

## Innovative Digital Updates in the Construction of an Information and Analytical Model of the Activities of Educational Personnel

Olena Orlova<sup>1</sup>, Margaryta Noskova<sup>2</sup>, Iryna Gavrysh<sup>3</sup>, Oleksandra Khltobina<sup>4</sup>, Mariia-Viktoriia Polets<sup>5</sup> and Mykola Kuzminov<sup>6</sup>

### Abstract

*The purpose of the article is to form an information and analytical model for ensuring the digital transformation of the educational process in the face of modern cyber threats. The object of the research is modern information systems for ensuring the digital transformation of the educational process. The scientific task of the study is to formulate the methodological foundations of information support for the digital transformation of the educational process in response to modern cyber threats and their negative trends. The research methodology includes the method of multi-criteria evaluation of alternatives and the method of system analysis. As a result, modern information and analytical models were formed that allow maintaining the cybersecurity of an institution and adequately responding to threats arising in the information space. The study has its limitations. The methodological principles developed as part of the study are aimed at increasing the level of cybersecurity of institutions and adequately responding to information threats.*

**Keywords:** *Information and Analytical Systems, Digital Transformation, Educational Process Mathematical Modeling, Multicriteria Evaluation*

## INTRODUCTION

In the modern world, where digital transformation penetrates into all areas of activity, education is undergoing fundamental changes. From traditional classrooms to virtual lecture halls, digital technologies are expanding learning and teaching opportunities, offering new methods and approaches to the educational process. This dynamics gives rise to the need to develop information and analytical models for conducting educational activities that take into account not only current needs and trends, but also can adapt to future challenges.

The information system includes a set of tools and methods that allow the user to collect, store, transmit and process selected information. An information system consists of an ordered set of documents, technologies and computer facilities and communications, on the basis of which information processes are implemented. The problem of creating and using information systems is solved by most modern institutions and enterprises, regardless of the type of activity. The problem of designing educational information systems is due to the need to create modern information systems that allow the transition from paper or partially automated document management to electronic document management in the field of education. In particular, an important direction for the implementation of ISO is the automation and support of scientific activities in order to increase the productivity and effectiveness of scientific research (De Witter, Chenier, 2023; Agasisti, et.al., 2017).

An information and analytical model is a reflection in a scheme, formula, sample, etc. characteristic features of the object under study. It is simplified by a specific life (management) situation, in other words, real events and circumstances are reflected in the models in a certain way.

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<sup>1</sup> Prykarpats'kyy Instytut Im.M. Hrushevs'koho Prats'koho Vnz «Interregional Academy of Personnel Management», Truskavets, Ukraine

<sup>2</sup> Department of Pedagogy and Innovative Learning, Lviv Polytechnic National University, Lviv, Ukraine E-mail: [margaryta.v.noskova@lpnu.ua](mailto:margaryta.v.noskova@lpnu.ua)

<sup>3</sup> Department of Primary and Professional Education, H.S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine

<sup>4</sup> Department of Theory and Technology of Pre-school Education and Art Disciplines, H.S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine

<sup>5</sup> Department of Pedagogy and Innovative Learning, Lviv Polytechnic National University, Lviv, Ukraine

<sup>6</sup> Department of Marketing and Business Management, Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine

Modeling is the creation of a certain image of the original object, called a model, which, under certain conditions, can replace the original object itself, reproducing the properties and interests of the researcher of the original and at the same time providing clarity, visibility, ease of operation and other advantages. It follows from the definition that the model is of a target nature, that is, it does not reflect the original object itself, but is formed based on the goal of displaying very specific properties of the modeling object.

The use of models allows making decisions, the justification of which takes into account all the factors and alternatives that arise in difficult conditions of production activity, therefore modeling is considered as an effective way to optimize management decisions (De Wit, 2017).

In the study of any object of education, as in any cognitive process, modeling acts as a link between theory and practice, is an effective research tool, and the model as its result is an important epistemological function. In addition, the epistemological significance of modeling in cognition is also manifested in the fact that the model is the key point in the process of movement of thought from less complete knowledge to more complete, from less profound knowledge to knowledge of the deeper essence of phenomena. In one respect, the model acts as a secondary object of study, in another - as a means of fixing it.

The digital transformation of the educational process requires an integrated approach to information support, in particular, integration of the latest IT solutions, ensuring cybersecurity, and adaptation to the changing needs of students and teachers. However, the digitalization of the educational environment faces numerous challenges, including growing cyber threats that can undermine not only information security, but also trust in the latest educational platforms.

In this context, the development of a methodology for constructing an information and analytical model for conducting educational activities becomes an urgent need. Such a model should take into account not only the technological aspects of digital transformation, but psychological, social and economic factors. It must be flexible to adapt to changing conditions, while at the same time being resilient to cyber threats (Hill, et.al., 2020; Jacob, et.al., 2016).

The basis for the development of such an information and analytical model is a general theoretical framework, which includes research in the field of computer science, pedagogy, psychology and cybersecurity. An important aspect is the analysis of existing practices and methodologies in the field of digital education, as well as the study of potential risks and threats. This will create a solid theoretical basis for the practical application of the developed model.

The work begins with a comprehensive literature review and contribution to knowledge in the Section. 2. In Section 3 we present a methodology, including a method of multi-criteria assessment of alternatives and a method of systems analysis (with the involvement of experts using the Delphi method). This is followed by the presentation of detailed results and discussion in Section 4 presenting the generated information models. The final part of the work is described in Section 5.

The purpose of the article is to form an information and analytical model for ensuring the digital transformation of the educational process in the context of modern cyber threats. The object of research is modern information systems for ensuring the digital transformation of the educational process.

## **LITERATURE REVIEW**

A literature review plays a crucial role in any scientific research as it provides an in-depth understanding of existing knowledge, theories and research methodologies related to the chosen topic. In the context of our research, devoted to the methodology for constructing an information and analytical model for conducting educational activities, the importance of analyzing existing sources cannot be overestimated. This process allows us to identify and synthesize key findings from previous research, identify knowledge gaps that our research can fill, and avoid repeating known pitfalls. In addition, the literature review contributes to the formation of a sound theoretical foundation for the development of our methodology, which is an integral part of preparation for the empirical part of the study.

Today, In the works of Wen et al. (2020) and Kryshchanovych et al. (2021) it is noted that the information model is understood as a method of forming images of objects, describing an event. Through this method, a person creates a collective artificial thesaurus: databases and knowledge, information systems. As a rule, an information model is given in the form of a table (database, knowledge base), graphs or a model diagram. In other words, information modeling is interpreted as the main way of interpreting information processes associated primarily with the emergence of information and knowledge, their perception, memorization, reproduction and storage, as well as transmission and processing.

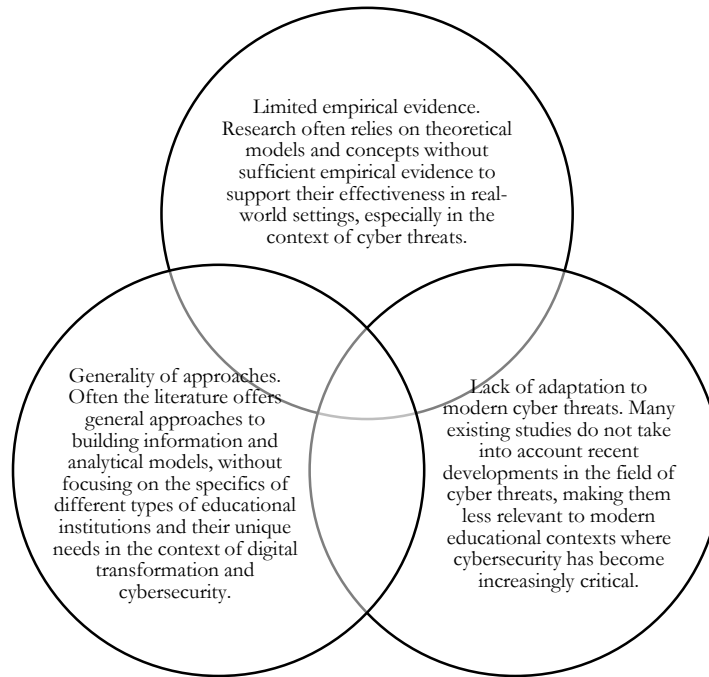
In general, Sylkin et al. (2018) and Samodumska et al. (2022) describe that information modeling technology and its methods are used to study information processes. Among the methods underlying the technology of information modeling, there are: the method of concept hierarchies (clarification, detailing, sequential symbolization); the method of meaningful definition (concepts are revealed through others that are considered to be known); method of operational definition (describes the procedure by which a particular phenomenon can be detected or measured); descriptive definition method (if the concept cannot be described through others, the object or event is new, indefinite, then the essential properties of the concept, objects and events are listed).

The work of Kryshchanovych et al. (2022) occupies a special place by offering an important philosophical perspective on the development of professional competence in students. The authors focus on identifying the key components that contribute to the development of professional skills in the context of higher education, including theoretical and practical aspects. This approach can be considered as fundamental for the development of an information-analytical model of educational activity, since it provides important guidance on the integration of professional competencies in a digital learning environment. In particular, in the context of the digital transformation of the educational process, understanding the philosophical aspects of the formation of professional competencies allows us to better adapt educational models to modern cyber threats, emphasizing the importance of developing critical thinking, moral education and digital literacy among students.

Nonthamand, Suaklay (2021) points to the fact that information modeling is closely related to mathematical and computer modeling. A mathematical model is a way of representing an information model that reflects the relationship of various object parameters through mathematical formulas and concepts. In cases where modeling is focused on the study of models using a computer, one of its stages is the development of a computer model, understood as a virtual image created using computer resources, which qualitatively and quantitatively reflects internal properties and relationships. a bundle of a modeled object sometimes conveys its external characteristics. A computer model is a material model that corresponds to the appearance, structure or action of the object being modeled. The development of a computer model is preceded by mental, verbal, structural, mathematical and algorithmic models.

The information model Bilyk et al. (2021) Harbouche et al. (2023) and Aman (2023) is recognized as the main way of cognition, the formation of images, therefore, in education, the use of this method as the main learning process and the object of research is recognized as relevant. Actual tasks for information modeling are: creation of data and knowledge models in the network community; artificial intelligence modeling, etc. In society, a person is accompanied by areas of activity that experts also refer to the information process, including cognition, training, education, communication, and mental activity. For the emerging information society, one of the key information competencies of a person is the possession of information modeling methods for the expedient and effective implementation of information programs (Alazzam, 2023).

So, in Fig. 1. depicts the key gaps of modern literature on the topics we are researching.



**Figure 1.** Key gaps of modern literature on the topics we are researching

Despite the significant amount of existing research, the topic of building an information and analytical model for conducting educational activities in the context of digital transformation and adaptation to modern cyber threats remains insufficiently studied. This is due to dynamically developing technologies and growing cybersecurity requirements, which are constantly evolving, posing new challenges for educational systems. Most existing studies focus on individual aspects of digital education or cybersecurity, without taking a holistic view of integrating these components into a single effective system. Also, despite the development of numerous theoretical models and approaches, their practical testing and adaptation to the specifics of various educational institutions often remains unattended by researchers. The lack of in-depth analysis of the interaction between technological innovation, pedagogical methods and cybersecurity in the context of developing students' professional competencies indicates the need for further research. This will ensure the development of more effective, flexible and secure educational models that can adapt to rapid changes in the digital world and ensure that students are highly prepared for the challenges of the modern labor market.

Thus, the scientific task of the study is to formulate the methodological foundations of information support for the digital transformation of the educational process in response to modern cyber threats and their negative trends

The paper contribution to knowledge includes:

- Using the Delphi method, three key options for the digital transformation of the educational process were identified, each of which is aimed at effectively countering cyber threats.
- Based on system analysis, options for information and analytical support for the digital transformation of the educational process in the context of countering cyber threats were identified.
- Due to the method of multi-criteria evaluation of alternatives, the most optimal cybersecurity strategies for various aspects of digital transformation in education were identified.

## **METHODOLOGY**

Our research methodology is complex and multifaceted, as it combines several advanced methods to develop effective information and analytical models aimed at maintaining cybersecurity and adequately responding to threats in the information space. The methodology is based on the method of multicriteria evaluation of alternatives, the method of system analysis and the Delphi method, each of which has its own characteristics, advantages and limitations.

The method of multicriteria evaluation of alternatives is key in our research, since it allows us to evaluate various decision options based on a set of criteria. This method is important when there are many different aspects to consider and a balanced approach to choosing the optimal solution. The essence of the method is to take into account various evaluation criteria, which may include efficiency, cost, reliability, safety and other important parameters. One of the main advantages of this method is its flexibility and ability to adapt to complex decisions, but at the same time it requires a large amount of data and in-depth analysis, which can become a limitation, especially in resource-limited settings.

The systems analysis method is used to understand complex systems and processes by viewing them as holistic systems that include interrelated components. In the context of our research, this method allows us to deeply analyze educational processes, identify key elements affecting cybersecurity and develop comprehensive strategies for their optimization. The technique has the advantage of being able to detect systemic relationships and potential points of intervention to improve efficiency and safety, but the complexity of systemic analysis and the need for an interdisciplinary approach can present a challenge.

The Delphi method uses experts to reach consensus on certain issues or predictions through a series of questionnaires where the experts do not know each other. This method plays an important role in our research because it allows us to gather the opinions of leading experts in the field of cybersecurity and education, providing a deep understanding of potential risks and effective response strategies. The advantages of the method include the ability to obtain informed expert assessments, but it also has limitations associated with the time and resources required to organize and conduct several rounds of questionnaires.

In general, the combination of the multi-criteria evaluation of alternatives method, the system analysis method and the Delphi method in our study forms a powerful basis for obtaining the desired results. This allows not only to develop effective information and analytical models to support cybersecurity, but also to ensure an adequate response to a wide range of threats arising in the information space, taking into account various criteria and expert opinions.

To ensure the objectivity and relevance of our study, we decided to focus on the educational process in the southern region of Sweden. The choice of this region was due to the presence of scientific connections with leading Swedish experts in the field of educational activities. This cooperation opens up unique opportunities for in-depth analysis and understanding of the specifics of the educational process in the region, and also takes into account best practices and innovative approaches that can be implemented in other countries. In addition, the choice of the southern region of Sweden was motivated by the potential for further adaptation and scaling of the proposed digital transformation and cybersecurity models, given the high level of technological integration and innovation in the country's education sector.

## **RESULTS AND DISCUSSIONS**

The first stage of our methodology was to identify three main options for the digital transformation of the educational process, aimed at countering cyber threats. This process was carried out through in-depth expert research using the Delphi method. Known for its ability to build consensus among experts through a series of anonymous surveys, the Delphi method allowed us to collect and analyze the opinions of leading experts in the fields of cybersecurity and digital education.

As a result, three main options for digital transformation were identified, each of which has unique features and potential for strengthening the cybersecurity of educational processes. These options were analyzed in detail and assessed in terms of their effectiveness, implementation and potential risks, which provided a solid basis

for further selection of digital transformation strategies and methods that will be used in our study to form effective information and analytical models.

Based on expert research and the application of the Delphi method, three key options for the digital transformation of the educational process were identified, each of which is aimed at effectively countering cyber threats.

1. Integrated educational platforms with advanced cybersecurity features. This option involves the creation and use of comprehensive educational platforms that combine educational materials, communication and learning management tools with built-in cybersecurity solutions. They must ensure that data and transactions are protected from external threats, and also include mechanisms to detect and neutralize potential cyber attacks. Such systems have the advantage of centralized security management and user convenience, but they can require significant resources to develop and maintain.

2. Development and application of adaptive artificial intelligence algorithms for predicting and preventing cyber threats. The use of AI can significantly improve the ability of educational systems to predict potential cyberattacks in the early stages and automatically implement measures to prevent them. This approach allows for the creation of dynamic defense mechanisms that adapt to changing threats. However, the use of AI algorithms requires access to large amounts of data for training and can create additional challenges related to privacy and ethical use.

3. Using blockchain technologies to ensure the security of educational data. The use of blockchain can provide a high level of security for educational records and transactions due to decentralization and cryptographic protection. This approach ensures the immutability and transparency of educational records, preventing unauthorized access and manipulation. However, the implementation of blockchain technologies may face technical and organizational challenges, and will also require significant efforts to integrate with existing educational processes.

Each of these options has its own advantages and disadvantages. In other words, the level of support for the educational process in the context of countering cyber threats, which can be achieved as a result of ensuring the digital transformation of the educational process in the context of countering cyber threats, in accordance with digitalization trends, it is advisable to evaluate on a scale (Table 1).

**Table 1. Scale for assessing levels according to options for digital transformation of the educational process in the context of countering cyber threats**

Options	Level	Level characteristics
Integrated educational platforms with advanced cybersecurity features	minimum	slows down the development of the cyber threat
Development and application of adaptive artificial intelligence algorithms for predicting and preventing cyber threats	normal	allows to stop development and eliminating the consequences of a cyber threat
Development and application of adaptive artificial intelligence algorithms for predicting and preventing cyber threats	maximum	makes it possible to stop development, minimize negative consequences and eliminate the root causes of the appearance of cyber threats

For each digital transformation option, we presented four options for information and analytical support for the digital transformation of the educational process in the context of countering cyber threats. For convenience, we denote them symbolically.

*A<sub>j</sub>*. Monitoring systems and incident responses. For integrated educational platforms with advanced cybersecurity functions, the use of monitoring and incident response systems can become a key element of information and analytical support. SIEM systems provide the collection and analysis of security logs from various sources in real time, allowing you to quickly identify and respond to potential threats, which significantly increases the level of protection.

*B<sub>j</sub>*. User and Entity Behavior Analytics. In the context of adaptive AI algorithms for predicting cyber threats, the use of user and entity behavior analytics can be an effective tool. UEBA analyzes the behavior of users and

system entities, identifying anomalies that may indicate internal or external threats, allowing the implementation of preventive security measures.

*C<sub>j</sub>*. Register books are distributed. For blockchain technologies that ensure the security of educational data, distributed ledgers can serve as the basis for information and analytical support. Using DLT allows you to create an immutable, transparent and secure storage system for educational records, making it much more difficult for unauthorized access or manipulation of data.

*D<sub>j</sub>*. Identification and access control systems. In addition to other options, identity and access control systems can be an important information and analytical support tool for all three digital transformation options. IAM allows you to control access to educational resources and data, ensuring that only authorized users have the ability to access critical information, thereby increasing the overall level of cybersecurity.

For each option of information and analytical support regarding the above-mentioned options for the digital transformation of the educational process in the context of countering cyber threats, it is important to form an appropriate level of support for the latter. Thus, during the research, security levels will be ranked from 1 (minimum) to 3 (maximum).

The next stage of our methodology will be a detailed comparison of the levels of support that are offered by different options for information and analytical support, in the context of the options we have chosen for the digital transformation of the educational process to counter cyber threats. This comparison should determine which of the proposed tools and methods most effectively meet the cybersecurity needs of educational institutions. To achieve objectivity and depth of analysis, this process will be supported by expert insights collected through the Delphi method. Involving experts will not only take into account diverse views and experiences, but also provide an integrated approach to assessing the effectiveness of each option based on the real needs of the educational environment and current cyber threats. The comparison is made using the following formula (1):

$$\begin{aligned} A_j &= \begin{pmatrix} 1 & 1/5 & 1/8 \\ 5 & 1 & 1/3 \\ 8 & 3 & 1 \end{pmatrix} \\ B_j &= \begin{pmatrix} 1 & 1/5 & 1/7 \\ 5 & 1 & 3 \\ 7 & 3 & 1 \end{pmatrix} \\ C_j &= \begin{pmatrix} 1 & 1/3 & 1/5 \\ 3 & 1 & 1 \\ 5 & 1 & 1 \end{pmatrix} \\ D_j &= \begin{pmatrix} 1 & 1/7 & 1/9 \\ 7 & 1 & 1/3 \\ 9 & 3 & 1 \end{pmatrix} \end{aligned} \quad (1)$$

The results of even comparisons can be considered satisfactory, because the consistency ratio of the even comparison matrix  $CR \leq 0.1$ . So we have a sufficient level of convergence of the comparison process and proper consistency of expert judgments regarding the weight values of the levels of provision of the levels of provision of options for information and analytical support of the above-mentioned options for the digital transformation of the educational process in the context of countering cyber threats.

We can conclude that we have a sufficient level of convergence of the comparison process and proper consistency of expert judgments.

The results of calculations due to the multi-criteria assessment of the levels of provision of information and analytical support options regarding the above-mentioned options for the digital transformation of the educational process in the context of countering cyber threats with appropriate resources are summarized in Table. 2.

**Table 2. The results of calculations due to the multi-criteria assessment**

$A_j$	$A_1$	$A_2$	$A_3$
$s_i$	0.06	0.27	0.66
$B_j$	$B_1$	$B_2$	$B_3$
$s_i$	0.07	0.27	0.64
$C_j$	$C_1$	$C_2$	$C_3$
$s_i$	0.11	0.40	0.48
$D_j$	$D_1$	$D_2$	$D_3$
$s_i$	0.05	0.28	0.65

The next step will be to compare the options we have chosen for the levels of information and analytical support with respect to the above-mentioned options for the digital transformation of the educational process in the context of countering cyber threats for each resource (2). To optimize and avoid data accumulation, we will demonstrate the comparison process according to the first option (A).

$$\begin{aligned}
 A_{max} &= \begin{pmatrix} 1 & 1/4 & 1/8 \\ 4 & 1 & 1/5 \\ 8 & 5 & 1 \end{pmatrix} \\
 A_{norm} &= \begin{pmatrix} 1 & 1/3 & 1/6 \\ 3 & 1 & 1/4 \\ 6 & 4 & 1 \end{pmatrix} \\
 A_{min} &= \begin{pmatrix} 1 & 1/2 & 1/3 \\ 2 & 1 & 1/2 \\ 3 & 2 & 1 \end{pmatrix}
 \end{aligned} \tag{2}$$

Similar calculations were made for all other options  $B, C, D$ .

Summarizing the results of the calculations, we build a table for evaluating alternative options for ensuring digital transformation of the digital transformation of the educational process in the context of countering cyber threats in accordance with the levels of options for information and analytical support for this process (Table.3).

**Table 3. Evaluating model for alternative options for ensuring digital transformation of the educational process in the context of countering cyber threats.**

Options for digital transformation	Options for information and analytical support for this process			
	A	B	C	D
Integrated educational platforms with advanced cybersecurity features	0.08	0.09	0.09	0.06
Development and application of adaptive artificial intelligence algorithms for predicting and preventing cyber threats	0.21	0.20	0.21	0.25
Using blockchain technologies to ensure the security of educational data	0.71	0.69	0.68	0.67

So, as we can see for the first option of digital transformation of the educational process in the context of countering cyber threats, the most suitable option is “B - User and Entity Behavior Analytics” and “C - Register books are distributed” for information and analytical support of this process. For the second option of digital transformation of the educational process in the context of countering cyber threats, the “D - Identification and access control systems” option of information and analytical support is most suitable. And for the third option of digital transformation of the educational process in the context of countering cyber threats, “A - Monitoring systems and incident responses” option of information and analytical support is most suitable.

Based on the analysis and comparative assessment of various options for information and analytical support for each of the options for the digital transformation of the educational process, our results indicate the specific



suitability of certain approaches in the context of countering cyber threats. These results not only highlight optimal cybersecurity strategies for various aspects of digital transformation in education, but also highlight the need to tailor approaches to each individual case to achieve the highest efficiency and security.

One notable aim of guidance counselling is to encourage students' academic, emotional, social, and personal development. To achieve this aim, students should be helped to understand themselves better and to be able to make well-informed decision in their daily lives.

As shown in figures 3-6, the out-of-school number in Africa displayed a high reduction trend over 12 years, mainly falling from  $7.5 \times 10^6$  million in 1988 to  $2.5 \times 10^6$  million in 2010. The reduction in the number of out-of-school children within this period was when world leaders agreed to work towards achieving Education for All by 2015, which was the commitment they made in the World Education Forum that took place in the year 2000 at Dakar. This result calls for regular organization of such World Education Forum. The result implies that a lot of the reduction in the number of out-of-school children was observed; hence if every African government is seriously committed to funding education at the foundation level, there could be a high reduction of out-of-school children.

On the other hand, a swift rise in the number of out-of-school children across Africa can be seen in the graphs in millions, particularly between 2019-2020. The surge may be attributed to school closure problems during COVID-19 epidemic emergence and lockdown that ravages the whole world of resources and convenience, principally in the are of health and income. Though, distance learning was introduced in some countries, but the above results have shown that its effectiveness was limited, probably due to poor access to digital capital for teaching and learning and technical know-how by many teachers and children. Thus, to ensure the number of out-of-school children is reduced drastically, there is an urgent need for collective mobilization by the government, parents, individuals and Non-governmental organizations to ensure that every single child has access to primary quality education is valued and respected.

In the process of analyzing and comparing our results with existing studies, it becomes obvious that our research makes a unique contribution to the field of information support for the educational process. Al Azzam (2019) work focuses on the adequacy of international cooperation in the fight against cybercrime, which differs significantly from our focus on the methodological basis of information support in education. Our approach, based on mathematical modeling and multi-criteria assessment, offers specific tools for adapting to cyber threats, while the studies of Saleh et al. (2020) focuses on threats to environmental legal practice in the context of COVID-19 without addressing the educational context.

Also, unlike the study by Zhukova et al. (2023), which explores digital technologies for introducing gamification into education, our work provides a broader view of information security and cybersecurity, which is critical for the modern educational process. Our methodology includes a comprehensive analysis of cyber threats and the development of methods to counter them, which is a key difference from focusing on gamification.

The work of Yaroshenko et al. (2022) on gamification in English language teaching and research by Behaz et al. (2023) about the analysis of educational videos identify specific aspects of the use of digital technologies in education, but do not pay attention to information security and cybersecurity to such a broad extent as our study does. We offer an integrated approach that covers not only the technological aspect, but also the methodological foundation for ensuring the safety and effectiveness of the educational process in the face of cyber threats.

In our research, focused on the methodology for constructing an information and analytical model for conducting educational activities, we were faced with a wide range of topics that require a deep understanding of not only educational processes, but also economic, social and psychological aspects. In reviewing Bondaruk et al. (2023) discussion of fiscal policy as a guarantee of sustainable development in wartime contexts, we note that although this study has a different primary focus, it highlights the importance of adaptive policies to ensure stability and development, which is also relevant for the education sector, especially in the context of cybersecurity and digital transformation

The work of Bazyliuk et al. (2019) focuses on comparing the institutional dynamics of regional development of publishing and printing activities in Ukraine, which opens up prospects for understanding the importance of adapting educational programs and methods to regional characteristics, including the development of digital competencies and cybersecurity.

Source Zachepa et al. (2019) demonstrates the modeling of the process of applying crisis management in the system of ensuring the financial security of an enterprise, which is important for our research, since it emphasizes the need to integrate complex analytical methods for predicting and responding to potential threats, which is key for the development of effective information and analytical models in education.

A study by Akimova et al. (2022) about the characteristics of creative burnout among educational workers in the public administration system makes an important contribution to understanding the psychological aspects of work in education, which is critical for the development of information and analytical models aimed at maintaining high efficiency and well-being of educational workers in the digital era.

Finally, a study by Schukajlow et al. (2018) on Empirical Research on the Teaching and Learning of Mathematical Modeling offers a valuable overview of the current state of the field that is directly relevant to our work because it highlights the importance of integrating mathematical modeling and analytical skills into the educational process, which is key to the development of comprehensive information and analytical models.

Summarizing, Table 4 summarizes the key differences and advantages of our study compared to others in this field.

**Table 4. The key differences and advantages of our study compared to others in this field**

Differences and benefits	The essence
Integration of information and analytical systems	Our research uses information and analytical systems to analyze data, which allows us to identify and predict potential cyber threats and trends in the educational process. This significantly improves the efficiency of cybersecurity planning and implementation compared to traditional approaches, which may not take into account all aspects of a dynamic information environment.
Application of mathematical modeling and multi-criteria evaluation	Using these methods allows you to comprehensively evaluate different cybersecurity strategies and solutions, taking into account a wide range of criteria. This provides more informed decision making based on quantitative analysis and expert judgment, preferring approaches based solely on qualitative assessments or a limited set of parameters.
Using the Delphi method to attract experts	Our approach includes the involvement of experts through the Delphi method, which allows us to collect and synthesize the opinions of specialists from different areas of cybersecurity and digital transformation in education. This provides a greater understanding of potential risks and effective avoidance or minimization strategies, an important advantage over studies that do not include a broad range of expert opinions.

Thus, our study focuses on the use of information and analytical systems as a key element in developing a methodology for constructing a model for conducting educational activities, which makes it especially relevant in the context of modern challenges of digital transformation and cybersecurity. The use of such systems allowed us to effectively analyze large volumes of data, identify trends and potential threats in the information space and develop strategies for adequately responding to them. This approach not only provides a deep understanding of the dynamics of the educational process in the context of digitalization, but also opens up new opportunities for improving the level of cybersecurity of educational institutions. The use of information and analytical systems in our study introduces significant scientific novelty, since it demonstrates how modern technologies contribute to the development of comprehensive and effective methods for managing educational activities, while providing a high level of protection against information threats.

## CONCLUSIONS

The relevance of the formation of information and analytical systems in the field of education, especially in the context of countering modern cyber threats, cannot be overestimated. In light of the rapid development of digital technologies and the constant evolution of cyber threats, ensuring the security of information processes in educational institutions becomes critical. This not only protects valuable information from unauthorized access, but also ensures the uninterrupted educational process, which is the basis for the development of innovative and competitive education.

Against the background of the growing cyber threat, the importance of developing and implementing integrated information and analytical systems that can effectively counter these threats becomes obvious. Such systems not only help identify and analyze potential risks, but also develop strategies to neutralize or minimize the negative impact on the educational process. In this context, our study makes a significant contribution to the development of methodological frameworks for the creation of such systems, with an emphasis on multi-criteria evaluation of alternatives and systems analysis.

The use of a multi-criteria evaluation of alternatives method allowed us to deeply analyze various cybersecurity strategies, taking into account a wide range of criteria. This is suitable not only for determining optimal solutions in complex environments, but also for ensuring the flexibility and adaptability of educational institutions to the rapidly changing conditions of cyberspace.

The system analysis method, in turn, allowed us to consider the educational process as a complex system, to identify key elements and connections between them that affect cybersecurity. This approach contributes to the development of holistic strategies that take into account all aspects of the functioning of educational institutions and their interaction with the external environment.

Involving experts through the Delphi method added significance to our research, allowing us to collect and synthesize the opinions of leading experts in the field of cybersecurity and education. This provided a deep understanding of potential threats and the most effective methods to counter them.

As a result of our research, modern information and analytical models were formed that can not only support the cybersecurity of educational institutions, but also adequately respond to changing threats in the information space. These models play a key role in ensuring a safe and effective educational process in the context of digital transformation.

However, it is necessary to take into account the possible limitations of our study, in particular the high dependence on the quality and relevance of the collected data. In the future, regular updating of databases and the use of innovative methods of data collection and analysis will overcome this limitation and improve the accuracy and efficiency of the developed models.

In general, the methodology of our research, including the method of multi-criteria evaluation of alternatives, the method of system analysis and the Delphi method, forms a solid basis for the development of effective information and analytical models. These methods allow not only to adequately respond to existing threats, but also to adapt to future challenges, ensuring the safety and sustainability of the educational process in response to modern cyber threats.

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