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Research Article

Digital hygiene among teachers

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ABSTRACT

The aim of the study was to diagnose the level of digital hygiene among teachers in Poland. The study was also intended to reveal the factors (socio-demographic variables) that differentiate the level of attitudes and activities enabling the safe use of digital devices and the Internet. The research was conducted using the digital hygiene test and was carried out in the second half of 2023 in Poland (N = 736) in line with the need to strengthen the skills enabling the use of new technologies in a way that does not threaten digital health and safety. Based on the data collected, it was noted that (1) the surveyed teachers most often drew attention to not using the phone in a situation requiring attention, e.g., crossing a road or a track. In addition, very frequent behaviors included not accepting unknown people as friends, limited trust in links and content on the Internet, and conscious digital footprint actions; (2) the least frequent behaviors were the physical disinfection of smartphones, avoiding using phones before bedtime, and actively responding to negative content posted on the Internet; (3) individual digital hygiene activities are rarely correlated in a significant way, suggesting high internal differentiation; (4) having good ICT habits in one area does not guarantee the same in another area; (5) cluster analysis showed that 9% of teachers have a high level of digital hygiene in selected areas; (6) 44% of teachers have varying levels of digital hygiene, while 46.2% have medium or low levels of digital hygiene; (7) gender does not differentiate digital hygiene levels; and (8) workplace and school type is a factor in digital hygiene levels.

Keywords: digital hygiene, digital competence, digital wellbeing, teachers, Poland

INTRODUCTION

Teachers are a pillar for digital safety in the school environment. The proficiency in handling digital media in both the didactic and educational dimensions depends on a number of important processes that increase didactic effectiveness (Stosic et al., 2020), minimize negative phenomena such as problematic Internet use, cyberbullying, online abuse and fraud, and others (Smahel et al., 2020). The skillful implementation of information and communication technologies (ICT) is now one of the elementary skills for modern educators, as is the use of analogue teaching resources. Nonetheless, over the last few years, a number of questions have been raised not only related to defining and determining a school's level of digital maturity (Balaban et al., 2018), but also relating to mapping and developing the skills that students and teachers should have in

this era of digital transformation characterized by a high saturation of ICT in private and professional life (Siddiq et al., 2023).

The current literature has a well-developed theoretical framework and an extensive palette of research findings relating to teachers' digital competence (Guillén-Gámez et al., 2020; Tomczyk & Fedeli, 2022). An exemplification of such an assumption is, for example, the popular DIGCOMP 2.2 concept, which comprehensively defines five main areas related to information and data processing, communication and collaboration, digital content creation, security, and problem solving. In the latest version of DIGCOMP (Vuorikari et al., 2022), which is a theoretical framework guiding research and the development of teacher digital competence, special attention has been paid to security issues. In section 4, issues related to the use of tools for individual protection in cyberspace, for the protection of personal data and privacy, for the protection of health and well-being, and for the protection of the environment are singled out. Based on the compilation of the latest version of DIGICOMP 2.2 (Vuorikari et al., 2022), as well as the results of systematic analyses related to the knowledge, skills, and attitudes related to the use of ICT in the teaching environment (Tomczyk & Fedeli, 2022) and the national report on digital hygiene (Bigaj et al., 2023), it was noted that the issue of digital safety, with a particular focus on digital hygiene, is a topic characterized by an empirical gap.

Although the digital competences of teachers have been researched for many years and with the help of a multitude of theoretical frameworks, such as that mentioned above, one can nonetheless notice a lack of research in Poland and the neighboring countries (e.g., Visegrad group) in the area of digital health and the security of this key social group. This gap refers primarily to research based on a clearly defined and up-to-date theoretical framework and including samples that allow for generalization. Furthermore, it should be emphasized that currently, the priority for diagnosis is mainly given to young people, while the issue of developing appropriate habits of ICT use among adults is receding into the background or is studied in only a very marginal way (Bigaj et al., 2023). Therefore, this article is in line with the need to explore the level of digital hygiene in the group tasked with complex educational tasks that also relate to cyberspace. The data collected will allow us to assess an important component of digital competence among teachers, contributing to the discussion on preparing teachers to face the challenges arising from the rapid digitization of school and non-workspaces.

To more clearly present the contribution to the international discussion on digital hygiene among teachers, the manuscript refers to extensive scientific literature on digital safety among teachers, as well as the concepts of digital citizenship and digital wellbeing, which are the pillars of this research. When it comes to cybersecurity in education, recent research documents teachers' readiness and range of experiences in developing cybersecurity lessons (Childers et al., 2023). The results of the research indicate that digital security, both from an individual and institutional perspective, is a global trend in primary and secondary schools (Ibrahim et al., 2024). These aspects are mainly developed in the context of strengthening the skills and knowledge of young people. It is natural for teachers and education policymakers to focus on the issue of security among groups that are exposed to various types of e-threats. At the same time, it should be noted that teachers receive significantly less attention in terms of both research and programs strengthening digital competences in the field of digital threats. Therefore, this study is an attempt to answer the question of to what extent teachers are prepared to protect themselves in the digital world.

When analyzing the literature on the subject, attention should also be paid to the issue of digital citizenship in the context of new diagnostic instruments and theoretical approaches that strengthen the functioning of teachers in cyberspace (von Gillern et al., 2024). Digital security (including digital hygiene as its component). Digital security is increasingly presented and diagnosed not only from an individual perspective, but also in a broader context resulting from social interactions mediated by ICT. When supplementing digital security issues with broader socio-cultural contexts, researchers should consider media literacy and socialization in the new media space (Trültzsch-Wijnen, 2020), which are undoubtedly crucial for all members of the school ecosystem. When conducting research of this type, it is important to be aware when one group has lower digital competences, it not only exposes itself to e-threats, but is also unable to effectively protect other groups. This is a critical factor when considering the status and roles assigned to contemporary teachers.

In parallel to the above-mentioned topics, it should be noted that the literature on digital wellbeing raises many issues focused on healthy screen use practices. In particular, these aspects have been emphasized in

the context of digital safety in the post-pandemic period (Pyżalski et al., 2021; Singh & Balhara, 2021). At the same time, in the areas at the intersection of pedagogy and new media psychology, as well as computer science, we can observe the development of security-oriented approaches, which increasingly emphasize the role of cyber hygiene for sustainable digital practices (Yegen et al., 2023). Considering the above contexts and the diversity of approaches to defining and measuring digital hygiene among teachers, the novelty of this work lies primarily in its contribution to the global discussion on the digital security of teachers and in filling a local empirical gap. Furthermore, it should be noted that measuring e-safety behaviors in the context of digital hygiene requires a large-scale, behavior-focused diagnosis of cyber hygiene. Such research fits directly into opinion-forming concepts, e.g., in line with the DigComp 2.2 'safety' framework (Vuorikari et al., 2022).

Research Overview and Theoretical Framework

Currently, media pedagogy is dominated by studies dedicated to the digital safety of young people (Mantilla & Edwards, 2019). This is understandable, logical, and justifiable, as the youngest users of new media are exposed to various types of e-risks due to their low level of digital competence and developmental conditions. Young people make intensive use of the entertainment and communication potential of new media. Such a situation and the assumptions of official educational programs (enshrined, among other things, in formal education curricula) automatically enforce the diagnosis and design of pedagogical interventions aimed at shaping correct behavior related to the use of digital media (also referred to as screen media). However, in recent years, there has been an increasing focus on the level of positive habits, knowledge, and skills related to the appropriate use of new media among other groups, such as parents (Wahyuningrum et al., 2020) and teachers (Potyrała & Tomczyk, 2020). Although these two groups are crucial in the upbringing and media socialization of young people (Trültzsch-Wijnen, 2020), research on their behavior in the new media space suffers from the large number of gaps regarding the diagnosis and strengthening of e-safety skills (Vissenberg et al., 2023).

A specific element of shaping digital security, which is a component of digital competence (Tomczyk, 2020), is the issue of maintaining adequate digital hygiene. Although this topic has been explored in the literature for several years (Boulet, 2006; Mikolajczyk et al., 2023), the diagnostic indicators of this key concept for achieving well-being in the digital age are currently being transformed and redefined. More recently, the concept of digital hygiene has become popular in the public debate and is driven by the increase in screen time, as well as the exponential growth of different types of e-hazards to which all users are exposed regardless of age. In this paper, digital hygiene will go beyond the typical perception of the concept by limiting the time spent using new media (Singh & Balhara, 2021), or the skills and knowledge relating to staying digitally safe in technical terms (Yegen et al., 2023). Such an assumption stems from the evolution of the concept and logically connects the different dimensions of activities aimed at preserving well-being resulting from the interaction taking place between humans and ICTs.

In this study, digital hygiene is defined according to the concept presented by researchers from the Institute for digital citizenship (Bigaj, 2023; Bigaj et al., 2023), which captures the concept as "health-protective behavior related to the use of ICT, especially screen devices and the Internet" (Bigaj et al., 2023, p. 10). The concept captures digital hygiene only in the context of real behaviors, as opposed to other approaches, concepts, and definitions that also take attitudes into account. In a comprehensive view of digital hygiene, attention is paid to desirable behaviors that protect against potentially harmful consequences of ICT use. In its approach, digital hygiene does not aim to emphasize negative consequences but focuses on appropriate and therefore positive habits regarding the use of ICT. The main components of digital hygiene include 39 behaviors attributed to setting boundaries and control in the use of screen devices; using the Internet and screen devices safely; creating and receiving information online appropriately; and other recommended health-promoting behaviors related to ICT use (Bigaj et al., 2023). A detailed summary of the areas that make up each of the main categories of digital hygiene is shown in **Figure 1**.

The selected elements presented in **Figure 1** are consistent with the soft areas of digital competence. From this perspective, digital competence is not only the use of software, hardware, and e-services, but also the understanding of how ICTs affect the behavior, health, and digital safety of their users (Tomczyk, 2020). Digital hygiene is therefore a key component of digital competence, related to habits and reflection on the intentional use of ICTs. Digital hygiene is a determinant of digital safety during everyday interactions with

Figure 1. Digital hygiene among teachers – Components of the concept (Authors' own work in Canva)

devices and software and is as important as the effective use of the potential inherent in new media for professional or private purposes.

Digital hygiene is also a response to the increasing impact of ICT on different spheres of human life regardless of age. Analyses related to the level of digital hygiene became particularly important during the COVID-19 pandemic (Pittaway, 2020). The overload of digital information, the need to quickly transform many activities typical of the offline world to the online space, forced many professional groups to reflect on their style and awareness of ICT use. This activity has also become relevant among teachers, a professional group that should be particularly prepared to mold the safe and reflective use of new media (Sklar, 2017). Given the empirical gap described earlier, it was decided to transfer the concept of digital hygiene (Bigaj, 2023; Bigaj et al., 2023) to the socially crucial group of teachers. This not only broadens the knowledge on the style of ICT used by educators but allows the discussion to begin about the real preparation of teachers to act as educators of the younger generations–digital natives. Such a necessity is also enforced by an increasingly computerized reality, in which screen time is systematically increasing (Tomczyk & Lizde, 2023), and each user–regardless of age–is exposed to a number of e-risks conditioned by low awareness and negative habits related to the use of new media.

METHODOLOGY

Research Objective, Research Problems, and Subject Matter

The aim of the research was to diagnose the level of digital hygiene among teachers. The aim of the research not only stems from the need to show the level of awareness of the impact of ICT on the daily functioning of those responsible for the media education process in the school environment but also relates to discovering the level of "soft areas" of digital competence. The purpose of the research has a diagnostic

aspect and allows the level of critical digital and media skills to be juxtaposed with the challenges of today's information society. The research objective has been operationalized by the following research questions (RQs):

RQ1: What is the level of each area of digital hygiene among teachers?

RQ2: What is the relationship between the different areas of digital hygiene?

RQ3: What proportion of the survey sample are people with low levels of digital hygiene?

RQ4: To what extent do sociodemographic variables differentiate the level of digital hygiene?

Survey Procedure and Characteristics of the Survey Sample

The research was conducted in the second half of 2023 in two provinces in Poland: Śląskie and Małopolskie (Silesia and Lesser Poland). The research involved active teachers of different ages and professional experience. The research was exploratory and diagnostic in nature, inscribing activities between the risk paradigm and the opportunity paradigm of media pedagogy (Tomczyk, 2021). The schools and teachers collaborating with the research team were invited to participate in the study.

A total of 736 teachers participated in the study. The mean (M) age of the respondents was 48.86 years (standard deviation [SD] = 8.58, minimum = 22, maximum = 71), which mirrors the age structure of teachers across the country (Statistics Poland, 2023). The surveyed educators included 88.85% women and 11.15% men. The average length of service was 23.14 years (SD = 10.47). Teachers from the following types of schools participated in the study: primary (71.73%), vocational (2.17%), secondary (12.90%), and technical (13.20%). The place of work was as follows: rural areas (17.66%), small city–population up to 20,000 (16.57%), medium city–population between 20,000 and 100,000 (34.64%), large city (31.13%).

The study was based on a non-probability sample recruited through cooperating schools in two provinces (Silesia and Lesser Poland). In accordance with the AAPOR guidelines (Baker et al., 2013) on non-probability samples, this project does not allow for conclusions to be drawn at the population level or claims to be made about the representativeness of teachers in Poland. The presented results, conclusions and recommendations are therefore limited to the sample participating in the study and aim to characterize the patterns occurring in the sample (e.g., the co-occurrence of digital hygiene behaviors and cluster profiles), rather than to precisely estimate the level of digital competence of teachers in Poland (Etikan, 2016). In order to increase the reliability of the research results, the age and gender distribution of the sample was compared with official statistics, noting the overall similarity of socio-demographic characteristics with the sample under study. Of course, it should be noted that such a comparison is descriptive in nature and does not eliminate the limitations associated with random sampling. The use of non-random sampling was primarily due to budgetary constraints that made it impossible to reach randomly selected teachers from a population of over 690 active teachers in Poland.

Research Tool

The study used the digital hygiene self-assessment questionnaire (Bigaj, 2023; Bigaj et al., 2023). The tool contained 39 indicators (diagnostic questions) defining 16 components:

- Area1: Setting boundaries and control in the use of screen devices (3 questions)
- Area2: Limiting contact with the screen device (3 questions)
- Area3: Focus on activities (3 questions)
- Area4: Secure sharing of personal data (3 questions)
- Area5: Protection against data theft (5 questions)
- Area6: Responsible content creation (1 question)
- Area7: Content selection and verification (3 questions)
- Area8: Responding to disturbing or dangerous content (2 questions)
- Area9: Taking care of quality of sleep (2 questions)
- Area10: Mindful eating (2 questions)
- Area11: Protection against malware infections (1 question)

- Area12: Attention to correct body posture and daily physical activity (4 questions)
- Area13: Hearing protection (1 question)
- Area14: Building good interpersonal relations (2 questions)
- Area15: Dealing with emotions and stress (2 questions)
- Area16: Compliance with traffic rules: prevention of accidents and injuries (2 questions)

For each of the RQs assigned to a particular area of digital hygiene, teachers responded on a 5-point Likert scale from *0–it does not apply to me* to *4–always or almost always*. The internal consistency of the tool was 0.877 (McDonalds omega), and 0.881 (Cronbach's alpha).

Given the instrument's composition (16 components and 39 items), several subscales are either single-item (A6, A11, and A13) or two-item (A8, A9, A10, A14, A15, and A16), and all three-item subscales (A1, A2, A3, A4, and A7) are saturated (df = 0). Consequently, global fit indices (CFI, TLI, and RMSEA) can only be provided for subscales with p ≥ 4 items. For A5 (5 items), χ^2 (5) = 61.35, CFI = 0.91, TLI = 0.82, RMSEA = 0.124; for A12 (4 items), χ^2 (2) = 9.31, CFI = 0.99, TLI = 0.97, RMSEA = 0.071. Sampling adequacy for the full 39-item battery was high (KMOoverall = 0.877; Bartlett's χ^2 (741) = 9042.47, p<.001). Internal consistency was acceptable for most multi-item subscales (e.g., αA1 = 0.785; αA2 = 0.727; αA12 = 0.741). We therefore interpret CFA where estimable, and triangulate validity evidence with reliability and structural analyses, noting that single-item and saturated two/three-item subscales limit the scope of global CFA fit reporting. The digital hygiene self-assessment questionnaire has a solid conceptual foundation: the items reflect the safety domain in DIGCOMP 2.2 and, what is particularly important, they measure actual behavior rather than merely declared attitudes. The content scope is broad: it covers exposure and concentration control, privacy and cybersecurity, as well as elements of psycho-physical well-being and traffic safety. The study confirmed the high adequacy of the sample for the entire battery of 39 items (KMO and Bartlett's test) and the acceptable reliability of most multi-item subscales. From a practical point of view, the tool is time-efficient and easy to use in diagnosis, monitoring and intervention design, and also allows teachers to be profiled according to behavior patterns. Nevertheless, the weakness of the tool is the varying length of the subscales: some of them have one or two items, and the three-item ones are statistically saturated. This limits the scope of classical confirmatory validation. For example, single-item subscales cannot be assessed in CFA or their internal reliability estimated. Two-point subscales are unidentifiable, and three-point subscales do not generate fit indices (df = 0). As a result, the full model at the item level is not subject to CFI/TLI/RMSEA reporting, and the fit is only presented for domains with ≥ 4 items.

As mentioned earlier, this research fits into the broader theoretical framework found in definitions of digital competence. Therefore, in order to explicitly establish the measurement tool in the European model of digital competence, the research tool used, the digital hygiene self-assessment questionnaire (Bigaj et al., 2023) with the Safety area in DIGCOMP 2.2. In accordance with the definitions and examples in DIGCOMP 2.2 (competences 4.1-4.4: device protection, data and privacy protection, health and wellbeing protection, environmental protection), this diagnostic approach contains 16 components mapped as follows:

(1) 4.1 protecting devices–indicators related to protection against malware and system security practices (e.g., AV updates, caution with links/downloads; areas A5.1-A5.3, A11.1),

(2) 4.2 protecting personal data and privacy–secure data sharing and management (e.g., strong passwords/MFA, privacy settings, selective acceptance of invitations; A4.1-A4.3, A5.4-A5.5), and

(3) 4.3 protecting health and well-being–behavioral habits to limit exposure and ensure mental and physical well-being (including setting boundaries and time controls, focusing on the task at hand, sleep and eating hygiene, posture/activity, hearing protection, emotion regulation and social relationships; A1-A3, A9-A15, as well as road safety A16 as an element of minimizing the risk of injury when using devices).

As a result, DIGCOMP 2.2 (Vuorikari, et al., 2022) provides the overarching theoretical basis, while the measurement provides behavioral, frequency indicators of three key safety sub-competences (4.1-4.3). Additionally, for a complete conceptualization, reference was made to the DigCompEdu framework emphasizing teachers' competences in the area of 'safety' (Punie, 2017), which justifies the operationalization adopted for the teacher population.

Research Ethics

The research was conducted in accordance with social research ethics. The self-assessment questionnaire was anonymized so that it was not possible to identify the teachers providing the answers. The surveyed educators were informed about the purpose of the research, how the data would be processed, and the possibility to withdraw at any time. A letter of introduction to the study also included information on how to contact the project team with any questions that might arise during the digital hygiene self-assessment process. The research was conducted in accordance with the procedures of the project's funding body, the National Agency for Academic Exchange, and in accordance with the methodological and ethical description of the project numbered (BPN/BKK/2022/1/00007).

FINDINGS

The issue of digital hygiene, understood as a series of positive habits related to the use of ICT, was operationalized through 39 activities characterized in detail in **Table 1**.

On the basis of the collected data, it was noted that most often (always or almost always–a group oscillating around 70%) the respondents drew attention to the issue of limiting the use of devices while

Table 1. Digital hygiene among teachers – Descriptive statistics

Items	M	SD	S	K	%				
					NA	NHE	T	O	AAA
A1.1. I pay attention to how much time I spend per day using screen devices such as phone, laptop/desktop computer, tablet, games console, and television.	2.47	1.00	-0.09	-0.67	1.63	14.95	35.60	30.30	17.53
A1.2. If I notice that I spend too much time using screen-based devices, I try to limit this time as much as possible.	2.60	1.01	-0.54	0.04	4.08	7.75	31.39	37.77	19.02
A1.3. I control the time I spend on entertainment in front of a screen on devices such as phone, laptop/desktop, tablet, games console, and TV.	2.59	1.10	-0.44	-0.55	3.80	13.04	26.63	33.15	23.37
A2.1. I avoid keeping my phone with me all the time, e.g., I do not carry it with me when I am at home.	2.88	1.15	-0.69	-0.69	2.04	14.95	15.35	28.13	39.54
A2.2. I limit the number of notifications on my phone, computer, e.g., turn off notification sounds, vibration, text notifications on a blank screen.	2.88	1.07	-0.71	-0.32	2.17	10.46	19.16	33.70	34.51
A2.3. I avoid checking messages and notifications on my phone and computer every time I notice them coming in.	2.47	0.98	-0.20	-0.62	1.50	16.03	31.11	36.69	14.67
A3.1. When doing an activity that requires concentration (e.g., working/studying/meditating/praying), I remove my phone from sight.	2.92	1.09	-0.70	-0.49	1.90	11.28	19.02	28.94	38.86
A3.2. When I do any work/study using the computer, I turn off background applications, games, and social networks.	2.72	1.25	-0.62	-0.78	5.44	15.76	15.76	27.45	35.60
A3.3. I delete programs or applications that I do not use.	3.02	1.04	-0.96	0.30	2.58	6.66	17.39	32.75	40.63
A4.1. I consider the negative consequences before I publish personal data, photos or other personal information online.	3.43	1.02	-2.07	3.74	4.35	2.58	5.98	19.57	67.53
A4.2. If I accept invitations to join my network of friends, they only come from people I know.	3.40	1.21	-2.08	2.97	9.10	1.22	3.13	13.45	73.10
A4.3. I check what data I leave about myself on the services, applications, and online platforms I use.	3.27	1.13	-1.68	1.99	5.98	3.26	8.29	22.55	59.92
A5.1. If I open a message or link, or download a file or application, it only comes from people or sources I know.	3.62	0.72	-2.46	7.38	1.09	1.09	4.08	22.15	71.60
A5.2. I update the antivirus software when a new version is available.	3.14	1.00	-1.04	0.51	2.04	4.48	18.21	28.13	47.15
A5.3. I only use Wi-Fi networks that I am familiar with	3.45	0.83	-1.75	3.33	1.36	1.77	8.70	27.17	61.01
A5.4. I protect my passwords on screen devices (e.g., I use hard-to-guess passwords, avoid using the same password for multiple accounts)	3.21	0.95	-1.13	0.66	1.09	5.57	13.59	30.44	49.32
A5.5. I set up privacy safeguards on accounts and social media, e.g., use multi-factor authentication	2.70	1.35	-0.80	-0.59	11.69	9.24	13.18	29.21	36.69
A6.1. When communicating on the internet (e.g., when writing posts, comments), I pay attention to the fact that what I write may have consequences for me and others, and affect the safety or well-being of people	3.24	1.40	-1.67	1.14	13.86	1.09	2.31	13.04	69.70

Table 1 (Continued).

Items	M	SD	S	K	%				
					NA	NHE	T	O	AAA
A7.1. I choose the content I want to see on the internet, e.g., I think before I click 'like' or 'follow', I avoid content that affects me badly.	3.43	1.04	-2.18	4.17	5.44	1.36	5.03	20.79	67.39
A7.2. I have limited trust in the content I come across on the internet, I don't believe everything I read or see there.	3.63	0.69	-2.46	7.80	0.95	0.82	3.67	23.10	71.47
A7.3. I verify information obtained on the Internet, e.g., check the source of the information, the author.	3.33	0.81	-1.22	1.50	0.68	2.04	11.28	35.46	50.54
A8.1. When I come across hateful posts, bullying, false news or fake profiles on the internet, I report it to the administrators of the site or app in question.	1.69	1.30	0.35	-0.94	21.33	28.13	23.64	14.40	12.50
A8.2. If I feel threatened on the internet, e.g., I am experiencing heckling or harassment, I turn to people close to me or those I consider competent for help.	1.32	1.55	0.66	-1.16	50.95	9.38	12.50	11.55	15.63
A9.1. I avoid using screen devices in the hours before bedtime.	2.03	1.06	0.32	-0.76	3.40	33.15	31.39	21.06	11.01
A9.2. I avoid putting my phone next to/near my bed before bedtime.	2.00	1.28	0.37	-1.19	6.79	41.30	16.71	15.08	20.11
A10.1. I eat my meals without a phone in sight.	2.90	1.11	-0.64	-0.65	1.90	11.69	20.92	25.68	39.81
A10.2. I avoid snacking while using screen devices.	2.75	1.17	-0.60	-0.58	4.48	11.28	23.51	26.36	34.38
A11.1. I clean/disinfect my mobile phone at least once a day.	1.79	1.05	0.43	-0.41	7.61	36.82	32.07	15.76	7.75
A12.1. When using screen devices, I adopt a comfortable, sitting or standing, upright, untwisted body position.	2.43	1.05	-0.19	-0.63	3.13	16.17	32.75	30.84	17.12
A12.2. When I use screen devices, I avoid staying still for too long, take breaks to change my body position, and do other activities.	2.58	0.98	-0.35	-0.33	2.31	10.87	31.79	36.69	18.34
A12.3. I devote a total of at least 30 minutes each day to activities involving moderate to vigorous physical exertion (e.g., brisk walking, running, cycling, and gym class).	2.47	1.07	-0.13	-0.87	2.04	17.94	30.84	28.94	20.25
A12.4. When I use a portable screen device, e.g., mobile phone, tablet, I try not to tilt my head, and I hold it at arm's length.	2.27	1.00	-0.02	-0.58	2.72	19.84	36.82	28.94	11.69
A13.1. When using headphones with screen devices, I turn down the sound so that it is quiet or moderately loud.	2.12	1.61	-0.24	-1.54	30.71	4.76	13.72	23.37	27.45
A14.1. I find time to talk to people in my family, friends or acquaintances as often as possible.	3.51	0.70	-1.78	4.57	0.82	0.68	5.30	33.02	60.19
A14.2. I keep my phone out of sight when meeting people, muting it whenever possible.	3.30	0.85	-1.29	1.59	0.82	3.67	9.78	36.55	49.19
A15.1. I pay attention to my well-being and my emotions when using the Internet or digital games, I notice the appearance of tension or discomfort.	2.75	1.26	-0.92	-0.12	10.05	5.71	16.98	33.29	33.97
A15.2. When my use of the Internet causes me tension or stress, I try to reduce it, e.g., take a break, do relaxation exercises, look for a solution to the problem, ask for support.	2.43	1.45	-0.55	-1.03	18.48	7.20	16.85	27.99	29.48
A16.1. When entering or crossing a carriageway, cycleway or track, including when entering or crossing a pedestrian crossing, I respect the provision prohibiting the use of telephones.	3.54	1.06	-2.37	4.43	4.76	4.35	2.45	9.38	79.08
A16.2. When operating a vehicle (e.g., car and bicycle), I respect the rule against using a phone.	3.28	1.26	-1.75	1.77	9.38	2.58	4.89	17.26	65.90

Note. S: Skewness; K: Kurtosis; NA: Not applicable; NHE: Never or hardly ever; T: Time; O: often; AAA: Always or almost always

travelling, e.g., crossing a road or track, accepting friend requests only from friends, limited trust in links and content on the Internet, and awareness of the digital footprint of activities undertaken in cyberspace. In contrast, the teachers surveyed (values of less than twelve per cent), are least likely to pay attention to cleaning mobile phones, avoiding using phones before bedtime, and actively responding to hate speech, fake profiles, and false information. Descriptive statistics showing the distribution of responses relating to the 39 indicators are presented in **Table 1**.

Responding to RQ2 using Spearman's rho coefficient, it was noted that, in the vast majority of cases, the areas of digital hygiene co-occurred at no more than an average level of correlation. The strongest co-

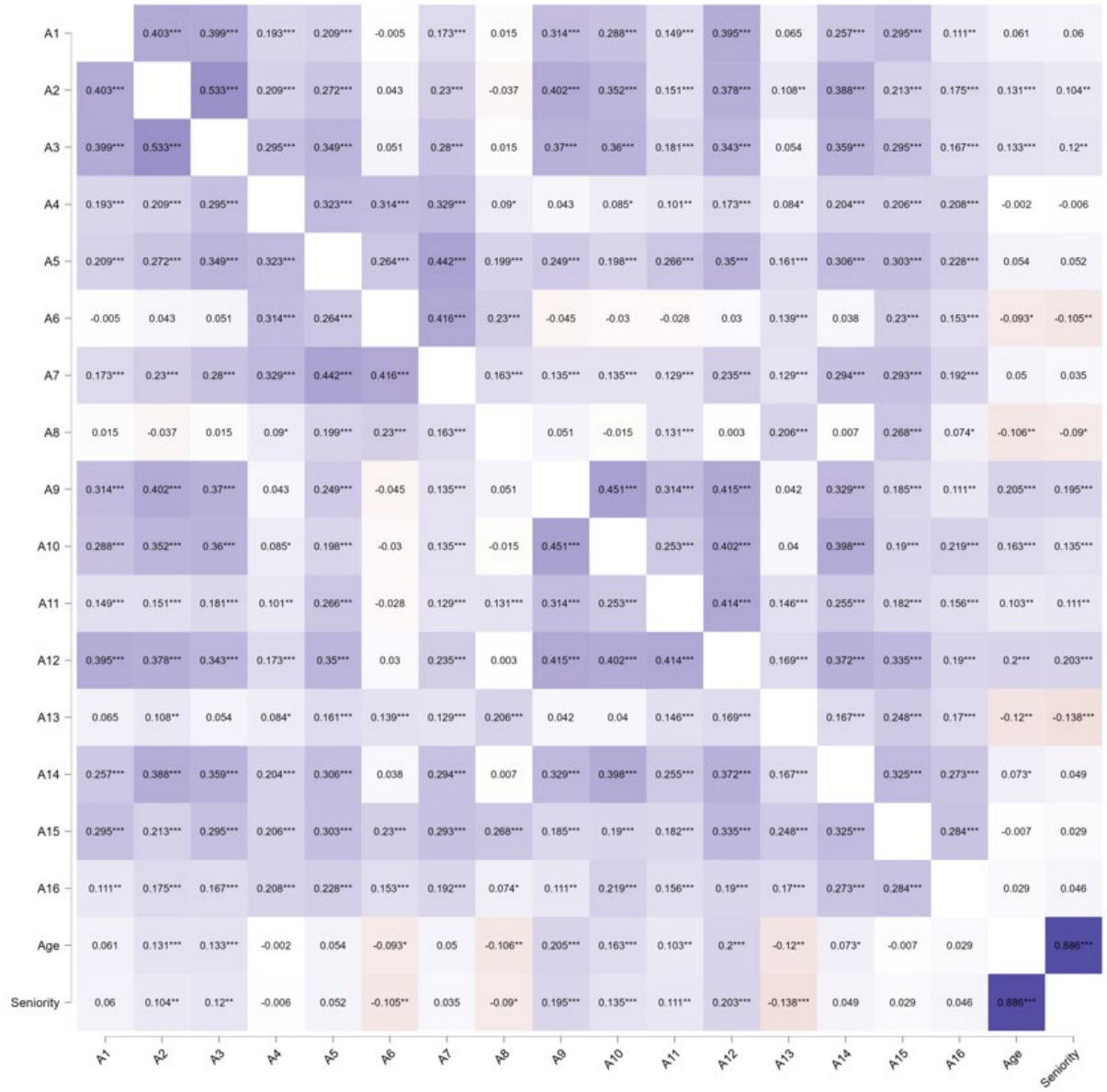

Figure 2. Co-occurrence of digital hygiene areas–Spearman's rho heatmap (Authors' own work in JASP)

occurrence was noted between *A2–Limiting contact with screen devices* and *A3–Focus on activities*. There are also several other correlations above the 0.4 level, such as the co-occurrence of A1 and A2, A7 and A5, and A10 and A9. The components A6, A8, and A13 are the least correlated with other areas of digital hygiene. Correlations of this type can be analyzed in several dimensions.

Firstly, the correlations illustrated in **Figure 2** show that the concept of digital hygiene is highly variable and having good habits in one area does not guarantee having good habits in another area. Minor exceptions are correlations at an average level and approaching the threshold of high correlations, such as A3 and A2, i.e., focusing on activities and limiting contact with the screen device. The two areas are complementary and serve to reduce screen time. However, this kind of high-threshold correlation is not abundant. This all demonstrates the lack of homogeneity in the concept of digital hygiene and demonstrates how vast the array of activities for physical and mental wellbeing is. When analyzing **Figure 2**, it is also important to note that for the variables metric age and length of service, no strong relationship was observed between any of these sociodemographic variables and the 16 dimensions of digital hygiene. In three cases (A6, A8, and A13), age and length of service have a negative correlation, so that digital hygiene in terms of responsible content creation or responding to negative content and hearing protection decreases minimally with the number of years.

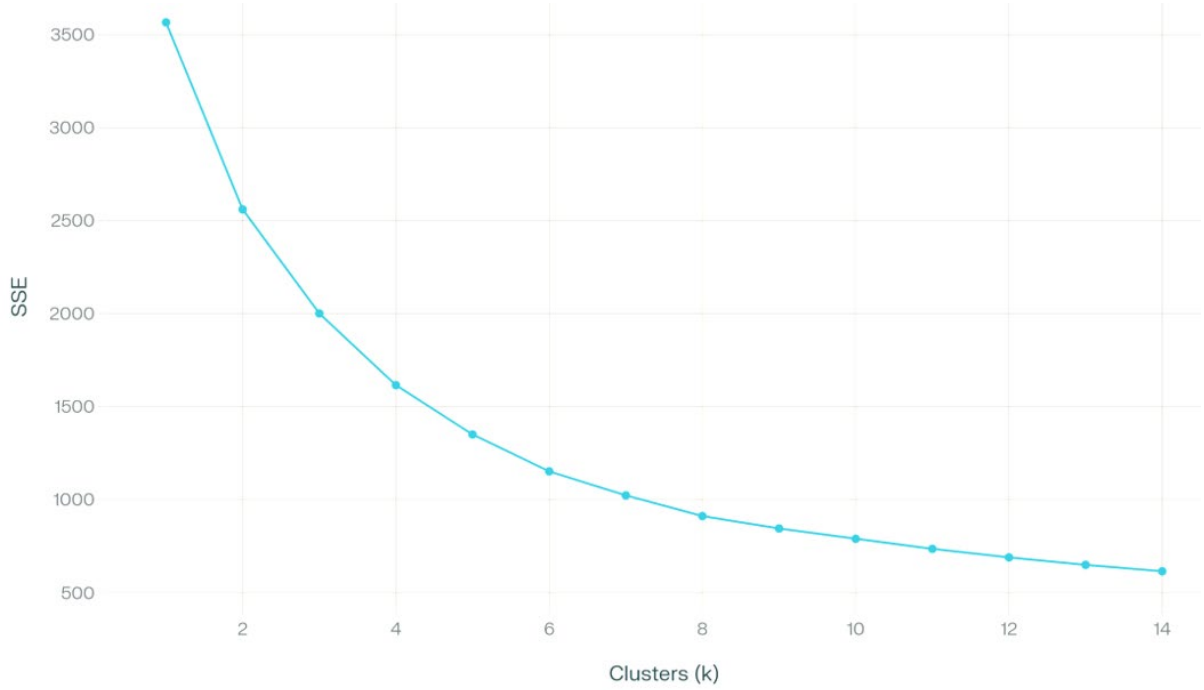

Figure 3. Elbow method for optimal k (Authors' own work in Excel)

The results presented in the **Figure 2** therefore suggest that the concept of digital hygiene is not a homogeneous construct, but rather a set of separate, partially independent practices. The weak and moderate interdependencies between the various areas of digital hygiene indicate that a high level of competence in one area (e.g., limiting screen time) does not necessarily translate into a similar level in another (e.g., responsible content creation or hearing protection). This fragmentation suggests the need to diversify educational activities. For example, instead of universal programs shaping 'general digital hygiene', interventions aimed at developing specific habits and skills may be more effective. The approach to defining and measuring digital hygiene is therefore a complex construct, as is the case with digital competences. At the same time, the lack of strong links between dimensions of digital hygiene and demographic variables (age, length of service) indicates that these practices are not determined by generational factors but rather result from individual behavior patterns and experiences in the digital environment.

Given the heterogeneity of the relationships between the components of digital hygiene, it was decided to carry out a detailed analysis relating to the differentiation of teachers by the level of the aforementioned behaviors. In order to answer RQ3, a method referred to as k-means cluster analysis was used. This is a non-hierarchical method, which allows for the classification (grouping–clustering) of data due to differential saturation of selected characteristics - in this case, digital hygiene components. Analyses using k-means cluster analysis are very often used in research in the social sciences with a particular focus on educational research (Dutt et al., 2017). In order to test the optimal number of clusters, representing groups with a certain level of digital hygiene, an analysis using the Silhouette method was first carried out (de Amorim & Hennig, 2015). Based on the multiple calculations performed and the determination of the fit coefficient AIC = 13,994.06 and BIC = 14,297.37, as well as the ability to logically characterize the individual clusters, the optimal number of clusters in the analysis was confirmed to be three. The elbow method graph (**Figure 3**) shows that for k = 3 there is a visible inflection point, which means that adding more clusters does not significantly improve the sum of squared distances (SSE). When analyzing AIC and BIC, the values are significantly lower than for one or two clusters. The values for a larger number of clusters decrease, but the decline is not as pronounced as in the case of k = 3, which is a reasonable compromise between model simplicity and fit quality. Furthermore, this choice is optimal in terms of interpretation and fitting the analysis to the theoretical model.

The first cluster (orange) is the group containing 9.0% (N = 66)–these are the respondents with the highest level of digital hygiene. In this group, there is no significant difference between male and female membership (9.0% vs. 8.5%). However, among the most prominent characteristics is the primary place of work (teachers

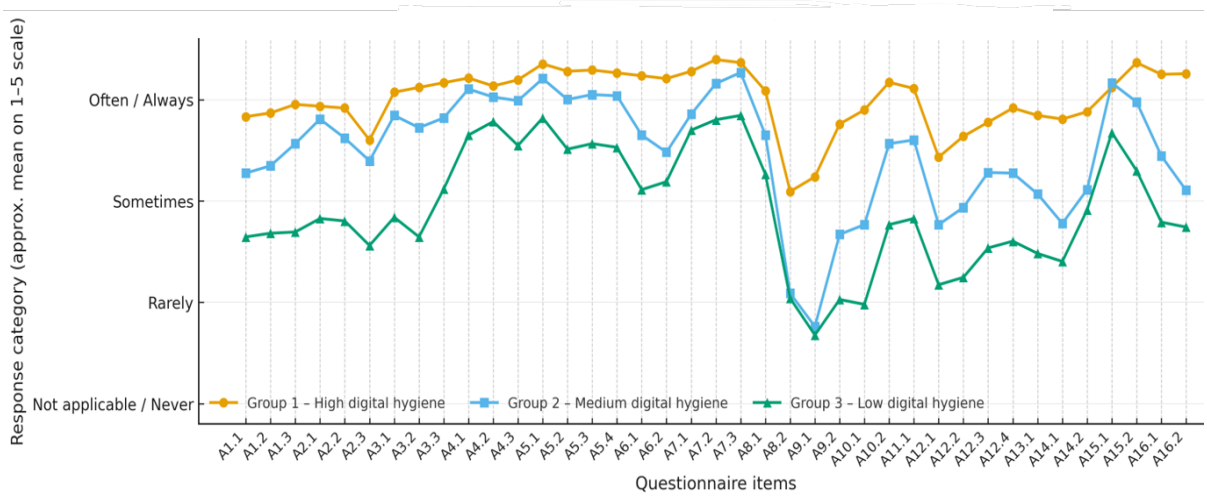

Figure 4. k-means cluster analysis: three groups of teachers with different levels of digital hygiene (Authors' own work in STATISTICA)

from vocational schools dominate this group at 31.3%, as well as those living in medium-sized cities (17.3%)). In the first least numerous group, the most frequent behaviors are A1.1-A8.3 and 14.1-16.2.

Cluster 2 (blue) is characterized by medium levels of digital hygiene. This is a cluster in which some digital hygiene behaviors are at an intermediate level (e.g., A1.3-A2.2 and A3.2) and some are at a low level (10.1, 11.1, and 14.1) or very low level (8.2) This cluster comprises 44.0% of respondents (N = 324). Within this group, gender does not differentiate membership ($p < 0.05$. Nevertheless, the leading group are teachers from technical schools (52.6%) and large cities with more than 100,000 inhabitants (60.7%).

The third group (green) contains almost half of the respondents 46.2% (N = 340). This is the group with the lowest level of digital hygiene. Only a select few (9 out of 39) exceed the threshold of performing the listed activities as *sometimes*. In this group, as in the others, gender does not differentiate membership. Nevertheless, in this group, teachers from rural areas (58.9%) and those working in primary schools (48.6%) can be distinguished most frequently.

It should also be noted that in the study sample, 0.6% of the observations were treated as unclassifiable, i.e., assignable to any of the three separate groups. The graphical distribution of the groups according to the level of digital hygiene is illustrated in **Figure 4**.

In order to verify in detail the relationship between teachers' membership of particular digital hygiene clusters and socio-demographic variables, a statistical analysis was performed using chi-square independence tests and. And also in the case of dichotomous variables, Fisher's test has been applied. The analysis included three sociodemographic variables like: gender, type of school, and location of the school. Since only the gender variable was dichotomous (female–male), Fisher's test was used only for this variable and analyzing the differences between the following cluster pairs: (1 vs. 2), (1 vs. 3) and (2 vs. 3). The results of Fisher's test did not show any statistically significant differences in gender proportions between any of the compared cluster pairs, so cluster 1 vs. 2: $p = 0.2369$; cluster 1 vs. 3: $p = 0.3407$; cluster 2 vs. 3: $p = 0.7035$. This means that the gender distribution was similar in all three groups of teachers. Also membership of the digital hygiene cluster did not significantly depend on the gender of the respondents. For the other variables, school type and school location it was not possible to use Fisher's test due to the multi-categorical nature of these variables (more than two categories). In these cases, Pearson's chi-square test was used, which also did not show any significant differences between clusters (school type: χ^2 [6] = 5.46, $p = 0.4866$; school location: χ^2 [6] = 7.45, $p = 0.2813$).

Table 2 presents the membership of each cluster by sociodemographic variable.

Table 2. Cluster membership by sociodemographic characteristics (in %)

Group	Female	Male	High school	Basic	Vocational school	Technical school	Large city	Small town	Medium-sized city	Village
1	9.00	8.50	11.60	7.60	31.30	10.30	1.70	10.70	17.30	3.90
2	44.10	43.90	42.10	43.50	25.00	52.60	60.70	50.00	29.80	37.20
3	46.20	46.30	45.30	48.60	43.80	35.10	37.10	38.50	51.80	58.90
Outlier observations	0.70	1.30	1.10	0.40	0.00	2.10	0.50	0.80	1.10	0.00
	Chi-square = 1.537, df = 2, p = 0.4636		Chi-square = 5.458, df = 6, p = 0.4866				Chi-square = 7.449, df = 6, p = 0.2813			

DISCUSSION

The bring your own device fashion of using the same equipment in the workplace as at home, as well as the prevalence of telecommuting, including remote courses, lessons, and tutoring, increases the permeability of the two environments. Indeed, maintaining an adequate level of safety in the professional environment also requires adherence to good safety practices in the personal and home environment (Pellegrini, 2019). Among the indicators of the digital hygiene self-assessment questionnaire used in the study, areas linking teachers' professional and personal-post-professional environments were included, which is in line with both Pellegrini's (2019) and other authors' views (Oddone et al., 2019, among others). At the same time, as proposed by the authors of this article, digital hygiene defined according to the concept of the team from the Institute for digital citizenship (Bigaj, 2023; Bigaj et al., 2023) alludes to Norbert Elias and Foucault's concept of 'care for the self' expressed in a biopolitical context and through its relevance to the field of health. This refers to a kind of vigilance to be implemented with regard to digital tools, the possibility to limit their impact on the rhythm of the day and night and, above all, the control of personal data (Wilhelm, 2021). Bosler and Wilhelm (2017) conducted research in France, Germany, Switzerland, and the USA, which revealed different attitudes towards digital lifestyle issues. The French and Germans remain above the European average (63%) when it comes to the threat context, but in general it is important that there is a certain hierarchy of topics centered around a specific context. Hence, the cluster analysis undertaken by the authors of this article, which confirmed that the concept of digital hygiene is very diverse, appears to have been justified. The heuristic model proposed by Wilhelm (2021) to explain representations and stated practices could be a further research field based on the results obtained by the authors, which opens up the prospect of exploration and the continuation of the present research.

One has to agree with the view that, at the level of socio-cultural discourse, historically constituted collective imaginaries (philosophy, education, and primary socialization) shape representations of knowledge on a given topic that are in constant circulation (media, texts, and discourses), which in turn influence the acculturation of technologies (concrete experiences and routines) into practices (Wilhelm, 2021). The authors of this article believe that it is certain regulations, education, and the pedagogical discourses that support them that influence the collective imagination and the circulation of the representation of knowledge about digital hygiene, in the first instance among teachers. Although teachers' habits seem relatively homogeneous in many respects, according to Blume (2020), this is a superficial view that requires deeper investigation to be understood, hence the attempt made to interpret the research findings in the context of the selected variables. This study did not delve into teachers' attitudes towards cultural and digital phenomena, which can be interpreted as a community of tastes and practices (Mutsch 2012); however, the selected contexts allow us to consider the pedagogical implications of these attitudes. These basic attitudes are shaped by dispositions derived from deeply ingrained and largely implicit values projected onto technology (Blume, 2020), which Sterne (2003, p. 376) describes as small, crystallized parts of the habitus.

When analyzing the research results, Bourdieu's (1977) concept of habitus is a useful tool for interpreting the diverse patterns of digital hygiene observed among teachers. The results indicating fragmentary but recurring behavioral tendencies can be understood as manifestations of a professional habitus shaped by routine institutional procedures, pedagogical norms and cultural expectations associated with the teaching profession. According to these norms, teachers should be the pillar of digital security in the school ecosystem and serve as role models for their students. As emphasized by Bourdieu (1977) and later by Wacquant (2016), habitus is both shaped by social conditions and has a structuring character in its generative power. Habitus

reproduces established practices while adapting to a changing environment, which is characterized by the intensive development of e-services and, consequently, the intensive transformation of the information society. In our findings, teachers' behaviors related to digital hygiene, such as cautious data sharing, moderate screen time and avoidance of online conflicts, appear to be embodied tendencies that translate institutionalized pedagogical values (e.g., responsibility, care, and moderation) to the digital sphere. The digital sphere is closely related to the offline sphere. At the same time, the differentiation between clusters reflects micro-differences in position in the field and capital composition. For example, teachers working in vocational or technical schools may have a habitus more suited to the instrumental, safety-oriented use of ICT, while primary school teachers exhibit more affective and communicative forms of digital engagement. Digital hygiene is therefore not just a set of individual behaviors, but a socially embedded system of tendencies adapted to the specific institutional contexts and age groups with which particular groups of teachers work. Including habitus in the interpretation of these results enriches the understanding of digital hygiene as a socially conditioned phenomenon, rather than an exclusively individual one. This is an assumption that broadens the general concept of digital and media literacy where digital safety is a one of key component. This approach provides a conceptual bridge between the digital competence framework (Vuorikari et al., 2022) and sociological theories of practice. Such an approach highlighting how specific norms influence teachers' responses to electronic threats and imperatives related to digital well-being.

The key finding of this study, namely that there are no differences in digital hygiene levels based on age and gender, is at odds with the findings of numerous studies that indicate these variables as significant predictors of digital competence and online behavior (Branley-Bell et al., 2022; Kezer et al., 2016; van Deursen & van Dijk, 2013). However, this discrepancy may result from differences in the operationalization of variables related to e-threats and digital safety. It should be emphasized that previous studies mapping differences based on sociodemographic variables focused on skills, while the present study focused exclusively on specific pro-hygienic practices, such as privacy protection, notification reduction, and work ergonomics. Gender and age differences are well documented in terms of operational and informational competence (Long et al., 2023; Ray et al., 2021), but they do not necessarily translate directly into actual behaviors, which may be strongly regulated by the environment and may also change with the emergence of new e-services or the strengthening of basic digital and media competences. In the group of teachers studied, professional homogeneity, social expectations of a profession of public trust, institutional pressure (GDPR, health and safety training, and training of the entire school ecosystem on e-threats) and, by definition, a higher level of awareness than average users of e-services may offset demographic differences, generating a homogenization effect in behavior, which was observed in the empirical part. It should also be noted that the lack of diversity should not be interpreted as a falsification of existing models, but rather as an indication that in professional contexts, age and gender lose their significance in favor of organizational (e.g., workplace and professional status) and cultural factors. This result suggests a need to redefine the relationship between competencies and digital practices (d'Haenens et al., 2024). The former may remain diverse, while the latter may be somewhat more homogeneous, e.g., standardized by institutional rules. As noted by researchers from the Czech Republic (Smahel et al., 2020), demographic differences are more likely to manifest themselves in usage styles and risks than in protective measures. For this reason, our results offer a new perspective: in highly regulated environments, such as schools, strategies for promoting digital hygiene in selected professional or age groups should be designed thematically (according to types of practices and real e-safety challenges) rather than demographically (according to age or gender). Furthermore, the lack of longitudinal research results in the indicated area and field of research limits the drawing of clear conclusions and makes it impossible to map trends.

Research Limitations

This study has several significant limitations that affect the interpretation of the results. Firstly, the use of the available sample of teachers from two Polish regions limits the possibility of generalizing the results to the whole country. Although the demographic profile of the sample roughly corresponds to the profile of the teacher population in Poland, recruitment based on a non-random approach limits the possibility of generalization (Etikan, 2016). Future studies should therefore use a random-stratified approach that considers, among other things, age, gender, professional experience and school location. However, such

studies require adequate organizational and financial resources (e.g., an external grant to fund research on the functioning of teachers in cyberspace).

The data presented are based solely on self-assessment, which is associated with the socially desirable response bias. This situation may be particularly prevalent among teachers, who may tend to agree with socially accepted behaviors related to digital hygiene. Self-assessment and its weaknesses in the context of measuring digital competences have already been recognized and described (Tomczyk, 2023), but on the other hand, this methodological approach also has its strengths. On the other hand, it should be noted that anonymity (no personal data was collected) probably mitigated this shortcoming. Nevertheless, future work should more closely link data from self-assessment of digital hygiene levels with behavioral measurements, i.e., specific digital traces, which will significantly increase the reliability of this type of analysis (Podsakoff et al., 2012).

It should also be noted that the cross-sectional research design does not allow for a direct cause-and-effect interpretation. The observed relationships between digital hygiene practices and professional characteristics may change over time or under different institutional conditions. Furthermore, the development of the information society and the emergence of new e-services are significantly changing the way new media are used. These changes also relate to transformations in the level of digital hygiene. Longitudinal studies can examine the dynamics of change in the long term and thus design more effective measures to increase the level of digital security among teachers.

Finally, certain instrumental limitations should be noted. Selected subscales of the digital hygiene self-assessment questionnaire contained only a few items, which may limit the control of the internal consistency of digital hygiene components. Therefore, it should be borne in mind that the basic concept of digital hygiene developed by Bigaj et al. (2023) should be more closely tailored to the teaching context, while considering trends in the digital sphere and the possibility of complete control of the psychometric properties of the tool.

CONCLUSIONS

This study provides a theoretical and practical contribution to understanding digital hygiene among teachers. By identifying three different groups of educators with varying levels of digital hygiene, the results of the study allow for a more nuanced interpretation of the level of digital safety in this socially important group. The results also provide a partial answer to how professional, institutional and personal factors shape teachers' engagement with safety and well-being in the digital environment. The collected data suggest that instead of treating teachers as a homogeneous group requiring general professional development, it is necessary to tailor activities to specific digital hygiene profiles. As with digital and media literacy, the study group is not homogeneous in terms of digital hygiene.

Teachers in the first group, i.e., those who consistently demonstrate a high level of digital hygiene, can act as leaders or mentors in the school ecosystem in developing school programs that promote digital wellbeing. Their experience and real-life safety-oriented activities allow them to model responsible behavior and co-create training activities that emphasize good privacy management, screen time regulation and self-care strategies in the age of ubiquitous digital media.

Teachers in the second group (with varying levels of digital hygiene) demonstrate selective proficiency and could benefit most from targeted training focusing on weaker aspects such as ergonomics, emotional regulation and actively responding to harmful online content. Incorporating these topics into existing continuing professional development frameworks (including training funded as part of professional development offered by educational institution management) could improve the practical transfer of digital hygiene principles into everyday school activities.

The third group, characterized by low levels of digital hygiene, is a group that requires systematic and targeted institutional support. For these teachers, interventions should start with raising awareness of the importance of digital hygiene and digital safety, while also including practical exercises. These highly practical measures should be particularly targeted at areas where teachers have achieved the lowest scores in terms of digital hygiene. The research results clearly diagnose a number of shortcomings in the level of digital hygiene, but including this group in the LLL process is not necessarily an easy task, both from a motivational

and organizational perspective (e.g., due to an overload of various teaching, educational and administrative responsibilities).

From a pedagogical point of view, these diverse recommendations are consistent with Bourdieu's (1977) concept of habitus. Considering the framework referred to in the discussion section, it should be borne in mind that attitudes towards technology are shaped both socially and institutionally. Strengthening digital hygiene therefore requires not only the acquisition of skills, but also the transformation of professional habitus through the triggering of reflection supported by mutual learning. Additionally, it should be noted that the effectiveness of these measures is impossible without a corresponding change in attitude towards digital security at the school level, which in itself is a complex challenge due to a number of constraints characterizing contemporary education.

In summary, the study indicates that teacher training programs should go beyond general statements about "raising awareness" towards data-driven, cluster-based professional development. Such an approach would allow educational institutions to develop interventions tailored to specific behavioral profiles and attitudes of teachers, increasing their ability to maintain digital wellbeing and serve as credible role models for students in increasingly hybrid educational environments.

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Ethics declaration: This study was approved by the National Agency for Academic Exchange (BPN/BKK/2022/1/00007/DEC/1). The purpose of the research was presented in the introductory letter to the tool. No data allowing for the identification of respondents was collected. Respondents could opt out of completing the tool at any time.

Declaration of interest: The authors declared no competing interest.

Data availability: Data generated or analyzed during this study are available from the authors on request.

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