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DIGITAL LITERACY AND CYBERSECURITY: AN EMPIRICAL STUDY IN THE CONTEXT OF PRIMARY EDUCATION

Abstract

This study empirically analyzed the level of digital literacy and the formation of cybersecurity skills among future primary school teachers, as well as their interrelationship. The research was conducted among 1st–4th year students of the educational program 6B01303 – Primary Education Pedagogy and Methodology at Korkyt Ata Kyzylorda University. Data collected through a questionnaire survey were processed using the JASP 0.95.2 statistical software. A Likert scale consisting of 10 items on digital literacy and 25 items on cybersecurity was applied. The results showed that students' level of digital literacy was above average ($M = 32.10$), while their cybersecurity skills were at a heterogeneous level ($M = 104.0$). Pearson's correlation revealed a very strong positive relationship between the two variables ($r = 0.915$, $p < .001$). This indicates that as students' digital literacy increases, their cybersecurity skills also improve. The findings are consistent with international literature and confirm the importance of fostering a digital safety culture in the field of primary education. It is recommended to introduce a course on "Digital Literacy and Cybersecurity" in teacher training programs and to use practical exercises and interactive teaching methods. The limitations of the study include the small sample size and restriction to a single region. The need for broader-scale research in the future was also identified.

Keywords: digital literacy, cybersecurity, primary education, future primary school teachers, empirical study, safety culture.

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ЦИФРЛЫҚ САУАТТЫЛЫҚ ПЕН КИБЕРҚАУІПСІЗДІК: БАСТАУЫШ БІЛІМ БЕРУ КОНТЕКСІНДЕГІ ЭМПИРИКАЛЫҚ ЗЕРТТЕУ

Аңдатпа

Бұл зерттеуде болашақ бастауыш сынып мұғалімдерінің цифрлық сауаттылық деңгейі мен киберқауіпсіздік дағдыларының қалыптасу деңгейі және олардың өзара байланысы эмпирикалық түрде талданды. Зерттеу Қорқыт Ата атындағы Қызылорда университетінің «6B01303 - Бастауыш оқыту педагогикасы мен әдістемесі» мамандығында оқитын 1–4 курс студенттері арасында жүргізілді. Сауалнама әдісімен жиналған деректер JASP 0.95.2 статистикалық бағдарламасында өңделді. Цифрлық сауаттылықты бағалауға арналған 10 тұжырым мен киберқауіпсіздікке қатысты 25 тұжырымнан тұратын Лайкерт шкаласы пайдаланылды. Нәтижелер студенттердің цифрлық сауаттылық деңгейі ортадан жоғары ($M = 32.10$), ал киберқауіпсіздік дағдылары біркелкі емес деңгейде ($M = 104.0$) екенін көрсетті. Pearson корреляциясы екі айнымалы арасында өте күшті оң байланысты анықтады ($r = 0.915$, $p < .001$). Бұл нәтиже студенттердің цифрлық сауаттылығы артқан сайын олардың киберқауіпсіздік дағдылары да жоғарылайтынын көрсетеді. Зерттеу нәтижелері халықаралық

әдебиеттермен үйлеседі және бастауыш білім беру саласында цифрлық қауіпсіздік мәдениетін қалыптастырудың маңыздылығын дәлелдейді. Болашақ бастауыш сынып мұғалімдерді даярлау барысында «Цифрлық сауаттылық және киберқауіпсіздік» пәнін енгізу, тәжірибелік жаттығулар мен интерактивті оқыту әдістерін қолдану ұсынылады. Зерттеудің шектеулері ретінде іріктеменің шағындығы мен бір өңірмен шектелуі аталып өтті. Болашақта кең ауқымды зерттеулер жүргізу қажеттігі де анықталды.

Түйінді сөздер: цифрлық сауаттылық, киберқауіпсіздік, бастауыш білім беру, болашақ бастауыш сынып мұғалімдері, эмпирикалық зерттеу, қауіпсіздік мәдениеті

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ЦИФРОВАЯ ГРАМОТНОСТЬ И КИБЕРБЕЗОПАСНОСТЬ: ЭМПИРИЧЕСКОЕ ИССЛЕДОВАНИЕ В КОНТЕКСТЕ НАЧАЛЬНОГО ОБРАЗОВАНИЯ

Аннотация

В данном исследовании эмпирически проанализирован уровень цифровой грамотности и сформированность навыков кибербезопасности у будущих учителей начальных классов, а также их взаимосвязь. Исследование проводилось среди студентов 1–4 курсов образовательной программы «6B01303 – Педагогика и методика начального обучения» Кызылординского университета имени Коркыт Ата. Данные, собранные с помощью анкетирования, были обработаны в статистической программе JASP 0.95.2. Для оценки цифровой грамотности использовалась шкала Лайкерта, включающая 10 утверждений, а для оценки кибербезопасности – 25 утверждений. Результаты показали, что уровень цифровой грамотности студентов выше среднего ($M = 32.10$), тогда как навыки кибербезопасности имеют неоднородный уровень ($M = 104.0$). Корреляционный анализ по Пирсону выявил очень сильную положительную взаимосвязь между двумя переменными ($r = 0.915$, $p < .001$). Этот результат указывает на то, что по мере роста цифровой грамотности студентов их навыки кибербезопасности также повышаются. Полученные данные согласуются с международной литературой и подтверждают важность формирования культуры цифровой безопасности в сфере начального образования. В процессе подготовки будущих учителей начальных классов рекомендуется внедрение дисциплины «Цифровая грамотность и кибербезопасность», использование практических заданий и интерактивных методов обучения. В качестве ограничений исследования отмечаются небольшой объем выборки и проведение в рамках одного региона. Определена необходимость проведения масштабных исследований в будущем.

Ключевые слова: цифровая грамотность, кибербезопасность, начальное образование, будущие учителя начальных классов, эмпирическое исследование, культура безопасности.

Introduction

Children are increasingly immersed in digital technology from a young age, earning the nickname ‘digital natives’ [1]. This generation has had access to the internet since birth. Digital tools now shape their daily lives both at home and at school [2]. Recent Ofcom research has shown that half of children aged 5–7 play online games, and a third use messaging, social media, and live-streaming platforms [3]. Many children use websites and apps that require profiles, usernames, and passwords. 30% of 5–7-year-olds and 63% of 8–11-year-olds are active on social media platforms. Digital technology offers many opportunities, opens up new possibilities, and fosters creativity. However, it also poses cyber threats to security and privacy [4]. To mitigate these threats, everyone

must understand good cybersecurity practices. This is particularly important for young children, who are vulnerable to online dangers and often lack the knowledge and skills to navigate the internet safely [5]. In the current education system, digital technologies have become primary tools for the teaching process. Particularly at the primary school level, pupils' early engagement with the digital environment not only facilitates their daily lives but also exposes them to new risks. Issues such as misinformation, social media scams, and the leakage of private data directly affect the behavior of teachers and primary school pupils in the digital environment. Therefore, enhancing digital literacy and developing cybersecurity skills are key priorities for the education system. In a broad sense, digital literacy encompasses the ability to find, process, evaluate, and use information safely. In research, it is considered alongside the concepts of 'digital competence' or 'digital skills' [6]. In recent years, the digital literacy of teachers and students has been studied as a key factor influencing the quality of education [7]. The issue of cybersecurity is also widely discussed at an international level. Furnell (2022) [8], while proposing effective models for teaching cybersecurity, highlights the importance of fostering a security culture. Meanwhile, Sağlam and colleagues (2022) [9] highlighted the need to introduce cybersecurity education to children and adolescents at an early stage. All these studies demonstrate that special attention must be paid to teaching cybersecurity during the training of future teachers. In Kazakhstan, there is a lack of empirical research that comprehensively examines the digital literacy and cybersecurity skills of future primary school teachers in the primary education sector. Therefore, the aim of this study is to determine the level of digital literacy and cybersecurity skills of future primary school teachers and to analyze the relationship between them. In line with this, the study aims to answer the following questions:

1. What is the level of digital literacy of prospective primary school teachers?
2. At what level are the cybersecurity skills of prospective primary school teachers developed?
3. Is there a correlation between digital literacy and cybersecurity?

Materials and Methods

This study was conducted in 2025 at Korkyt Ata Kyzylorda University in the specialization '6B01303 – Pedagogy and Methodology of Primary Education'. First- to fourth-year students participated in the study, with a total of 48 students surveyed. Participants gave voluntary consent to take part in the survey, and all their responses were processed confidentially. A three-part questionnaire was used as the research instrument. The first section collected demographic information, including gender, year of study, frequency of internet use, and device type. The second section comprised 10 statements designed to assess students' digital literacy. These questions were specifically developed by the authors. The third section included 25 statements designed to determine the students' cybersecurity skills. The questions in this section were adapted from an international survey published in the journal *Education Sciences* [10]. All statements were rated on a 5-point Likert scale: 1 – "strongly disagree", 2 – "disagree", 3 – "neutral", 4 – "agree", 5 – "strongly agree". The collected data were processed using JASP version 0.95.2. First, descriptive statistics (mean, median, mode, standard deviation, minimum–maximum, quartiles) were used to determine the overall level of students' digital literacy and cybersecurity skills. Cronbach's alpha, a reliability coefficient, was used to assess the questionnaire's internal consistency. Furthermore, the item-rest correlation and 'α if item dropped' indicators were calculated to assess the suitability of each question. Pearson's correlation was used to determine the correlation between digital literacy and cybersecurity skills. The results were visualized as tables and charts using the JASP program.

Results

The data obtained during the study began with a check of the internal consistency and reliability of the measurement tools used. This step is crucial for ensuring the scientific accuracy and validity of the study's results. It was determined that the digital literacy scale used had a high level of reliability.

Table 1. *Reliability indicators of the digital literacy scale*

Frequentist Scale Reliability Statistics

Coefficient	Estimate	Std. Error	95% CI	
			Lower	Upper
Coefficient α	0.904	0.024	0.857	0.950
Average interitem correlation	0.485			

Note. The standard error of the average interitem correlation is not available.

To assess reliability, Cronbach's alpha coefficient was calculated, and its value was 0.904 (95% confidence interval [0.857, 0.950]). This indicates that the questionnaire is highly reliable and that the responses obtained are consistent with one another. The average inter-item correlation coefficient was 0.485. This result indicates that the survey questions are well-related in terms of content. The item-rest correlation for each individual question was higher than 0.45. This means that each question in the survey contributes positively to the scale's overall unidimensionality, and there is no need to remove any. All the questions complement each other, allowing for a comprehensive assessment of students' digital literacy (Table 1).

Table 2. *Reliability indicators of the Cybersecurity Skills Scale*

Frequentist Scale Reliability Statistics

Coefficient	Estimate	Std. Error	95% CI	
			Lower	Upper
Coefficient α	0.893	0.033	0.828	0.959
Average interitem correlation	0.251			

Note. The standard error of the average interitem correlation is not available.

The reliability of the Cybersecurity Skills Scale was high, with Cronbach's alpha (α) = 0.893 (95% confidence interval: [0.828, 0.959]). This indicator demonstrates that the scale has good internal consistency. The average item-total correlation was 0.251, indicating that the items are sufficiently interrelated and that each item in the questionnaire contributes positively to the scale's overall stability. The instrument used is considered valid and reliable for measuring students' cybersecurity skills (Table 2).

Table 3. *Descriptive statistics for the level of digital literacy*

<i>Descriptive Statistics</i>	
	Level of digital literacy
Valid	48
Missing	0
Median	31.00

Mean	32.10
Standard Deviation	6.349
Coefficient of variation	0.198
Shapiro-Wilk	0.970
Shapiro-Wilk P-value	.263
Range	30.00
Minimum	15.00
Maximum	45.00

Regarding Research Question 1, what is the level of digital literacy among prospective primary school teachers? A total of 48 students participated in the study, and all responses were complete and valid (Missing = 0). Descriptive statistics revealed that the mean digital literacy level of the prospective teachers was $M = 32.10$, with a standard deviation (SD) of 6.35 and a median of 31.00. The students' lowest score was 15 points, while the highest was 45 points. The range was 30 points. The Shapiro–Wilk test for normality indicated that the data conformed to a normal distribution ($W = 0.970$, $p = 0.263$). This indicates that the students' digital literacy scores were statistically normally distributed. The results obtained demonstrate that the digital literacy level of future primary school teachers is above average (Table 3).

Table 4. *Descriptive statistics for cybersecurity skills*

<i>Descriptive Statistics</i>	
	Cybersecurity Skills
Valid	48
Missing	0
Mode	98.95
Median	101.5
Mean	104.0
Standard Deviation	18.83
Shapiro-Wilk	0.923
P-value of Shapiro-Wilk	.004
Range	98.00
Minimum	62.00
Maximum	160.0

Research Question 2: What is the level of cybersecurity skills among prospective primary school teachers?

The mean score for prospective primary school teachers' cybersecurity skills was $M = 104.0$, with a standard deviation (SD) of 18.83 and a median of 101.5. The lowest score recorded was 62, while the highest was 160. This indicates that the students' skills were unevenly developed, with some participants possessing high-level skills, while others remained at a lower level. The Shapiro–Wilk test indicated that the data were not normally distributed ($W = 0.923$, $p < 0.05$). This indicates clear level-based differences in cybersecurity skills among future teachers and highlights the need to develop specialized curricula in this area (Table 4).

Table 5. Correlation coefficients between digital literacy and cybersecurity skills

Pearson's Correlations

		Pearson's r	p	Lower 95% CI	Upper 95% CI
цифрлық сауаттылық	- киберқауіпсіздік	0.915***	< .001	0.853	0.952

* $p < .05$, ** $p < .01$, *** $p < .001$

Research Question 3: Is there a correlation between digital literacy and cybersecurity? The results of the correlational analysis conducted as part of the study showed a very high positive correlation between the digital literacy levels of future primary school teachers and their cybersecurity skills. Specifically, the Pearson correlation coefficient $r = 0.915$ ($p < .001$) indicates that this relationship is statistically significant at a high level. This indicates a strong interrelationship between the two variables—digital literacy and cybersecurity—suggesting that as the level of one increases, so does the other. In other words, as a student's skills in handling information and using technology in a digital environment improve, their ability to maintain internet safety measures also increases. The confidence interval (95% CI) obtained from the analysis, the [0.853, 0.952] interval, indicates that the true population value of this result is likely to be within this range. Given the positive direction of the correlation and its very high strength, the research findings are significant not only statistically but also theoretically and practically. These data address the third research question, "Is there a correlation between digital literacy and cybersecurity?" and provide a clear, reliable answer. The obtained results indicate that these two components are interrelated and interdependent in the professional training of future teachers (Table 5).

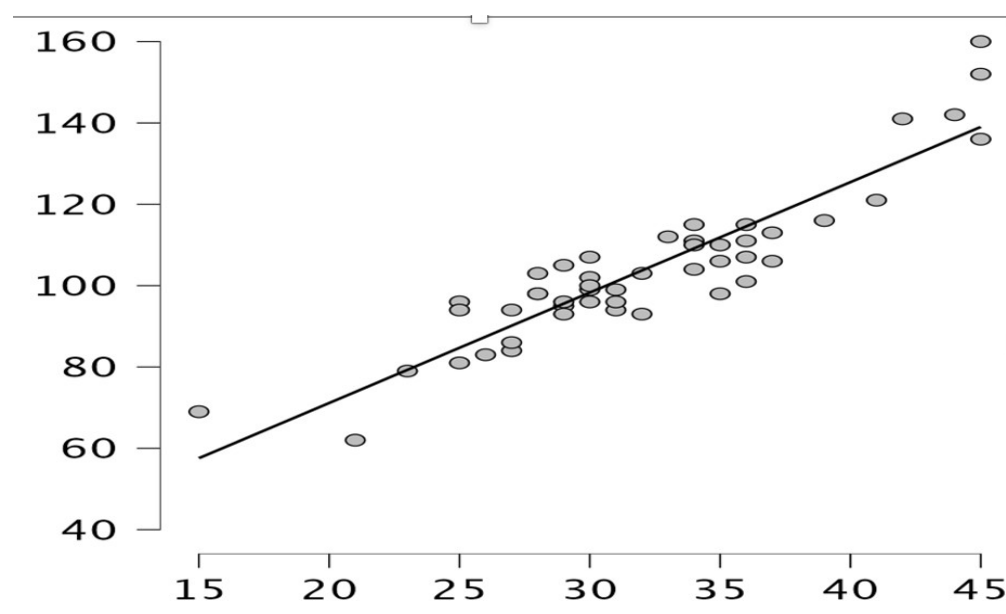


Figure 1. The relationship between digital literacy and cybersecurity.

Note: The diagram illustrates the correlation between students' digital literacy levels and their cybersecurity skills. The points represent each participant's individual results. The straight line indicates the regression trend and demonstrates a high positive correlation between the variables ($r = 0.915$, $p < 0.001$). These results demonstrate that as the digital literacy of future primary school

teachers increases, their cybersecurity skills also improve. The 95% confidence interval [0.853, 0.952] indicates that the results are statistically significant (Figure 1).

Discussion

This study examined the relationship between the digital literacy levels and cybersecurity skills of prospective primary school teachers. The results clearly showed that as students' digital literacy increased, their knowledge and practical skills in cybersecurity also improved. The Pearson correlation coefficient ($r = 0.915$, $p < .001$) demonstrates a very strong positive correlation between the variables. This result is significant not only statistically but also practically and theoretically. In this section, the obtained results are compared with international and Kazakhstani scientific literature, their theoretical significance is elucidated, their impact on the primary education system is analysed, and the study's limitations and future directions are proposed. International studies confirm a clear link between students' digital literacy and their safe behaviour in online environments. A study by Aesaert et al. (2017) [11] showed that pupils with higher digital competence acted more critically when searching for, processing, and evaluating information. Conversely, a low level of this competence was found to make them more susceptible to fake information, phishing attacks, or manipulation on social media. Our research findings also align with this conclusion, indicating that as students' digital skills improve, their cybersecurity practices become more systematic. A study conducted among university students assessed their cybersecurity awareness and found that students with lower digital literacy are more frequently exposed to online threats. They were particularly prone to using weak passwords and oversharing personal information on social media. This is directly consistent with our findings, as the majority of surveyed students focused on password complexity and the protection of personal data [12]. Livingstone and Helsper (2007), in their study of the internet behaviour of UK pupils, noted that a high level of digital competence is a key prerequisite for protecting children from online threats. This finding also supports our research results: the more future teachers master digital literacy, the more important their role will be not only in their own practice but also in teaching a safe internet culture to primary school pupils [13]. In Kazakhstan, the issue of digital literacy has been addressed at the state level in recent years. As part of the "Digital Kazakhstan" programme, projects aimed at developing the digital skills of the population are being implemented. However, cybersecurity issues remain insufficiently addressed. In particular, there is a noticeable lack of specialised courses and practical training in this area at pedagogical higher education institutions. This indicates that while the digital literacy of Kazakhstani students is increasing, a culture of cybersecurity has not yet been sufficiently established. For instance, many students are careless about protecting their personal data online, while some are falling victim to information manipulation on social media. The results of our research offer a new perspective on this issue: digital literacy and cybersecurity are closely interrelated and, therefore, must be developed concurrently within the education system. The findings contribute to existing theories of digital competence in educational science. Digital literacy is not merely a set of technical skills; it is intrinsically linked with the ability to critically analyse information, adhere to online ethical norms, and, most importantly, implement security measures. The preparation of future primary school teachers must foster digital literacy and cybersecurity skills as integral parts of their professional culture. Theoretically, our research findings align with the concept of 'digital citizenship.' This concept implies that internet users possess not only knowledge but also responsible, ethical, and safe behaviour. For future teachers, digital literacy and a culture of cybersecurity are considered an integral part of professional competence. Research findings indicate that digital literacy is not just about technical skills but is also closely linked to the critical evaluation of information and safe behaviour [14]. Research findings can have a direct impact on the primary education system. If future primary school teachers are proficient in digital literacy and cybersecurity, they can also teach their pupils a culture of safe internet use. This is particularly important for children today, as primary school pupils gain access to social networks and internet resources at an early age. In practice, it is proposed to introduce a

dedicated “Digital Literacy and Cybersecurity” course into university programmes. In addition to traditional lectures, the learning process should include game elements and simulations. It would be effective to conduct practical lessons based on Escape Room methods. Such experiences not only increase students' interest but also help to develop cybersecurity skills that can be applied in real-life situations. The research findings could have a direct impact on the primary education system. If teachers master digital literacy and cybersecurity, they can serve as role models in teaching pupils how to use the internet safely. Such practices have also been used in international experiences [15]. Like any empirical study, this work has certain limitations. Firstly, the sample size is relatively small (48 students). This does not allow the results to be generalised to all students in Kazakhstan. Secondly, the study was conducted in only one region, namely at a specific university. The characteristics of students in other regions may have been overlooked. Thirdly, as the method used was a survey based on students' self-assessments, there is potential for subjectivity. In the future, the sample size should be increased to include university students from various regions. The use of qualitative research methods (interviews, focus groups) alongside quantitative methods would complement the findings. Comparative studies between primary school pupils and their teachers could also provide interesting scientific data. Research findings have demonstrated a strong positive correlation between students' digital literacy and their cybersecurity proficiency. This is a significant conclusion for enhancing the professional training of future primary school teachers. Digital literacy is not just an informational skill but also the foundation for fostering safe behaviour. By strengthening this aspect, Kazakhstan's education system can cultivate a high-quality, safe digital culture among the new generation of teachers. As the study was conducted in only one region, it is difficult to generalise the results. Other researchers have also noted such limitations [16].

Conclusion

This study analysed the relationship between the digital literacy levels and cybersecurity skills of prospective primary school teachers. According to the results, the students' digital literacy was above average, while their cybersecurity skills were uneven. A very strong positive correlation was observed between the two variables, indicating that as digital literacy increases, cybersecurity skills also improve. The study's findings offer important practical implications for the field of primary education.

Firstly, developing digital literacy is a key factor in establishing the internet safety and information literacy of primary school pupils. Secondly, the need to introduce specialised modules and elective courses on cybersecurity in the training of future teachers has been identified. Recommendations for teachers:

Use modern methods of teaching digital safety in the teaching process.

Increase student engagement by incorporating elements of gamification into lessons and educational activities. Systematically include topics on digital literacy and cybersecurity in specialised curricula.

The findings of this study provide a methodological basis for enhancing the professional preparation of future teachers and for ensuring that primary school pupils learn in a safe digital environment.

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Appendix A

Survey
1. Gender: ☐ male ☐ female
2. Your age: _____
3. Your course / class: ☐ 1 ☐ 2 ☐ 3 ☐ 4
4. I can search for information on the internet correctly.

5. I can assess the reliability of information.
6. I can use email and messengers for formal purposes.
7. I can use cloud services such as Google Drive and OneDrive.
8. I can use online learning platforms (Moodle, Google Classroom).
9. I can process information and prepare it as a presentation or a document.
10. I can use social media for educational purposes.
11. I can critically evaluate information from the internet.
12. I can work with multimedia tools (video editing, audio recording).
13. I understand my responsibility for my online activity.
14. I use the same password for all my online accounts.
15. I respond to authentication requests (login, password, etc.) received via email.
16. I chat with strangers on webcam.
17. I share my personal data (SSN, date of birth, phone number, etc.) online when necessary.
18. I open attachments in emails from strangers.
19. I share my personal information on social networks.
20. I reveal my location online.
21. I click on adverts on social media and make online purchases through them.
22. I set passwords that are easy to remember.
23. I reply to emails from sites such as banks and online shops (requesting card numbers or passwords).
24. I ignore online requests for money or credit.
25. I do not accept friend requests from people I do not know on social networks.
26. I don't register on untrustworthy websites.
27. I do not download files from untrustworthy websites.
28. I check the security and certificates of web pages.
29. I keep the programmes I use up to date.
30. I have antivirus software installed on my computer.
31. I avoid using weak passwords.
32. I regularly adjust my web browser's security settings.
33. I conduct internet banking transactions only on my personal computer.
34. I only conduct online shopping on my personal computer.
35. I try not to store my personal data on computers other than my own.
36. I regularly clear my web browser history.
37. I always log out of my accounts, such as social networks and email, after I have finished.
38. I regularly change the passwords I use online.
Likert scale
1 – Strongly disagree
2 – Disagree
3 – Neutral
4 – Agree
5 – Strongly agree