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Digital Competences of Polish and Slovak Students—Comparative Analysis in the Light of Empirical Research

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Abstract: Skills in using information and communication technology solutions in the modern world determine the quality of professional and social life for everyone. The last decade has shown that digital competences are an important group of key competences for every employee and every organization. The purpose of this study is to present results of surveys on digital competences of Polish and Slovak students. Generally, results show that assessment of the level of digital competence of Polish students is not only higher but also less diverse. The rationale for addressing the subject of digital competences is its significance, constant changes resulting from development of ICT and the need to improve quality of life of individuals and organizations in the modern digital world. In this questionnaire, the students were asked to evaluate their level of understanding both existing and non-existing terms from the ICT area. The results have shown that there are significant differences between the questioned groups of students especially in case of IT competences.

Keywords: digital competences; information competences; IT competences; qualitative analysis; digital world

1. Introduction

Digital competence is an important factor shaping the quality of life of both individual and entire organizations. Their importance is constantly growing, which results from dynamics of development of information and communication technologies (ICT) and progressing digital transformation [1]. Development of ICT transforms/changes business models, the way individuals and organizations operate, and enforces a continuous process of learning new things [2]. Digital competences obviously depend on the age, professional activity or education of a given person [3]. These competences are important because they enable functioning in a world dominated by ICT and are part of lifelong learning process [4,5]. It could be assumed that people learning in the digital age who commonly use ICT solutions should naturally shape their digital competences, or at least some groups of these competences. However, current research shows that knowledge and skills play an important role in shaping competences, not only access and daily use [6,7]. The role of higher education in this area should be underlined, because it enables students to be independent in both academic and professional environment [8]. Therefore, development of digital competences, regardless of the level of education

it takes place, is targeted at the entity of the respective educational impact and corresponding level of digital literacy [9]. Teaching digital competences is a result of a combination of technological knowledge and skills, knowledge of the methodological possibilities offered by technological resources, and approach towards the use of ICT to transform and improve education [10].

The purpose of this study is to characterize digital competences based on the literature on the subject and to present own research on digital competences, which was carried out among Polish and Slovak students. The main research question is: How do Polish and Slovak students perceive their digital competences? Are there significant differences in this regard? The research was conducted using the survey method in the period from October 2018 to December 2018.

Characteristics and attempts to define digital competences and determination of a digitally competent person is not simple and unambiguous [11]. Depending on the measurement method and/or information that we want to acquire, defined competences can be gathered in a different number of groups [12]. In addition, areas of using digital competences are not limited to communication or entertainment, but also to education, work and personal development [13]. Digital competences are one of the priority factors in building the strategy of digital economy and digital society [14].

In the article by Jansen et al. [15] Delphi survey results were presented regarding expert opinion on what it means to be digitally competent today. The article describes and discusses final results of the Delphi study with 95 experts from across Europe and beyond.

The results indicate that digital competences are based on knowledge, skills and attitudes regarding twelve different areas:

1. General knowledge and functional skills
2. Use in everyday life
3. Specialized and advanced competence for work and creative expression
4. Technology mediated communication and collaboration
5. Information processing and management
6. Privacy and security
7. Legal and ethical aspects
8. Balanced attitude towards technology
9. Understanding and awareness of role of ICT in society
10. Learning about and with digital technologies
11. Informed decisions on appropriate digital technologies
12. Seamless use demonstrating

This study gathers opinions of experts, not facts, and in this respect the importance of this study lies not in the structure, but in the breadth and richness of collected ideas. This approach to research is part of a broader process that aims to understand and define more precisely the concept of digital competences from different perspectives.

According to the report *Information Society in numbers*, the concept of digital competences refers to two groups of competences: IT and information. The first group concerns the use of ICT equipment, software, specialized applications, Internet use and digital content creation, and is largely associated with emerging Global Software Development (GSD) process [16]. In turn, information competences refer to all processes related to information management and are related to: the ability to search and obtain information from various sources, assessment of it (assessing credibility and usefulness) and its use Ministry of Administration and Digital Affairs. Another definition is that digital competences are defined as skills, knowledge and attitudes that enable learners to use digital media to participate, work and solve problems, independently and in collaboration with others in a critical, responsible and creative way [17]. According to the European Parliament and the Council, "Digital Competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative

networks via the Internet" [3]. On the other hand Hatlevik and Christophersen. define digital competences as ability to exploit technology in order to use and access information [18]. In addition, according to these authors, digital competences also include the way in which technologies can be used to process, acquire and evaluate collected information, and how information can be created and transmitted using digital tools or media. Digital competences have also been included in the recommendations of the Council of the European Union as one of eight groups of key competences in the process of lifelong learning. In this document, digital competences have been defined as certain, critical and responsible use of digital technologies and interest in them for learning, work and participation in society European Union [19]. In turn, the European Digital Competence Framework for Citizens, referred to as DigComp, describes digital competences and groups them in five areas: information, communication, content creation, security and problem solving. According to this framework, in the modern world, a person with digital competence must move smoothly within these five areas, not just be able to use the functions of digital technologies.

The division of competences into IT and information level competences has also been extended by the level of functional competences. Functional competences are based on IT and information competences, which are foundation for implementing specific actions and achieving benefits through the use of digital technologies. Functional competences refer to eight areas of life, which were determined on the basis of research on areas of activity of Internet users. They included such areas as: work and professional development, relations with loved ones, realization of interests, health, finance, religion and spiritual needs, everyday matters and civic involvement [20].

Digital competence is increasingly the subject of multiple research papers. Digital skills related to the use of ICT are examined and assessed among students [21–24] also at the secondary level [25] or developing these skills among teachers [26,27] or other working [4] in order to create significant educational environments for future citizens. At the same time, it is not stated that the competences at a given level of education are the same—rather, their high level of differentiation is confirmed [18]. It is important to conduct research on already developed digital competences and on methods of modelling these competences.

2. Materials and Methods

Presented different approaches to defining digital competences focus on two basic divisions relating to IT and information competences. These two groups of competences were adopted as the basis for the study of digital competences of Polish and Slovak students. A similar division in their digital competence research of Spanish undergraduate students was used by Guzman-Simon et al. An important element of our research is to indicate how students evaluate their digital competences, for whom the digital world is somewhat a natural world, since from the beginning of their lives this world has been well integrated into their reality. On the one hand, it can be assumed that they are brought up in the digital world and naturally shape their digital competences. On the other hand, it should be assumed that there is a great diversity in how they deal with ICT and what they know about it [6]. In addition, development of digital competences is associated with some effort and time. The study seems to be justified in the light of postulates indicating the need for a broader analysis of a group of young people—the most vulnerable to the development of these competences [28].

For the purpose of this study, own research was carried out, which aimed at analysing the perception of digital competences by Polish and Slovak students. The study was divided into three stages. In the first stage of research, based on the available literature, the groups of competences: IT and information were listed (Table 1). The second stage included selection of a research sample, development of a questionnaire, conducting research and statistical preparation of obtained results. Respondents assessed their skills in the area of surveyed competences based on their own opinion. In the third stage of research, groups of skills within the scope of IT and information competences were determined, both for Polish and Slovak students, which in their opinion they can demonstrate. Statistical relationships.

Table 1. IT and information competences.

Variable	IT Competences	Variable	Information Competences
T1	Write, edit and send text in a text editor	C1	locating pages with the information you need
T2	Verify the text by checking spelling/dictionaries		
T3	Insert images/symbols in a text editor	C2	web browsing
T4	Insert and edit tables in a text editor	C3	Finding the specific information you need on the websites of government agencies
T5	Use drawing/graphics applications such as Power Point		
T6	Move files/folder on the computer	C4	searching websites in a language other than Polish
T7	Move files/folder on the smartphone		
T8	Move files/folder between devices	C5	selection of the right information from the Internet
T9	Use copy tools		
T10	Use cutting tools	C6	organized file organization on your computer
T11	using the basic functions of spreadsheet		
T12	compressing files	C7	Organize the information found by e.g., placing them in lists and tables
T13	Connect and install new devices, e.g., printer, scanner, etc.?		
T14	Install the program on your computer	C8	Assess the quality of information that can be found on the Internet, for example, whether it is old, biased or unreliable
T15	Search for and install a smartphone program/application		
T16	Uninstall the program on your computer		
T17	Uninstall the program/application yourself on your smartphone	C9	Assess the security level of publishing information on the Internet, for example on Facebook,
T18	Programming in a specialist language		
T19	Use internet search engines (e.g., Google, Yahoo etc.)	C10	entering information using a template on the web
T20	transferring data from a spreadsheet	C11	Read and/or comment on the blog
T21	Set up/create private email address		
T22	Send and receive e-mail		
T23	Send an email with attachments		
T24	using e-mail/calendar systems		
T25	using file-sharing programs (P2P)		
T26	creating websites		
T27	Transfer photos from a digital camera to a computer		
T28	Transfer photos from a smartphone to a computer		
T29	Make calls via the Internet		
T30	creating an electronic signature		
T31	Send/receive SMS/MMS from a mobile phone		
T32	Connect to the Internet using a mobile phone		
T33	Order and buy tickets online		

Table 1. *Cont.*

Variable	IT Competences	Variable	Information Competences
T34	Buy and sell goods via native websites		
T35	making commercial transactions using languages other than native		
T36	Use IP telephony or Skype		
T37	Using an electronic signature		
T38	Participate in online communities, e.g., Facebook or Instagram		

Source: Own processing.

For statistical analysis, we used the Statistica 12 programming software, which we chose as a suitable tool for creating statistical models and data analysis. This program is also used in the creation of graphs and their subsequent analysis. During the clustering process, we chose Ward's method and the degree of similarity of the investigated objects was determined using the Euclidean distance.

A prerequisite for performing a cluster analysis is the testing of statistical significances depending on the individual variables at the significance level of 5% (α = 5%). The starting point for the analysis was the construction of a correlation matrix that contains Spearman correlation coefficients. In compiling this matrix, we tried to eliminate the problem of high dependence between variables, which could affect the results of the classification. To partially solve the problem, we used the main components method, which transforms the input indicators into new variables. The cut-off level—indicating the number of groups—was set arbitrarily on the basis of graphical analysis and marked with a dashed line. A given group includes the answers with the greatest similarity in terms of frequency and structure of occurrence. Due to the presence of an interval scale in the research questionnaire, the U-Mann-Whitney test was used for group comparisons (e.g., Polish and Slovak students), which is treated as an equivalent of the t-Student's test for weaker scales.

3. Results

The study involved 343 Polish and Slovak students, including 172 from Poland and 171 from Slovakia. The survey was conducted in October-December 2018. Students participating in the study were students of both engineering and bachelor studies. They were full-time and part-time first and second cycle students. The survey was conducted directly using survey questionnaires. Reliability of the questionnaire was verified using Alfa-Cronbach (α = 0.973).

Division into two groups of competences seems to be clear (Figure 1). The first concerns programming in a specialist language, using file-sharing programs (P2P), creating websites and an electronic signature, using that signature and making commercial transactions using languages other than Polish. A deeper division would isolate, at most, programming in a specialist language from this group. Other IT competences are basically grouped, and further division would distinguish two groups.

In the case of Slovak students, the division into two groups reaches a distance of "60" (Figure 2). In the first group, transactions in a foreign language were not indicated, but IT competences such as using e-mail/calendar systems, transferring data from a spreadsheet, using the basic functions of this spreadsheet and compressing files were included. In practice, in the case of Slovak students, the division into three groups of IT competences seems to be more justified.

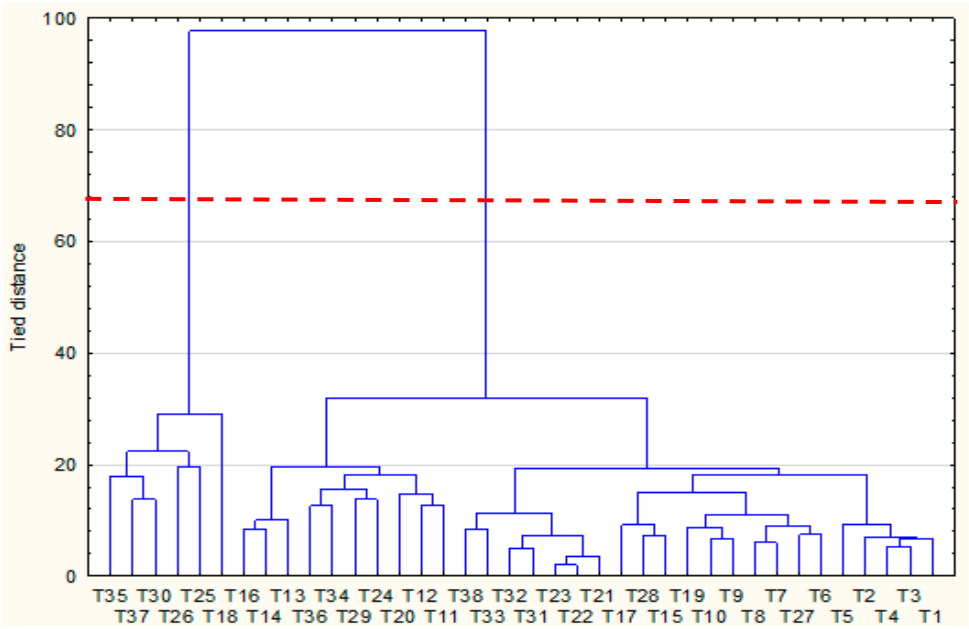

Figure 1. Cluster analysis using Euclidean distance (Ward method) for digital and IT competences—students in Poland. Source: own elaboration.

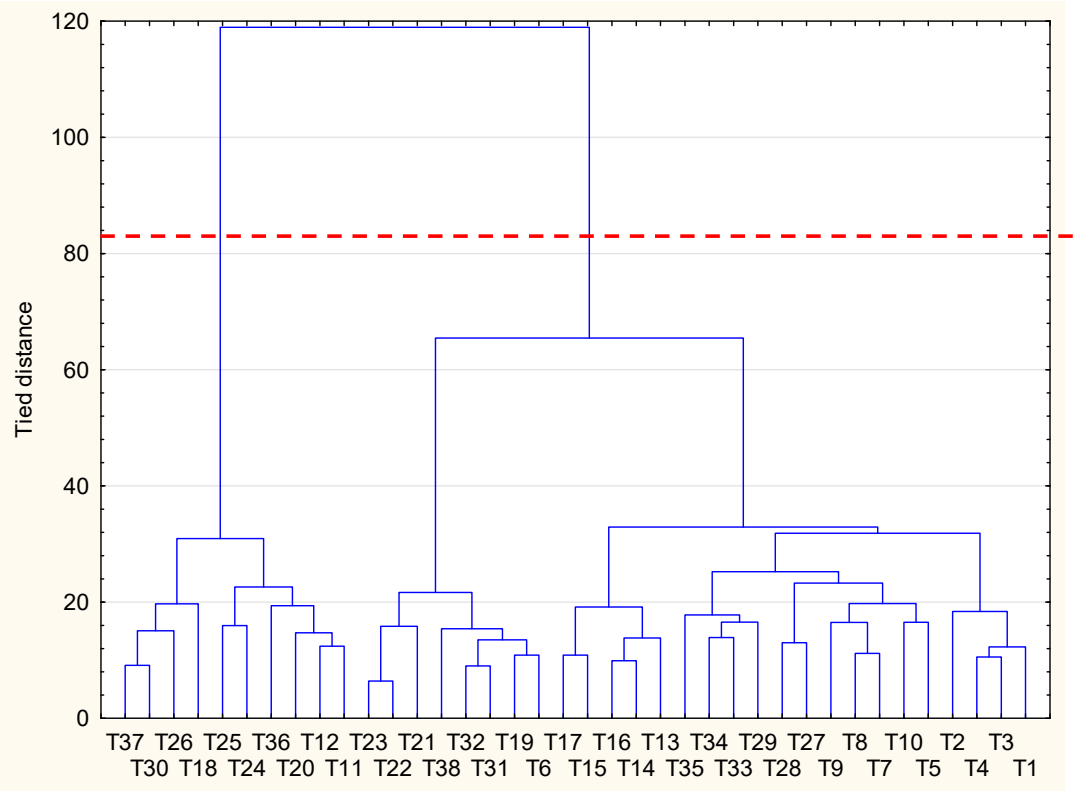

Figure 2. Cluster analysis using Euclidean distance (Ward method) for digital and IT competences—students in Slovakia. Source: own elaboration.

In the case of digital information competences, differences in the approach of respondents from both countries are much clearer (Figure 3). In Slovakia, one group includes web browsing and locating pages with the information you need, organized file organization on your computer and selection of the right information from the Internet. In the case of Poland, these competences are also closely

related, but they occur in a much broader group. In turn, here we can distinguish a two-element group containing only searching websites in a language other than Polish and entering information using a template on the web.

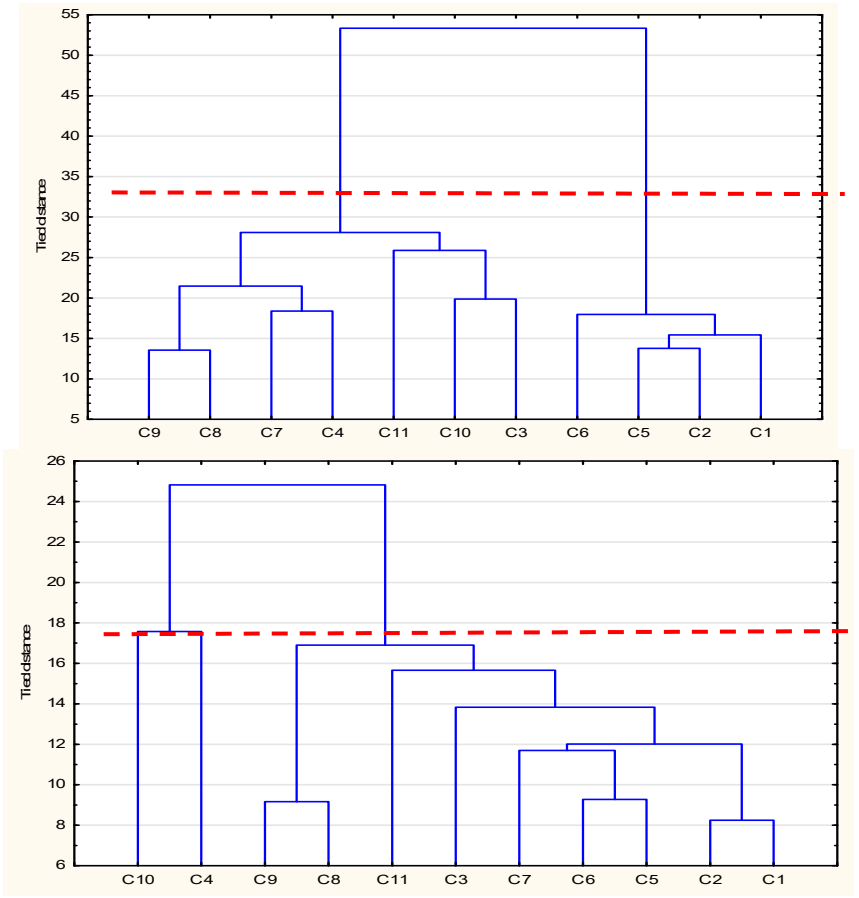

Figure 3. Cluster analysis using Euclidean distance (Ward method) for digital and IT competences—students in Poland and Slovakia. Source: own elaboration.

In the case of competences, Polish students clearly have stronger relationships. As much as 89.2% of the correlations between competences are statistically significant and positive correlations. For Slovak students, this only applies to 69.8% of them, while an additional 8 (1.1%) are statistically significant negative correlations between competences.

Results of the U-Mann-Whitney test clearly show that in all cases (except for locating websites containing important information) Polish students rate their competences higher than their Slovak counterparts (Table 2).

In general, the assessment of the level of digital competence of Polish students is not only higher but also less diverse. According to the PISA research, Polish students also demonstrate higher competences than Slovak ones in all surveyed areas, and this difference is significant [29]. These results, although consistent with other reports, raise some doubts. Therefore, the data held, although determined on the same scale, was normalized. The obtained ratings were once again subjected to the testing procedure. The hypothesis: 'equal/unequal level of assessment of a given competence between students from Poland and Slovakia' was verified.

Table 2. Mann-Whitney coefficient values for competences assigned to students from Poland and Slovakia.

Variable	Raw Data		After Normalization		Variable	Raw Data		After Normalization	
	Z	*P*	Z	*P*		Z	*P*	Z	*P*
T1	10.838	0.000	−1.179	0.238	T26	10.302	0.000	1.423	0.155
T2	11.589	0.000	−0.499	0.618	T27	11.112	0.000	3.582	0.000
T3	11.837	0.000	0.094	0.925	T28	10.56	0.000	1.883	0.060
T4	11.658	0.000	0.415	0.678	T29	8.798	0.000	−2.381	0.017
T5	9.984	0.000	−2.154	0.031	T30	9.819	0.000	−0.060	0.952
T6	4.700	0.000	−5.497	0.000	T31	6.746	0.000	1.969	0.049
T7	7.833	0.000	0.223	0.823	T32	3.915	0.000	1.046	0.295
T8	9.497	0.000	2.976	0.003	T33	9.222	0.000	1.198	0.231
T9	9.546	0.000	2.579	0.010	T34	7.125	0.000	0.117	0.907
T10	10.776	0.000	1.028	0.304	T35	6.241	0.000	−2.351	0.019
T11	12.864	0.000	1.295	0.195	T36	11.663	0.000	2.744	0.006
T12	11.877	0.000	5.169	0.000	T37	9.48	0.000	2.071	0.038
T13	11.128	0.000	0.861	0.389	T38	5.402	0.000	0.947	0.344
T14	11.247	0.000	1.248	0.212	C1	1.446	0.148	−0.055	0.956
T15	10.197	0.000	−2.422	0.015	C2	5.262	0.000	−4.290	0.000
T16	11.777	0.000	0.963	0.336	C3	5.506	0.000	−9.140	0.000
T17	10.506	0.000	−0.750	0.453	C4	8.752	0.000	2.328	0.020
T18	3.309	0.001	−1.418	0.156	C5	11.381	0.000	1.071	0.284
T19	4.372	0.000	−6.386	0.000	C6	11.028	0.000	1.733	0.083
T20	10.892	0.000	−7.398	0.000	C7	10.291	0.000	2.806	0.005
T21	10.259	0.000	0.120	0.904	C8	11.788	0.000	3.775	0.000
T22	8.167	0.000	3.105	0.002	C9	10.709	0.000	1.151	0.250
T23	9.204	0.000	1.692	0.091	C10	7.107	0.000	−4.852	0.000
T24	11.016	0.000	−0.612	0.541	C11	11.598	0.000	2.557	0.011
T25	9.33	0.000	1.512	0.130					

Source: Own processing.

Out of 49 examined competences, 32 were rated higher for students from Poland, including 12 significantly higher. In turn, for Slovak students 17 competences were rated higher, including 10 higher than for Polish students. Thanks to the tool used, we received information about the advantage of assessing a given competence in relation to others. Moreover, possible disturbances resulting from customs, cultural behavior, 'false' modesty have been eliminated thanks to normalization. It turns out that while in the case of IT competences the most of Polish students is clear (25 out of 38, including 9 important ones, in the case of Information competences we are dealing with almost equilibrium, and certainly it concerns the number of significant advantages (Figure 4).

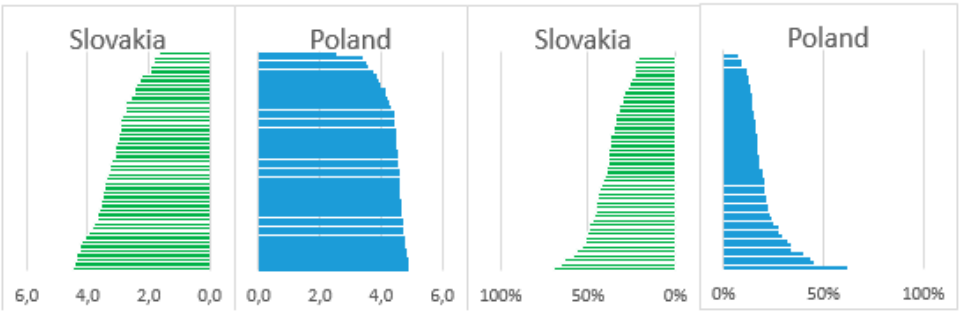

Figure 4. Average grades for students from Poland and Slovakia as well as average grading. Source: own elaboration.

It turns out that diversity of competences of Slovak students is significantly higher than that of Polish students ($F = 2.648$; $p < 0.001$). Moreover, in the case of student competence assessments in Poland, a statistically significant positive correlation is observed between the size of grades and their

differentiation ($r_{xy} = -0.986$; $p < 0.001$), in contrast to Slovak students ($r_{xy} = 0.840$; $p < 0.001$). If we assumed that a grade above 2.5 was acceptable and satisfactory, at least 3, 20% of competences in Slovakia would be assessed unacceptably and 39 unsatisfactory. In Poland, only programming in a specialized language would receive an unsatisfactory but acceptable assessment (2.51).

4. Discussion

The proposed assessment of digital competences is one of the approaches that can be taken as a voice in the extensive discussion on these assessments and the complications associated with it. Research on the perception of the diversity of digital competences of various social and professional groups is important not only for the development of a strategy for strengthening digital futures in individual regions [30] but also for larger areas. Having digital competences supports distance education and opens up opportunities for further education [31].

The conducted research did not take into account the factors influencing the level of digital competences, as was the case with the research by Hatlevik and Christophersen [18]. Nevertheless, this study also found differences in the digital competences of learners from different schools. This means that the competences at a given level of education are not the same, which rather confirms their level of differentiation and corresponds to the results obtained by other researchers [17]. The presented research also correlates with the PISA research, according to which Polish students show higher than Slovak competences in all the analyzed areas, and this difference is significant [32].

An important element in creating digital competences of students is the analysis of the relationship between educational programs and the level of competences of learners, which has not been taken into account in this study, and, as the papers indicate [10,23,27,33] obtaining an answer regarding these relationships will allow for the creation of appropriate work and education environments.

Our research shows that students cope better with basic tasks describing digital competences than with more difficult tasks, where the level of their competences is rather low [34]. The obtained results are important not only at the level of shaping an appropriate education strategy, but also at the stage of finding a suitable job [35,36] by people graduating from schools and universities. In the modern world, digital competences affect the quality of life of an individual and entire organizations, which is why their constant monitoring, classification and evaluation is a process included in the development of our society.

5. Conclusions

Research presented in the work shows how Polish and Slovak students perceive their digital competences. Such results do not imply how actual skills really look like because at this stage of research they have not been verified. These studies primarily show similarities and differences in the perception of skills between groups of questioned students and can indicate those groups of competences that are more developed or needed in a given environment. Results of these studies may be important for creating new educational environments for future citizens [10].

Research results showed that assessment of the level of digital competences of Polish students is not only higher but also less diverse (Figures 1 and 2). In addition, it was pointed out that IT competences of Polish students can be divided into two groups and Slovak ones into three groups. The first group for Polish and Slovak students is almost the same—In Poland it is a bit broader but contains (apart from buying and selling goods via websites in languages other than native) all variables indicated in Slovakia. In both cases, variables listed in the top ten are furthest from the mentioned group. The other grouping elements, however, are much more diverse. In the case of digital information competences, clearer differences in the view of respondents from both countries were observed (Figure 3).

The way students perceive their competences can be important when looking for a job, building a career, creating relationships and overall functioning in society. In addition, research results can be

useful for those in charge of education who are developing a new learning framework at every level of education to improve the competences of students.

Obtained results of the research cannot be generalized to other groups of students because it carries some risk resulting from limitation of the research. This study does not identify elements that are relevant to shaping competences, to what extent participation in classes, level of studies, their type and field of study have an impact on the perception of digital competences. This also applies to the status of origin or the fact that students undertake work during their studies.

Nevertheless, presented results should form the basis for further discussion on the development and direction of shaping digital competences. The significance of ICT is constantly growing, therefore research related to digital competences can contribute to their better development, which is important.

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