducting the research [26]. Online research tools allow for greater control over some aspects of research, such as the start and end time of collecting responses. They also enable easier access to respondents, especially if the groups we are interested in are active on the Internet. Respondents' answers can be checked on mobile devices, and the study can be paused or ended at any time. Problems associated with such solutions include sample selection, confidentiality, and privacy issues, as well as the characteristics of people who don’t become respondents [27].

Currently, there are many services available that allow researchers to conduct online surveys. They differ by their availability, price, functionality, and ease of use. The aim of this

chapter is the comparison of four tools: Google Forms, Microsoft Forms, Qualtrics XM and Lime Survey.

Google Forms is the most often used tool out of the four [28]. As the tool connected to the most popular Internet search engine in the word it is available to all its users who own a Gmail account, also owned by Google. Google Forms is a free service and includes the basic features necessary to conduct simple research. It's available in many languages, including polish. It allows the creation of open, closed, and multiple-choice questions. It is possible to conduct tests and provide anonymous answers or link them to e-mail addresses. The program allows customization of the appearance of the survey. While collecting answers, it's possible to see a preview of the results so far at any time. Responses can also be opened in Google Sheets and then downloaded in a variety of formats, including Microsoft Excel.

Google Forms invites its users with its accessibility and ease of use. It is a good basic tool for conducting internet research.

Microsoft Forms is a service available as part of the Microsoft 365 package. This package costs from $69.99 per year, but it can also be made available to students and PhD candidates for free by the university. The program is available in dozens of languages and allows its users to create surveys in many languages. Surveys can be translated into 11 languages simultaneously. As an application included in Microsoft 365, Microsoft Forms is available for use on mobile devices, which enables remote control over research conducted in this program. The program allows intuitive creation of questionnaires containing various types of questions and personalization of the appearance of the survey. It is also possible to use the branching option, where answers to a given question leads to other variants of further questions. As with Google Forms, it is possible to collect both anonymous and email-related responses. Microsoft Forms can also be used to conduct knowledge tests, where you can use the option to mix the order of answers. The obtained answers can be monitored on an ongoing basis from the mobile app level. Results can be exported directly to an Excel file. Another interesting option is the ability to present the results directly from the survey level.

Microsoft Forms has features that are missing in Google Forms, e.g. the option to create a multilingual survey (the user can add questions in different language versions). The aspect that limits access to this program is the required subscription, but in this case the Maria Grzegorzewska's University supplies access to its students and PhD candidates, so it is not a noticeable problem.

Qualtrics XM allows the creation of a free account with an academic or personal e-mail. It is also possible to acquire access from an institution such as university. Due to the lack of language localization and the higher level of advancement of the software, users must have more advanced knowledge of English. Qualtrics XM allows the creation of open, closed, and multiple-choice questions, as well as the use of the branching option. During the creation of the survey, this tool delivers additional information, e.g. about the accessibility for people with disabilities. It is also possible to see the preview of the survey in both the desktop and mobile version. It is a big advantage considering how much time people spend using their phones [29]. It allows the export of data in many formats, Excel, and IBM SPSS among others. Qualtrics XM allows the creation of reports directly in the program, so it is possible to place and describe test takers' answers quickly and easily.

Qualtrics XM has numerous options that do not appear in other survey creators. These include, among others, creating reports and information on the availability of surveys for people with disabilities. Being able to access its features for free is also a significant advantage.

LimeSurvey is another tool that is available in English. It stands out in comparison with the other survey creators in a couple of ways. The creator looks very different – instead of a list of questions and answers one under another, LimeSurvey shows the summary of the survey and its elements on the side, while most of the screen is taken up by the details of a particular part of the questionnaire. The options to change the look of the survey are also limited by the less obvious way of editing that doesn't allow the user to see the changes happen in real time. At the same time, LimeSurvey doesn't allow any changes after the survey starts accepting answers. On the one hand, it's understandable, on the other – it takes away the possibility to correct even a minor mistake. Due to those less conventional solutions, this tool can be more difficult to master. An advantage of this software is the easy export of data into IMB SPSS. Another small advantage is the fact that information about the anonymity of the study is automatically added to the information presented on the introductory page.

Working with LimeSurvey is not intuitive, and yet it is a tool made available for students conducting research by the Maria Grzegorzewska's University.

TABLE I
THE COMPARISON OF PRESENTED ONLINE SURVEY TOOLS

Name	Google forms	Microsoft forms	LimeSurvey	Qualtrics XM
Price	Free of charge	69,99 USD (Microsoft 365 Personal for one person)	Free of charge	Free of charge
Answer preview	Yes	Yes	Yes	Yes
Data export directly to SPSS	No	No	Yes	Yes
Language	Different options available	Different options available	English	English

The comparison of the tools is shown in Table I. It includes direct export to SPSS because the article is focused on the social sciences. Due to its characteristics, online research stays popular among students. It is worth remembering that regardless of the tool used, research conducted in this form has its drawbacks that affect the obtained results. It should be in the interest of the academic institutions and lecturers to educate their students about these aspects, but also about various tools available on the market. In my experience, students are left without significant substantive support, assuming that they can somehow figure it out by themselves. This approach may negatively affect not only the quality of research, but also the motivation of students and PhD candidates.

IV. CASE STUDY IN THE WORK OF A BEGINNING RESEARCHER – METHODOLOGY AND ANALYSIS

The subject of my research inquiry is the role of using formative assessment in working with young people at risk of

social inadequacy. The Youth Sociotherapy Centre, the only institution of its kind in Poland which uses formative assessment as a teaching strategy, is analyzed using the case study method. Triangulation involving a combination of complementary qualitative and quantitative methods is planned.

The development of qualitative research methodologies as well as the technological possibilities for analyzing data has increased the popularity of the case study method. It considers multiple theoretical approaches and provides an in-depth understanding of the uniqueness of the case being analyzed [30]. It often combines the use of qualitative and quantitative data collection methods [31]. Among its limitations, one can indicate the low representativeness of the results, intuitiveness, and subjectivity, together with time-consuming and high costs associated with conducting research [32]. Subjectivity is associated with the researcher's entanglement in the process (e.g. during observation of the participant) and the familiarity with and experience of the topic under investigation makes it difficult to adopt a cognitively naive attitude [33]. The researcher's views should not influence the description of the subject [34]. A well-crafted case study requires a thorough understanding of the subject whose functioning the researcher is analyzing. More than one research technique should be used [31]. This stage is also described as the least developed aspect of the methodology of the strategy. Indeed, not all case studies are suitable for statistical analysis [35]. There are many tools for computer-assisted qualitative research, but the analysis of the data obtained, described as unstructured, does not rely solely on the use of software. Even the best-developed software cannot classify the gestures or facial expressions of respondents. Meaning can only be given to them by the researcher. One software for analyzing qualitative data is NVivo, which belongs to the CAQDAS (Computer Assisted/Aided Qualitative Data Analysis) software type. Its history dates to the 1980s and the latest version was released in December 2022, demonstrating that it is a constantly - improving software. Although it is a computer-based application, it is integrated with the cloud. The software offers many possibilities; however, the researcher will fully benefit from them once the collected data have been classified and structured. Among other things, it allows importing files of different sizes and types (PDF, Microsoft Office and statistical data contained in SPSS or Excel [36], it also assigns attributes to sources, cases, and code categories [37]. A major drawback is its price (a one-time license purchase of US $1,249) [36]. A PhD student who is at the beginning of his or her research path and who has not been exposed to data analysis software before (this is often the case for pedagogy students) is obliged to self-educate in this area. The packages belonging to the NVivo software have instructional videos to support the execution of the planned tasks. In addition, they are also made available on YouTube and in links attached to the software [38]. Another software from the CAQDAS family is MAXQDA, to which the Maria Grzegorzewska University offers free access for PhD students. However, it includes fewer features than NVivo. In the work of a novice researcher, however, fewer functions may mean greater focus and ease in mastering the software. For this purpose, the beginner scientist can use the "step by step" manuals, which are in free access [39]. The MAXQDA software meets the requirements of my research project, among others, because of its versatility [40] in being able to analyze all kinds of data (text, video, audio, photographs) performing both content and thematic analysis. MAXQDA is also recommended for use in all types of research making it the leading one (not only in the social sciences) [41]. Its availability for iOS devices is also helpful, allowing import and export between tools and apps. It is a useful tool for every stage of planning the conduct of research: from the literature review, to collecting, coding, and analyzing the collected research material. One can also import survey data from an Excel spreadsheet into it. The software automatically encodes the various parts of the table. Each row represents a separate case, and each column represents a studied variable. The research analyzed so far through MAXQDA prove that it makes it much easier to work with a large amount of collected material [42], which is important for my project, as there will be observation recordings and interviews with numerous groups of people. The ability to import data from SPSS may also prove useful.

The multitude of qualitative data analysis software, with their individual functionalities, advantages, and disadvantages, have in common that they assist (rather than relieve) the researcher. A pilot study to assess different solutions beforehand can be useful in selecting the right tools for you. Initially, the CAQDAS tools had basic functions such as encoding and searching, and the differences between them came from the fact that the software was designed by representatives of trends and theories. Often these were researchers presenting a particular methodological approach and it was why they adhered to the software [43]. Four criteria are given in the literature that are useful in selecting a tool. I will refer to these in presenting the usefulness of CAQDAS software family:

1) Type of project - the CAQDAS family tools are suitable for individual as well as team projects.
2) Data type - the software is helpful with all types of data (text, audio, video).
3) Nature of data analysis - CAQDAS is mainly used for qualitative analysis, but also allows the data to be subjected to operations of a quantitative nature, i.e., calculating the frequency of words or phrases in a given text.
4) Research method - when using a phenomenological approach that is concerned with learning about a certain phenomenon (for example, adolescent school negativity), the MAXQDA program) [44] proves to be useful. A problem that can be encountered when encoding data in a phenomenological approach is the loss of context of already encoded material. MAXQDA retrieves this context with a single click. In this aspect, the ability to take notes and return to them at any time is also useful [45]. NVivo and Atlas.ti favor grounded theory, in which theory is built on data. It takes as its basis blocks of data, which can take the form of individual phrases, sentences, or paragraphs to which the researcher assigns appropriate codes. Both tools are equipped with functions that allow the extraction as well as editing and description of individual chunks of data. Before a theory is formed, the researcher constructs hypotheses. This is made possible by the functions of encoding, category generation and the creation of relationships between categories (available in both programs), which are essential for the work of an analyst using grounded theory methodology [46]. QDAMiner supports a deductive approach [44] which allows a theory to be derived from the collected data [47]. The software includes advanced solutions to support the analysis of textual data, i.e. thematic, correspondence, contextual and lexical analysis, and allows categorization, semantic modelling and categorization [48]. There are few articles in the literature on tool selection dedicated to novice researchers. Most of them

discuss their functions and are tailored to advanced users. Niedbalski and Ślęzak [44] surveyed students and workshop participants to fill this gap. To choose the best tool for themselves, a PhD student should take a critical look at their analytical and computer skills and develop them to the required level. Even the most experienced researcher with deficiencies in computer skills will not use the tool to its full potential. Beginning researchers often have excessive expectations of the software. They treat it as little more than a support element in the analysis. The researcher is forced to master the methodology and qualitative analysis as much as the operation of the software.

Analysis of quantitative data, which can always be represented by numbers, is decidedly different. One of the best-known software for analyzing quantitative data is SPSS (Statistical Package for the Social Sciences). It is an attractive choice for PhD students at the APS PhD School, as the university provides students free access to it. An undoubted advantage of the software is its compatibility with the three main operating systems (Windows, macOS and Linux). It suits the objectives of my research project, as it is adapted to analyze multiple variables and the relationships between them. It does not require programming competence, although it does have a command editor to enable complex analyses to be conducted efficiently. The program can import data in various file formats (e.g. .xlsx, .csv, etc.). It is important from the point of view of the young researcher that there are several manuals describing the practical application of the software in an understandable way (for example, "Statystyczny Drogowskaz" published by PWN or "Metodologia i statystyka. Przewodnik naukowego turysty"). The software requires manual file saving, which, if neglected, may result in the loss of material. SPSS provides a complete package for analyzing quantitative data [49]. It has free alternatives such as Jamovi, PSPP or JASP.

The case study requires flexibility on the part of the researcher related to the selection and use of different but mutually complementary tools. Mixed data collection techniques do not ease the analysis of the collected material [50]. Beginning humanities PhD students may find it difficult to select appropriate tools for analysis, which should be done at the initial level of research design [51]. This is not possible without prior mastering theory in methodology and analysis. Lack of knowledge regarding methodology can lead to inappropriate application of tools. Doctoral students should be informed about the functionality of the software, while remaining flexible and creative so as not to be dominated by the tools used. However, help and support from lecturers alone is not enough - effective learning to use the software also requires spending time on self-study [44]. Researchers who are at the beginning of their journey should be open-minded and, at the same time, vigilant not to transfer the entire responsibility for interpreting results to the software used. The use of such solutions must not involve the elimination of all intellectual activity of the researcher [37].

V. COMMON DENOMINATORS

The first chapter discusses the importance of ICT competencies in higher education and shows the impact of digital tools and various software applications on research competencies, teaching methods and learning strategies. The second chapter compares four online survey tools in terms of their functionality, accessibility, and suitability for research purposes, and emphasizes the importance of choosing appropriate tools. The third chapter discusses the usage of computer assisted qualitative data analysis software (CAQDAS) when using case study method which integrates qualitative and quantitative data collection and analysis techniques.

All three PhD students touch upon challenges and considerations in research methodologies, related to the correct adoption of right digital tools, complexities of data analysis, and importance of choosing adequate methodologies and proper tools for effective research. Significance of educating researchers, particularly PhD students, about available software, its possibilities and limitations, its application to selected methodology is emphasized. The need for training, self-education, and support from experienced researchers is highlighted. It is essential to remember to maintain a balanced approach, because while digital technology and computer programs play a crucial role, they should not overshadow the intellectual contribution and critical thinking of the human researchers. Researchers should not solely rely on digital amenities, but rather use them as an aid to their analytical process.

VI. CONCLUSIONS

Working at the doctoral level is associated with higher levels of digital competence [52]. To encourage development in this area PhD should not be a lonely journey, but an optimal learning environment for interactive doctoral communities should be created [53]. This will facilitate the improvement of PhD students ICT related research competences. As the work on this text has shown, an effective way of transferring knowledge about ICT is the project method, during which PhD students not only learn about the tools and use them in practice but can assess their effectiveness while performing an authentic task. Involving doctoral students in the actual activities of researchers and the coordination of taught content between lecturers may increase the scope and effectiveness of their education.

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