Information approach in education and its use in the training of computer science teachers to form students' digital safety skills

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Annotation. The article discusses the problem of using the information approach in education to train computer science teachers to form students' digital security skills. An analysis of pedagogical strategies for using IT to improve the quality of teaching computer science to students and applying an information approach to training computer science teachers to form students' digital safety skills is presented. Based on the analysis (terminological analysis, content analysis, comparative analysis) and generalization of scientific results on the use of the information approach in vocational education in general and in the training of computer science teachers to form students' digital security skills, in particular; Several tasks have been studied: the information approach in education has been characterized; clarified how the information approach affects teaching methods and integrates digital tools into education; it is revealed how the information approach makes it possible to form digital security skills; the risks of implementing the information approach are assessed; the role of computer science teachers in the formation of knowledge about digital security is defined; Case studies and best practices for the formation of students' digital security skills have been identified. It is substantiated that the current challenges are related to the rapid evolution of cyber threats, different access to technologies and resources, and the need for continuous professional development of teachers, and they require constant attention and innovative solutions. Therefore, future computer science teachers need appropriate methodological skills and IT knowledge to implement active learning strategies and integrate digital tools into the computer science teaching process. Proactive and anticipatory training and continuous professional development of computer science teachers will be essential to develop students' knowledge and skills in digital security.

Keywords: information approach, computer science teacher, digital security skills, professional training, vocational education.

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Інформаційний підхід в освіті та його використання при підготовці вчителів інформатики формувати навички цифрової безпеки учнів

Анотація. Стаття торкається проблеми використання інформаційного підходу в освіті у підготовці вчителів інформатики для формування в учнів навичок цифрової безпеки. Представлено аналіз педагогічних стратегій використанням ІТ для покращення якості навчання інформатики учнів та застосування інформаційного підходу в підготовці вчителів інформатики формувати навички цифрової безпеки учнів. На основі аналізу (термінологічний аналіз, контент-аналіз, порівняльний аналіз) та узагальнення наукових результатів щодо використання інформаційного підходу в професійній освіті загалом і в підготовці вчителів інформатики для формування в учнів навичок цифрової безпеки, зокрема; досліджено низку завдань: охарактеризовано інформаційний підхід в освіті; уточнено, як інформаційний підхід впливає на методи навчання та інтегрує цифрові інструменти в освіту; виявлено, як інформаційний підхід уможливлює формування навичок цифрової безпеки; оцінено ризики впровадження інформаційного підходу; визначено роль вчителів інформатики у формуванні знань про цифрову безпеку; виявлено тематичні дослідження та кращі практики формування в учнів навичок цифрової безпеки. Обґрунтовано, що поточні виклики пов'язані зі швидкою еволюцією кіберзагроз, різним доступом до технологій і ресурсів, а також необхідністю постійного професійного розвитку вчителів, вони потребують постійної уваги та інноваційних рішень. Тому майбутнім учителям інформатики потрібні відповідні методичні навички та ІТ-знання для реалізації стратегій активного навчання та інтеграції цифрових інструментів в процес навчання інформатики. Випереджувальна і проактивна підготовка та постійний професійний розвиток вчителів інформатики матимуть важливе значення для розвитку знань та вмінь учнів у галузі цифрової безпеки.

Ключові слова: інформаційний підхід, вчитель інформатики, навички цифрової безпеки, професійна підготовка, професійна освіта.

Introduction

The penetration of digital technologies into various spheres of public life requires an awareness of digital security and risks. Therefore, the list of key skills in the field of digital security that are necessary for young people today includes an understanding of various threats (malware, phishing, social engineering, and others), the ability to analyze threats and their impact, awareness of the legal and ethical consequences of cybersecurity (data privacy laws, intellectual property rights, responsible online behavior), as well as having practical skills in secure online practices, password management, and data protection. These skills require developing and implementing effective learning strategies through the transition from traditional teaching methods to more effective and interesting ones for young people. One of these learning strategies is introducing an information approach based on the ability to search, process, and disseminate various data in the digital space. Its use in the training of computer science teachers is seen as effective, and therefore, the problem of training computer science teachers based on an information approach is actualized.

Analysis of current research. Modern computer science teacher training models differ ([3; 6; 13] and others). Some programs emphasize programming to a greater extent, while others incorporate pedagogical approaches to teaching computer science [25]. At the same time, all educational programs provide for integrating IT into the training of computer science teachers.

This is common, and many applications use online platforms and interactive tools [20]. The extent to which these programs address digital security skills varies considerably [1]. Some emphasize targeted cybersecurity training, while others focus on building broader digital literacy skills [17]. At the same time, scientists emphasize that project-based and active teaching methods are gaining popularity in the digital educational environment. They contribute to deeper involvement and retention of knowledge [2].

National educational policy and available educational resources also affect the content and methods of teaching computer science [3], and the effective formation of digital security skills, in addition to technological knowledge, requires knowledge of possible pedagogical strategies and methods of teaching disciplines in the field of IT. Teachers, according to scholars [7], must be able to present complex concepts in an accessible form. In particular, visual forms are effective [14]. The ability to simplify complex concepts and processes involves understanding how students learn, and therefore, the ability to adapt teaching methods to the digital educational environment is important [23]. Effective pedagogical methods include interactive modeling, role-playing games, case studies, real cyberattacks, and joint projects [1]. Active learning methods such as case-based problem-solving, simulations, and hands-on exercises are effective. Such methods focus on working with information and are important for the development of critical thinking [2].

On the other hand, scientific research indicates the need for teachers' professional development in the digital security field. The rapid growth of technology and cyber threats makes updating knowledge an ever-challenging task [22]. Many teachers need more technical skills and experience to confidently build students' digital safety skills [7]. The availability of high-quality educational resources appropriate to the student's age should be considered limited [24]. Teachers often create their materials, but this is time-consuming [19]. It is also necessary to take into account the digital divide in the implementation of educational programs for the training of computer science teachers [7; 19]. At the same time, the rapid pace of technological progress necessitates the continuous professional development of computer science teachers to ensure the relevance of knowledge about security threats and positive practices for the formation of digital security skills.

The aspects we have listed (the content of educational programs for the training of computer science teachers; the integration of IT into the professional training of computer science teachers; educational policy and available digital educational resources; the need for the ability to transform information; the feasibility of interactive modeling; the need for professional development of teachers through various digital resources) are related to IT and information resources, which indicates the potential importance of the information approach as a basic one in teacher training computer science for the formation of students' digital security skills. Therefore, the article aims to provide arguments in favor of the information approach in the training of computer science teachers to form students' digital security skills.

The set goal is implemented by several tasks and appropriate methods of scientific knowledge (analysis, synthesis, and generalization of scientific results on the use of the information approach in vocational education in general and the training of computer science teachers for the formation of digital security skills in students, in particular; terminological analysis, content analysis, comparative analysis):

1) to characterize the information approach in education;
2) clarify how the information approach affects teaching methods and integrates digital tools;
3) to identify how the information approach enables the formation of digital security skills;
4) assess the risks of implementing an information approach;

5) to determine the role of computer science teachers in the formation of knowledge about digital security;

6) identify case studies and best practices for building students' digital security skills.

Results

Information approach in education: definition and characteristics. The "information approach" in education, although not strictly defined, encompasses pedagogical strategies using IT to improve teaching and learning [6]. It goes beyond simply replacing traditional methods (for example, whiteboard with a projector). thinking, problem-solving in education [3]. The IT makes it possible to create an interactive educational environment that caters to various learning models [18]. Interactive e-learning models, for example, significantly improve students' cybersecurity skills [1], demonstrating the practical application of the information approach.

The informational approach is based on the idea that learning is fundamentally an information-processing activity [25]. It considers knowledge not static facts but a dynamic system that people construct and use. Active participation fosters critical thinking by allowing students to evaluate sources of information, identify biases, and synthesize information from different perspectives [19].

Successful implementation of the information approach requires a detailed analysis of pedagogical strategies and the development of appropriate digital literacy skills among teachers and students [17]. Effective use of IT involves the preliminary design of the educational process to form learning experiences using IT [9]. Real-world scenarios and case studies help students understand digital dangers and the importance of preventive measures [5]. Simulating a phishing attack can provide essential experiences for students, and collaborative learning activities (group projects or peer-to-peer learning) increase student engagement and promote teamwork skills [2].

The information approach recognizes the importance of individual learning strategies that provide opportunities for the implementation of personalized educational trajectories [19]. Also, the information approach requires the development of information literacy – the ability to find, evaluate, and effectively use information as an essential skill of the 21st century [25]. It often involves including various educational resources, digital tools, and technologies to increase motivation and cognitive activity [10].

As an information approach, it improves teaching methods and integrates digital tools. The informational approach improves learning outcomes by shifting the emphasis from the student's passive perception of information to the student's active involvement in learning [25]. Standard methods, such as lectures, often lead to passive learning. In contrast, the informational approach encourages active learning methods, including problem-oriented, project-based, play-based, and inquiry-based learning [11]. Such teaching methods require students to actively search, analyze, and synthesize information to solve problems, complete projects, or find answers to research questions, developing their critical thinking. Active learning improves knowledge retention and develops analysis, evaluation, problem-solving, and collaboration skills.

The informational approach promotes active discussions, simulations, and the study of various (even a large number) specific cases of different learning tasks. Research shows a positive impact of active learning on student engagement and academic performance [2]. According to [19], the information approach promotes individualized learning, recognizing different learning paces and styles.

The information approach allows for the integration of digital tools and resources into the educational process. Information on the Internet and interactive digital technologies contribute to acquiring the necessary experience. Digital tools facilitate access to various sources of

information, and this allows for research on various problematic issues [19]. The use of digital environments (interactive simulations, virtual labs, and online collaborative platforms) increases student engagement in the learning process and provides practice-oriented learning [15].

The use of digital tools as a means of an informational approach promotes personalized learning that is based on adaptive learning on digital educational platforms [21]. Examples of such platforms are Moodle, Google Cloud Services, Skype, and BigBlueButton [19]. Interactive e-learning units significantly improve students' digital skills [1]. However, as stated in [7], interactive learning requires taking into account the level of digital literacy of learning subjects, as well as ensuring access and security to the Internet, which also requires digital security skills. Future computer science teachers need to be trained in using these tools, so educational initiatives and activities in the e-learning format should provide a safe learning environment [17].

Information approach and digital security skills. The informational approach is vital in building students' digital security skills in computer science lessons. With a focus on critical thinking and evaluating information, it empowers students to identify and mitigate online threats [7], which includes recognizing phishing attempts, understanding strong passwords, and practicing safe web browsing on the Internet. The integration of digital tools provides a practical aspect of developing digital security skills in the study of computer science. Therefore, students, future computer science teachers, and students in computer science classes can participate in simulated cyberattacks, analyze security vulnerabilities, and experiment with security measures. Project-based learning is effective because it allows students to apply their knowledge in real-world situations [4]. At the same time, the information approach helps students understand the ethical aspects of digital security, promoting the responsible use of technology and respect for privacy.

Risks of implementing an information approach. The training and professional development of computer science teachers are essential for the development of students' knowledge and skills in the field of digital security. Therefore, computer science teachers need appropriate methodological skills and IT knowledge to implement active learning strategies and integrate digital tools into the computer science teaching process. important [17], as well as solving issues of digital literacy, Internet safety, and managing one's activities on the Internet [7], awareness of risks and knowledge of methods to avoid them through the development of information hygiene skills [12]. At the same time, using an information approach to training future computer science teachers provides various opportunities. With the growing availability of digital resources and the spread of innovative approaches to learning, the organization of various electronic learning environments can generally contribute to the development of critical thinking, problem-solving skills, and other important skills of the 21st century. Access to technology and Internet connectivity can be a barrier to the use of an information approach, especially in schools with insufficient information resources [3].

Computer science teachers' role in forming knowledge about digital security. Using an information approach, computer science teachers have opportunities for their development in digital security. Their acquired technological experience in the process of professional training and pedagogical knowledge allows them to integrate digital security education into the computer science curriculum [22] in the manifestation of various forms and methods. This may include special courses (clubs, extracurricular activities) on cybersecurity or the inclusion of digital security elements in existing computer science lessons. Interactive e-learning methods focused on developing specific digital safety skills can improve students' learning outcomes. Computer science teachers have the opportunity to form the knowledge and skills of citizens of the digital society (promote the development of digital citizenship), teach students responsible behavior on the Internet and data protection, and form students' ideas about the ethical and unethical consequences of using IT [25]. Effective computer science teaching requires teachers

to have a high level of digital competence and understanding of modern cyber threats [22]. Therefore, appropriate proactive professional training and subsequent continuous professional development are necessary for rapid IT development [16]. Proactive training of computer science teachers is essential to ensure that students develop the necessary skills to navigate the virtual space safely and responsibly. Critical, according to, is the awareness of computer science teachers about social engineering due to its growing prevalence and modern methods of cyberattacks.

Teachers also need effective assessment strategies to measure students' understanding and ability to act effectively and safely in cyberspace, avoiding cyber threats [22]. Mastering formative assessment allows computer science teachers to identify areas that need additional support and adjust the learning process [19]. At the same time, according to [8], the development of critical thinking and problem-solving skills is essential for timely and effective risk analysis and informed decision-making and effective communication is essential for clearly communicating the importance of digital security [7].

Case studies and best practices. Several studies highlight successful strategies for integrating the information approach into teacher training programs. One approach involves the creation of interactive e-learning units tailored to the specific determinants of digital citizenship [1]. This method, implemented at Um al-Qura University, used a quasi-experimental design with cognitive tests and observation cards to measure the effectiveness of cybersecurity skills' mental and executive aspects. The results demonstrated a statistically significant improvement in students' cybersecurity knowledge and skills. Another successful strategy involves the use of project-based learning [4]. This approach provides a basic understanding of digital security and teaches students to apply the acquired knowledge in a technological environment. The study demonstrated that the project-based approach allows future teachers to cover the problem-solving process. Developing digital and STEM skills in training chemistry teachers is another example of the successful integration of the information approach [17]. This study, using a blended methods approach, found that the development of students' digital skills was directly related to curriculum progress. Analyzing educational practices, we note the importance of a well-structured curriculum of the academic discipline, the use of active and interactive teaching methods, the need for continuous assessment of students, as well as the importance of adapting teaching methods to meet the needs of the digital generation [2]. Creating a favorable information and educational environment is essential for the practical training of teachers, where various educational content, various methods, and forms of academic activities are necessary to meet students' individual needs. The effectiveness of the digital environment (including Moodle, Google Cloud services, and video conferencing tools) has been statistically confirmed.

Conclusions

We investigated the relationship of the information approach in preparing computer science teachers to form students' digital security skills. The informational approach in education, especially in combination with practical teacher training and integrating relevant technologies, has significant potential for forming students' digital safety skills. However, the current challenges are related to the rapid evolution of cyber threats, different access to technology and resources, and the need for continuous professional development of teachers. They require constant attention and innovative solutions. Therefore, future computer science teachers need appropriate methodological skills and IT knowledge to implement active learning strategies and integrate digital tools into the computer science teaching process. Proactive and proactive training and continuous professional development of computer science teachers are essential for developing students' knowledge and skills in digital security.

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