



Skills in the area of digital safety as a key component of digital literacy among teachers

Łukasz Tomczyk¹ 

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Abstract

The goal of the research was to assess the level of Digital Literacy (DL) among teachers. The study was diagnostic in order to show DL in six selected key areas: the ergonomics of using ICT, assessing the credibility of information, secure online communication, maintaining anonymity in the digital world, safe logging-in, and intellectual property. DL was measured using a knowledge and competence test. The study was conducted in Poland in 2017/2018 among 701 primary school teachers (primary being the second stage of education). Based on the data collected, we have noticed the following: DL is a heterogeneous concept; the respondents possess the lowest level of knowledge in the area of intellectual property law and know the most about ergonomics; gender does not determine the level of knowledge and competencies in the group. Furthermore, the Dunning-Kruger effect is noticeable among the teachers, in the context of evaluation of DL related to digital safety. We also need to emphasise that for teachers, DL is one of the key protective factors in digital safety, viewed holistically, in schools. Thus, diagnosing and facilitating the development of DL has become one of the key challenges faced by schools today.

Keywords Digital literacy · Teachers · E-safety · Dunning-Kruger effect · Poland · Lifelong learning · Safety · Challenge

1 Introduction

The development of the information society has brought many challenges to almost every area of human life (Ziemia 2018). Transformations resulting from the common access to ICT also affect education (Frانيا 2014). In recent years there have been

✉ Łukasz Tomczyk
Tomczyk_lukasz@prokonto.pl; <https://up-krakow.academia.edu/LukaszTomczyk>;
https://www.researchgate.net/profile/Lukasz_Tomczyk;
<https://scholar.google.ca/citations?user==LacffKwAAAAJ&hl=en>

¹ Faculty of Pedagogy, Pedagogical University of Cracow, Ul. Ingardena 4, 30-060 Krakow, Poland

numerous discussions about the nature of the changes caused by digital media (Klement et al. 2017). There are many positive opinions and research results in these debates that support the use of ICT in education (Livingstone 2012; Shaffer 2014). The analyses conducted also identify the threats posed by new media (Kopecký 2016). Undoubtedly both the effective use of ICT as well as understanding and preventing negative consequences requires an adequate level of digital literacy (DL). Due to the intensity of these changes, the ability to navigate media, the awareness of the mechanisms involved, and the relationships between humans and information technologies, all need to be constantly updated. Developing DL in the context of its positive implementation within the teaching and learning processes is as important as knowing the negative aspects of the common use of new media.

2 Literature review

In the context of digital safety, DL is seen in the light of praxeology (Kern and Bean 2018). This is due to the fact that school teachers carry out preventive activities which are designed to minimise risk behaviours mediated by digital media and most often connected with: student cyberbullying (Pyżalski 2012; Del Rey et al. 2015) and cyberbullying aimed towards teachers (Kopecký and Sztokowski 2017); the problematic use of the Internet (Fineberg et al. 2018); understanding the mechanisms of online abuse (Walotek-Ściańska et al. 2014); image protection (Szpunar 2017); the infringement of intellectual property law (Tomczyk 2018); and numerous other e-threats. All the above-listed problems are in a state of constant evolution along with both the changing scale of existing and the appearance of new risk behaviours (Livingstone 2018; Livingstone et al. 2017). According to the EU KIDS research, young people are considered fluent new media users but at the same time they require intense support focused on strengthening their digital literacy in the area of safety (Pyżalski et al. 2019). Protection against threats is the responsibility of significant others; that is, parents and teachers. Considering the complex nature of ICT-mediated problematic situations, adults need to know and be able to facilitate adequate media socialisation, skills which reach far beyond the typical employment of new media for the purposes of information and entertainment (Neumann 2016).

The ability to create a safe digital environment, for example, by integrating various forms, methods and didactic measures into the formal and informal curricula, is developed from the very initial stages of education. This is due to the prevalence of digital media in school, family, and social life (Velickovic and Stosic 2016). Digital literacy has become the set of key competencies of the twenty-first century. This statement becomes even more powerful when we think of the complexity of the educational problems teachers and parents face today, as compared to those of the analogue era (Bayraktar 2017). Not only must parents and teachers prevent the emergence of risk situations offline but they also need to have an up-to-date knowledge about new digital and hybrid threats (Tomczyk and Wąsiński 2017).

We can also recognise that teachers' knowledge related to digital media is associated with their attitude towards the Internet, computers, tablets, and mobile phones. A negative attitude contributes to the lower level of actual knowledge regarding both the positive and negative ways in which ICT is used, and the

influence of ICT on the behaviour of children and youths, as well as on learning conditions (Hobbs and Tuzel 2017). The analyses of the ICT-related attitudes and skills of teachers and future teachers show that this group is heterogeneous. This heterogeneity is evidenced by the group's fluency in navigating websites, using hardware and e-services, as well as the diverse attitudes towards the use of new media in education (Preradović et al. 2017; Eger et al. 2018). Therefore, when analysing DL, we need to be aware of this diversity in knowledge, skills, and attitudes among teachers regardless of the country and stage of education.

Experts emphasise that specialist informal educational programmes focusing on strengthening the technical and social components of DL are a useful solution for developing DL and changing attitudes towards new media (Hobbs and Coiro 2019). Considering the range of e-threats that affect adults (including teachers and parents) and, first of all, children and teenagers, it is teachers who bear the responsibility for responding to problematic situations in schools and developing the skills and knowledge students can apply to protect themselves against digital threats (Eyal 2012). Academic preparation in the form of the inclusion of approximately ten to twelve hours in the curricula of subjects like media pedagogy, media in education, and ICT, appears to be insufficient. Teachers expand their knowledge and skills as they solve problematic situations in their schools, through peer education, specialist training, or self-education (Yusupova and Skudareva 2018). In the context of the development of the information society, DL is a concept subject to constant transformations that are triggered by novel circumstances (mainly, intensification of the negative phenomena connected with new technologies, the emergence of new e-threats, and the development of the IT industry).

3 Theoretical/conceptual framework DL

In the context of school, and in reference to the group of teachers followed in this research, DL is identified with the use of devices, digital services, and websites, and is included in learning and teaching activities (Lindstrom and Niederhauser 2016). The educational aspect of new media is particularly important when we consider its potential to improve the efficiency of and the presence of multimedia in the didactic process (Potyrała 2017). In this aspect, DL mainly involves the technical ability to operate the hardware (interactive boards, computers, tablets, and smartphones) which is available as teaching aids (Lamanauskas 2017). The technical components of DL are unquestionably of great importance; however, the soft, social elements of DL are also relevant (Al-Qallaf and Al-Mutairi 2016). In this text, DL will be defined holistically as the skills and knowledge regarding the fluent use of digital media and the awareness of the mechanisms that challenge digital safety. Both components, technical and social, interfere with forming the holistic concept of DL.

As for the soft aspects, DL involves the skills and knowledge related to the anticipation of e-threats, understanding the social mechanisms mediated by the Internet, and digital technologies. This soft knowledge refers to both the positive and negative consequences of the digital world. Reflection on the ICT-related changes to individual and collective aspects is as important for the intentional navigation of the digital space as it is for the technical ability to use devices, applications, and websites. An exemplary

DL component is the critical assessment of content available online (Mendoza 2018). The ability to verify the reliability of information published online is as important as the ability to assess information found in the traditional analogue media. This example shows clearly that the concept of DL contains elements that are useful for both the online and offline worlds (Stošić and Stošić 2015). Therefore, the risk behaviours mediated by the media should be analysed not only in the light of one's technical ability in using digital media (this then being the stereotypical approach to DL) but also from the perspective of the "soft elements" which are connected with both the positive and negative consequences of using ICT. Unfortunately, the analyses of DL presented in the literature of the subject usually refer to self-evaluation of DL in the context of one's technical proficiency in operating devices and digital teaching aids, while ignoring the digital safety component. Therefore, one of the challenges of contemporary media pedagogy is to redefine the approach to DL in terms of the identification of indicators of the whole DL construct, as well as to suggest methods of measuring and comparing all of the components of DL.

4 Methods

4.1 Research objectives

The objective of the study was the assessment of the knowledge and skills connected with digital literacy in the area of e-threats among teachers working in the second stage of education (grades 4–6 of primary school) in Poland. The additional, practical objective was to effect the modification of governmental programmes addressed to teachers; this modification would increase the sense of digital safety among stakeholders focused around Polish schools. The results presented are only an excerpt from the wider research project covering the 12 groups analysed. The results were selected based on the stage of education and the subject's role (teachers, parents, students). Thus, the results are both diagnostic and applied.

4.2 Tool structure

The main tool used in the study was a questionnaire that measured the level of DL related to digital threats and that identified the characteristics connected with the given result. The questionnaire was divided into two parts (Frankfor-Nachmias and Nachmias 2001). The first part served to gather socio-demographic data (age and gender, years of professional experience, stage of professional development). It also included questions about the methods and the frequency of using digital media in education, a self-evaluation of the subject's own digital literacy, and incidents digital security in school being breached. The second part of the questionnaire focused solely on assessing DL as it relates to digital safety. For this purpose, 6 DL components were identified, connected with technical safety of using media (ergonomics, duration of use etc.); assessment of the credibility of online information (knowledge and awareness of hoaxes, and the creation and dissemination of online content); safe interactions with other users (knowledge ensuring the safety of children during their interactions with other users); anonymity (awareness of the mechanisms of manipulation used in order to obtain

important data, and how to maintain anonymity); creating secure logins and passwords (knowledge of the processes of logging-in and generating secure access passwords); and copyright (the ability to recognise the legal liability for downloading and sharing files, using someone's intellectual property, and the legal aspects of using digital content in education). The teachers involved in the research had to answer 16 questions. For each of the selected areas, the parents answered questions from the competence test. The respondents could score from 0 to 100% points for their answers in each of the 6 areas. Based on the arithmetic mean, a global variable was constructed as the average result in the six abovementioned areas (0% – unsatisfactory DL level in terms of digital safety, 100% – all answers were correct). The areas of DL regarding digital safety were imposed by the Ministry of National Education and the executors of the project *Bezpieczna+ (Safety+)*. This tool extends beyond the hitherto employed quantitative studies that measured digital literacy based on self-assessment.

4.3 Sampling and research procedure

The sampling was random. The research was conducted as part of a nation-wide project commissioned by the Polish Ministry of National Education, and executed by the Cities in Internet Association (*Stowarzyszenie Miasta w Internecie*) in Tarnów. The study was carried out by experts in social studies (e.g. representatives of the research and training agency NAVIGO) and media pedagogy, with years of experience in gathering data from representative samples. The research was conducted in compliance with ethical standards. The data collected were completely anonymous; the test result was also classified. The study was conducted at the turn of 2017 and 2018. The final report was sent to the Ministry of National Education.

4.4 Sample characteristics

The research was conducted among 701 teachers from the second stage of education (grades 4–6), from all over Poland. The group consisted of 85.7% females ($N = 601$) and 14.3% males ($N = 100$). The average age of the respondents was 43.45 years with SD=0.06 and median 44. This data is in line with the characteristic of the general teacher population in Poland. The respondents had reached the following stages of their professional career (4 stages were used, and these are listed here in order from the least to the most experienced): trainee (4.9%), contract (11.3%), appointed (18.3%), and chartered (65.6%). The average number of years of professional experience was 18.79 with SD = 9.72 (max = 40 years, min = 0 years of working in school). The respondents were employed in schools located in: villages (32.0%); towns with a population up to 50,000 (30.8%); cities with a population of 50–100,000 (14.4%); cities with more than 200,000 residents (12.6%); and cities with a population of 100–200,000 (10.2%).

5 Results

The teachers obtained diverse results for each of the DL components analysed. The highest results were recorded in the area of ergonomics, that is, time spent using new media, maintaining proper posture, and organization of the work space. The weakest

component was copyright awareness: using musical works, videos and applications in the didactic process, or modification of other copyrighted materials. The highest dispersion of the results was observed in the category of the assessment of the reliability of information and copyright, which means these two areas differentiate the group the most. Detailed characteristics are presented in Table 1.

Considering how the majority of the research subjects were female, we decided to show what gender-related differences might have resulted from the competence test. A detailed analysis revealed that there are no statistically significant differences in the level of certain elements related to e-safety. Both men and women obtained similar results. The lack of differences is shown in Fig. 1.

The mean final outcome in all areas was 63.69 percentage points out of a possible 100, with $SD = 8.05$, $Min = 8.00$, $Max = 86.75$ and $median = 63.88$. Almost half of the teachers provided between 60% and 70% correct answers. Based on the final test results, the global variable to be used in further analyses was determined. The ranges of the results are presented in Table 2.

There was a subtle difference in the test results between those teachers who use electronic textbooks on a regular basis and those who prefer traditional, printed textbooks - $F(3, 695) = 2.9294$, $p = .03297$. Furthermore, teachers who declared that there had been an incident of infringement of digital safety in their schools also showed a slightly higher level of awareness of the e-threats in the selected areas - $F(2, 696) = 5.9410$, $p = .00276$.

At the same time, we noticed that teachers who regularly use ICT obtained slightly higher results than their colleagues who declared they used digital media less frequently - $F(4, 694) = 5.0609$, $p = .00050$. This tendency is shown in Fig. 2.

Teachers who declared that the use of ICT in class positively increased students' interest in the subject obtained higher results - $F(5, 693) = 11.893$, $p = .00000$. Additionally, teachers at the second stage of education, who know and use ICT, also scored slightly better - $F(1, 697) = 5.3574$, $p = .02092$. Simultaneously, respondents who definitely disagreed with the idea that schools need modern ICT to support the educational process obtained lower results compared to those groups with a positive attitude towards new media in education - $F(4, 694) = 10.154$, $p = .00000$. This tendency is illustrated in Fig. 3.

We also noticed that the following factors - the degree of professional promotion $F(3, 695) = .09810$, $p = .96107$; years of experience ($r^2 = -0.03$); age ($r^2 = -0.05$); and school location $F(4, 694) = 2.1799$, $p = .06967$ - did not differentiate the competence test results.

Teachers who declared a high level of expertise and skills regarding digital threats also felt confident about their knowledge and skills regarding the use of digital devices ($Chi^2 = 589.8578$, $df = 30$, $p < 0.0000$, $Vc = 0.41$). Most frequently, the teachers evaluated their knowledge as average. Only 3 % of the respondents were not able to assess their level of competence related to e-threats (Table 3).

The respondents could not evaluate their DL adequately. There are groups which overestimate or underestimate their skills and literacy. This visible discrepancy is shown in Fig. 4. The disproportion between the self-evaluation and competence test results can be found for both awareness of e-threats - $F(6, 692) = 2.5482$, $p = .01900$ and knowledge related to the use of digital devices - $F(5, 693) = 2.2631$, $p = .04667$.

Table 1 Descriptive statistics for 6 components in the area of digital safety

	Mean value	Median	Minimum	Maximum	Lower quartile	Upper quartile	Std. Dev.	Skewness	Kurtosis
Health and safety	81,22715	77,77778	0,00000	100,00000	77,77778	88,88889	12,02567	-1,13033	3,571335
Information credibility	63,36195	60,00000	10,00000	100,00000	50,00000	80,00000	21,51828	0,07999	-0,697119
Safe interactions with others	74,74169	77,77778	0,00000	100,00000	66,66667	77,77778	12,09296	-1,14006	3,226573
Anonymity	61,88205	66,66667	22,22222	100,00000	55,55556	66,66667	16,44706	-0,04937	-0,110944
Logins and passwords	62,48212	62,50000	0,00000	100,00000	62,50000	75,00000	12,94860	-0,78818	2,530809
Law	38,48355	44,44444	0,00000	100,00000	22,22222	44,44444	18,02940	0,55784	0,336929

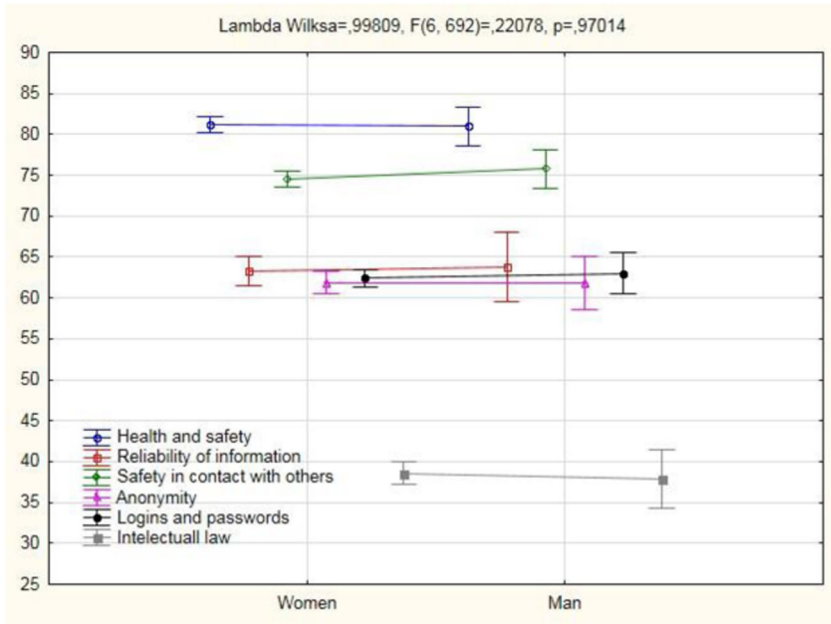


Fig. 1 Gender-related differences

We noticed a correlation between the DL components. Knowledge and literacy in one of the areas analysed is positively related to the other components. However, the values of the Pearson linear correlation coefficient shed new light on the relationship

Table 2 Ranges of mean values of the final results in the competence test

Results – ranges	Number	Cumulative number	Percentage of valid	Cumulative % of valid	% of general cases	Cumulative % of general
0,000000 < x <=10,00000	0	0	0,00000	0,0000	0,00000	0,0000
10,00000 < x <=20,00000	1	1	0,14306	0,1431	0,14306	0,1431
20,00000 < x <=30,00000	1	2	0,14306	0,2861	0,14306	0,2861
30,00000 < x <=40,00000	2	4	0,28612	0,5722	0,28612	0,5722
40,00000 < x <=50,00000	26	30	3,71960	4,2918	3,71960	4,2918
50,00000 < x <=60,00000	176	206	25,17883	29,4707	25,17883	29,4707
60,00000 < x <=70,00000	346	552	49,49928	78,9700	49,49928	78,9700
70,00000 < x <=80,00000	135	687	19,31330	98,2833	19,31330	98,2833
80,00000 < x <=90,00000	12	699	1,71674	100,0000	1,71674	100,0000

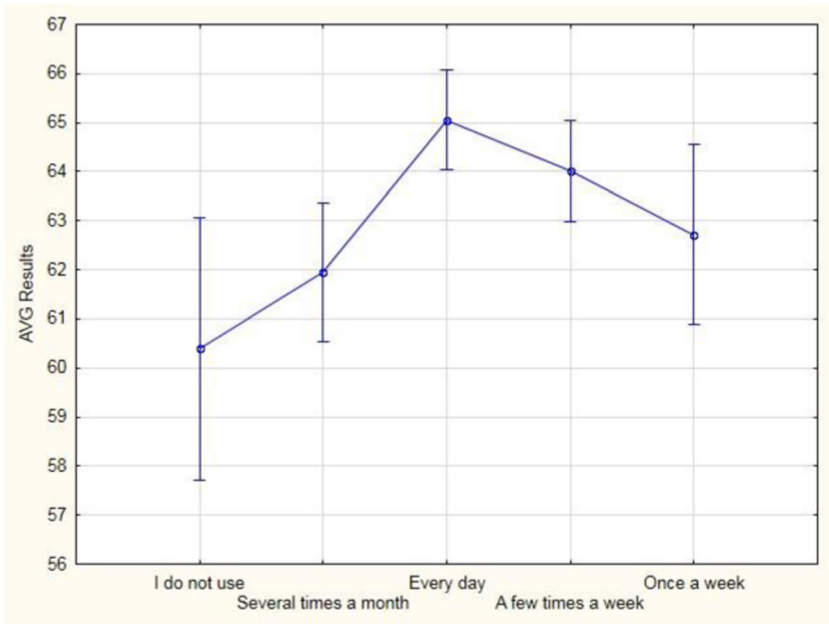


Fig. 2 How often do you use digital technology during class vs. test results obtained

between the components – despite the statistical significance, the strength of the correlations does not exceed the mean value. A detailed analysis of the relations between the components is presented in Table 4.

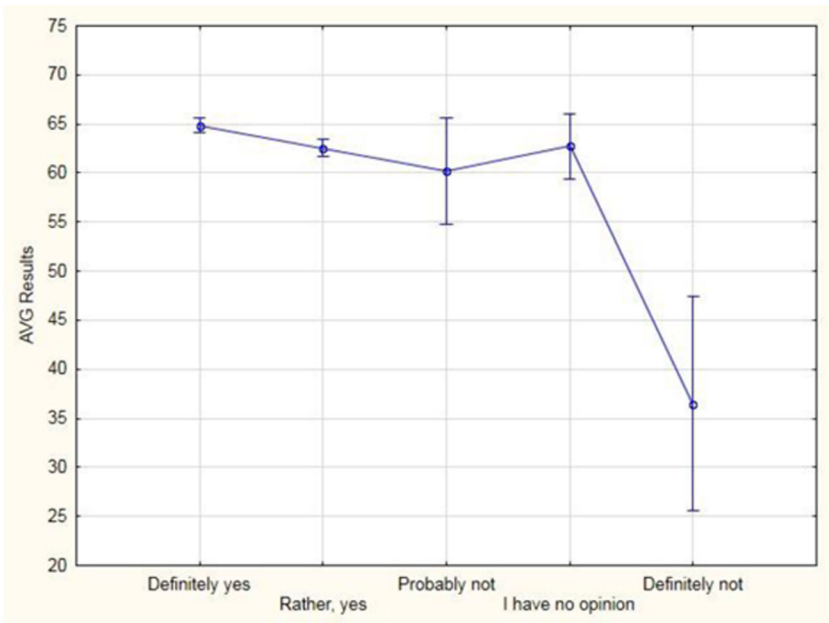


Fig. 3 Evaluation of the need to use ICT in the didactic process and test results

Table 3 Self-evaluation of knowledge and skills related to e-threats and use of ICT

	How do you evaluate your level of literacy and knowledge related to e-threats?		How do you evaluate your level of literacy and knowledge related to the use of digital devices (computer, Internet)?	
	Number	Percentage	Number	Percentage
I don't know how to evaluate it	20	2,86123	11	1,57368
Average	437	62,51788	379	54,22031
High	174	24,89270	225	32,18884
Very high	21	3,00429	51	7,29614
Low	40	5,72246	29	4,14878
Very low	7	1,00143	4	0,57225

The heterogeneity of the DL components prompted an investigation of the subgroups within the sample. Using cluster analysis, which allows the identification of such subgroups among the respondents, we determined 3 main groups. They show a diverse level of knowledge and skills, except in the areas of assessing the reliability of information and securing logins and passwords to private accounts (Fig. 5).

The greatest dispersion of correct answers in the competence test was found in the area of the assessment of the reliability of information (the differences amount

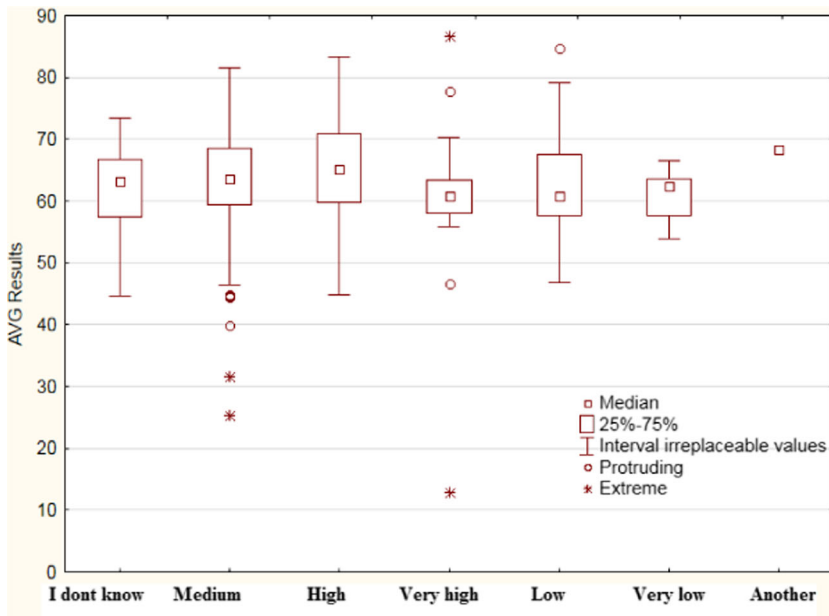


Fig. 4 How do you evaluate your level of literacy and knowledge related to e-threats vs. competence test results

Table 4 Pearson linear correlation coefficient between the DL components

	1. Health and safety	2. Information credibility	3. Safe interactions with others	4. Anonymity	5. Logins and passwords	6. Copyrights
2.	,0277	1,0000				
3.	,1633***	,1023**	1,0000			
4.	,1363***	,1566***	,1812***	1,0000		
5.	,1627**	,1307**	,1928***	,1519***	1,0000	
6.	,0672	,0993**	,1319***	,0653	,0311	1,0000

* < 0.05, ** < 0.001, *** < 0.0001

to approximately 40% of the answers). This competence involves, for example: understanding the mechanisms by which fake news is distributed; the evaluation of the credibility of online data; and knowledge of the mechanisms related to the creation of online content. The other DL component which divides the teachers is copyright (a difference of up to 25% of answers). The remaining areas selected for the study confirm the partial homogeneity of the level of expertise and literacy related to digital safety among the teachers surveyed. The distribution of the groups is presented in detail in Table 5.

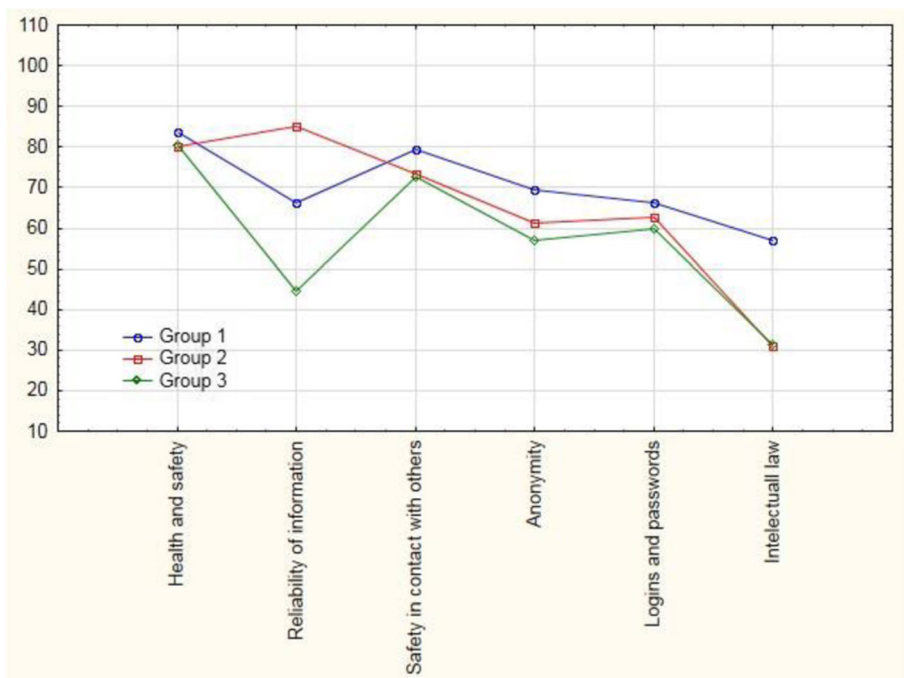


Fig. 5 Cluster analysis of DL components among teachers

Table 5 Percentage share of certain groups according to cluster analysis

	Group 1	Group 2	Group 3	Total
Size	197	218	284	699
Percentage	28,18%	31,19%	40,63%	100%

6 Discussion

Today, digital safety is as important as any issue related to the prevention of offline threats. In recent years, we have observed the rapid growth in the number of publications and scientific analyses focused on e-security (Livingstone and Haddon 2009; Barbovschi 2014). It has even been stated that e-threats have set a new direction for research in media pedagogy, one called ‘the risk paradigm’ (as opposed to ‘the opportunity paradigm’). Staying digitally safe regardless of age requires a certain level of digital literacy (Fantin 2010). A basic level of knowledge and skills related to minimising e-threats in the areas of the protection of confidential data, understanding the mechanisms of cyberbullying, the problematic use of the Internet, and e-gambling are problems that have attracted increasing attention in relation to digital literacy (Kajec 2016). DL not only involves the fluent use of digital media, but also means understanding how ICT influences users’ behaviours online and fosters risk behaviours (Lohnes Watulak 2016).

The particular role in minimising the negative consequences associated with the saturation of new technologies is assigned to the individuals’ primary environment, that is the parents and significant others, especially teachers in educational facilities (Berge 2017). It is the teachers who are required to have up-to-date knowledge of the threats brought by the digital world and the ability to model DL in this area through, for example, comprehensive prevention programmes (van de Oudeweetering and Voogt 2018). Today, teachers are responsible not only for the prevention of offline and online threats but also hybrid threats that cross the boundary between the two forms (Potter 2017). However, DL among the teachers varied depending on the several factors presented in the empirical part of this paper. For this reason, the discourse on DL components and support programmes – the informal education of teachers becomes one of the challenges of media education. This is so because it is the teachers who face different risk behaviours mediated by the Internet in their socialisation and media education activities (Bazalgette and Buckingham 2013; Zizek 2017).

The results collected show that DL among the respondents is not homogeneous. Teachers show a relatively high level of expertise and skills in the area of the ergonomics of using new technologies. This aspect is particularly important in terms of developing positive habits among students during the second educational stage. The weakest DL component is copyright (Harbaugh and Khemka 2010). The examples of the low awareness of copyright-related issues include the use of materials downloaded from the Internet (videos, music, software) during subject lessons, and these are not always used in accordance with copyright law. It is interesting that gender does not differentiate the test results. The biggest group (about half of the respondents) are the teachers who scored 60–70% correct answers.

Of course, the results presented herein might change depending on test calibration (e.g. the questions selected, the number of questions, the structure of the questions, the relevance of the problems introduced in the questions). However, the methodological weaknesses mentioned above were partially reduced through engaging an external expert to select the questions used. The inability to add all Internet-related threats to the competence test is also a disadvantage of the study, but due to the potential scale of the tool, it is impossible to include all the variables and factors in the measuring tool. Due to the scale of risk behaviours and the constant emergence of new areas of risk, the DL concept is fluid and requires constant redefinitions (Lee 2014; Sharma and Deschaine 2016).

The data analysis revealed that there is a group of teachers who obtained much higher test results because of their attitudes towards new media. Thus, techno-optimists are much more informed than techno-pessimists (Tomczyk et al. 2015). Teachers who regularly use ICT in their classes, use e-textbooks, or think that new media facilitate greater engagement for their students, obtained statistically higher results. Thus, attitudes, knowledge, and literacy related to digital media are very often connected with the type of knowledge possessed about the negative consequences of the saturation of schools and students' lives with ICT (Teo et al. 2009; Khokhar 2016).

The aspect of evaluation of the respondents' own DL is also interesting. Most often, teachers evaluated their own literacy as average or high. The lack of clear reference points or DL framework makes it difficult to adequately correlate this assessment with the test results. For example, there are teachers who think their knowledge about e-threats is advanced but they obtained much lower results than those who declared their competencies as average or low. The lack of a clear linear correlation between the self-evaluation and the test results may be explained through consideration of the Dunning-Kruger effect among other phenomena (Dunning 2011; Chen et al. 2013).

DL is a multi-faceted construct which involves the technical ability to use devices and websites, browse for information, secure data, set up equipment and update own's knowledge about new e-threats. All of these factors make it difficult to list and measure all of the digital safety indicators. However, we noticed that the higher the awareness and literacy in one area, the higher the level of knowledge in other areas. These correlations do not extend beyond the average level of the Pearson linear correlation, and therefore we cannot say the relationship between the DL components are tight. This approach also confirms the division of the sample into 3 separate clusters, each of them a heterogeneous set. The biggest differentiation in knowledge and skills occurs in the areas of the assessment of the reliability of information (Rosenzweig 2017) and copyright (Mróz 2016). These correlations, however, require further in-depth studies on, among others, a clear definition of DL that would set the direction for diagnostic research.

7 Conclusions

The results presented fit into the discourse on the functioning of schools in the digital age. The modern school is an institution which not only implements IT and management solutions to its educational practice but also prepares students to protect themselves successfully against the growing number of e-threats (Wyżga and Mróz 2018).

The key element in the process of strengthening DL among the students is a competent, intentionally-acting teacher (Macuch et al., 2018; Borthwick and Hansen 2017). This assumption requires a wider discussion on the changes in the information society and both the positive and the negative consequences connected. The concept of lifelong learning supported by the professional sector (NGOs, non-formal and self-education of teachers) becomes a response to the need for updating or expanding DL as new circumstances emerge. Once acquired, the knowledge of digital threats is a set of information that needs to be constantly expanded and updated (Veteská 2017). From this perspective, the concept of digital literacy becomes an integrating construct, subject to ongoing transformations.

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