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APPLICATION OF PROCTORING TECHNOLOGIES IN MODERN EDUCATION

ҚАЗІРГІ БІЛІМ БЕРУДЕГІ ПРОКТОРИНГ ТЕХНОЛОГИЯЛАРЫН ҚОЛДАНУ

ПРИМЕНЕНИЕ ТЕХНОЛОГИЙ ПРОКТОРИНГА В СОВРЕМЕННОМ ОБРАЗОВАНИИ

Abstract. *The scientific article "The use of proctoring technologies in modern education" is a comprehensive analysis of modern approaches and trends in the use of proctoring technologies in educational institutions. In the light of dynamic changes in the educational process, especially in the context of the spread of distance learning, the relevance of effective methods of assessment and ensuring integrity becomes undeniable. The article covers a wide range of topics, including technical innovations in proctoring systems, the variability of methods (biometric data, audio and video surveillance, etc.), the ethical aspects of the use of such technologies, as well as the impact on the psychological aspect of learning and student outcomes.*

Keywords: *distance learning, examination session, proctoring, academic integrity, innovations in education, control automation.*

Аңдатпа. *«Заманауи білім беруде прокторинг технологияларын қолдану» ғылыми мақаласында білім беру ұйымдарында прокторинг технологияларын қолданудың заманауи тәсілдері мен тенденциялары жан-жақты талданды. Білім беру үдерісіндегі динамикалық өзгерістер аясында, әсіресе қашықтықтан оқытудың таралуы жағдайында бағалаудың және тұтастығын қамтамасыз етудің тиімді әдістерінің өзектілігі болып отыр. Мақалада бақылау жүйелеріндегі техникалық инновациялар, әдістердің өзгермелілігі (биометриялық деректер, аудио және бейнебақылау және т.б.), мұндай технологияларды пайдаланудың этикалық аспектілері, сондай-ақ, құқық қорғау органдарына әсер ететін тақырыптардың кең ауқымы, оқудың психологиялық аспектісі мен оқушының нәтижелері қарастырылған.*

Түйін сөздер: *қашықтықтан оқыту, емтихан сессиясы, прокторинг, академиялық адалдық, білім берудегі инновациялар, бақылауды автоматтандыру.*

Аннотация. *Научная статья «Применение технологий прокторинга в современном образовании» представляет собой всесторонний анализ современных подходов и тенденций в области использования технологий прокторинга в образовательных учреждениях. В свете динамичных изменений в образовательном процессе, особенно в контексте распространения дистанционного обучения, актуальность эффективных методов оценки и обеспечения честности становится несомненной. Статья охватывает широкий спектр тем, включая технические инновации в системах прокторинга, вариативность методов (биометрические данные, аудио- и видеонаблюдение и др.), этические аспекты применения таких технологий, а также влияние на психологический аспект обучения и результаты студентов.*

Ключевые слова: *дистанционное обучение, экзаменационная сессия, прокторинг, академическая*

честность, инновации в образовании, автоматизация контроля.

Introduction. Modern education faces challenges that are formed as a result of the rapid development of information technologies and changes in educational paradigms. Online courses, distance learning and flexible education formats have become an integral part of the educational process, opening up new horizons for learning and expanding access to knowledge. In this dynamic context, there was a need to create effective knowledge assessment mechanisms that would ensure the honesty, reliability and validity of student assessments.

Proctoring, as a technology for monitoring and monitoring the process of online testing and exams, is coming to the fore as one of the answers to this need. This innovative practice, with the aim of preventing fraud and providing reliable student assessment, has become an integral part of the educational landscape [1].

The purpose of this article is to conduct a comprehensive review of the use of proctoring technologies in modern education. Accompanied by a growing interest and active discussion in the field of education, the topic of proctoring is incredibly relevant and subject to rapid changes.

Materials and methods of research. During the ongoing coronavirus disease 2019 (Covid-19) pandemic, higher education institutions around the world have moved their education online as face-to-face teaching has been banned due to the rapid spread of the virus.

However, many universities and educators who lack experience and knowledge in developing and delivering online courses have found this rapid and radical pedagogical shift to be very difficult [2].

Since 2019, most Kazakhstani universities have been conducting a significant part of the exams online. The bottom line is that through the videoconferencing system, the student connects to take the exam or test from his computer.

The examiner (proctor) checks the identity of the student (the student provides his/her document), and then the assessment is carried out orally or in the form of computer testing under the supervision of the proctor. While the digitalization process opens up more opportunities, it also poses a number of challenges for higher education institutions. Student authentication is recognized as an important issue in online education [3].

In their article "Using Biometrics to Authenticate Users in Online Learning: A Systems Perspective," Virginia Tech Professor Asad Moini and University of Southern California Professor, Founder and Chairman of Intelligent Systems Technology, Inc., Azad M. Madni emphasized that students must pass authentication before they are granted access to sensitive content such as tests, assignments, or personal notes.

Therefore, with the development of online education and e-assessment methods, it is critical to improve student authentication. If universities can provide secure and convenient systems for electronic authentication, they will be able to create a more secure environment in which they will offer a variety of studies for all students [4].

Electronic authentication tools can be divided into three main types:

1. Knowledge – information that the subject knows (password, PIN code);

2. Possession is a thing possessed by the subject (electronic or magnetic card, token, flash memory);

3. The property that the subject possesses (biometrics, natural unique differences: face, fingerprints, iris, capillary patterns, DNA sequence) [5].

Authentication refers to verification of the identity of a user, device, or process, and is often required before access to system resources is granted. Authentication can be performed either at the beginning of a session, or as an ongoing process in which the user is continuously authenticated during the session [6].

Table 1. Authentication Methods for Exams

Equipment	Equipment classification	Description
User ID	Knowledge Based Authentication	Based on personal information provided by the user.
Password		
Security question		
Mouse movement	Behavioral biometrics	Behavioral characteristics. Can be used with continuous authentication.
Keystroke dynamics		
Voice		Voice test with a microphone. Can be used as continuous authentication.
Signature		Behavioral characteristics.
Stylometry		Behavioral characteristics. Identifies authorship by language styles of authors
Handwriting		There are two types of handwriting-based authentication: one based on static information (letter width, density) and one based on dynamic information. Can be used for online exams.
Face recognition	Physiological biometrics	Can be used with continuous authentication
Fingerprint		Can be used for continuous user authentication; if it is included with other devices.
Eye tracking		Eye tracking feature to check users.
Binaural beats		ERP (Event Related Potential). Signals used to explain the cognitive information process.
Palm print		Physiological features. Requires additional scanning devices.
Smart card, memory card	Ownership-Based Authentication	Based on private objects owned by the user. Maybe stolen or duplicated
IP address	Other-mechanisms	Can be used to determine the user's possible location. The IP address can be used as an indicator of cheating during exams.

Authentication in the proctoring system is the process of verifying the identity of the participant (student) before starting an online test or exam. This measure ensures that the test or exam is being taken by the students enrolled in the course and prevents fraud such as cheating or reporting someone else's scores. Proctoring systems offer a variety of authentication methods, providing a more secure process for verifying participants' identities.

In all of these systems, user privacy is a major concern. When such a system is in use, it has access to students' audio and video input.

Some systems also detect other programs running in the background and limit their activities. While all of this is done to ensure a safe and fair testing environment, an institution

having access to all of this data from any user could be considered by some as a serious breach of privacy. Therefore, when developing such a system, steps must be taken to make the user feel safe when they are in the testing environment [7].

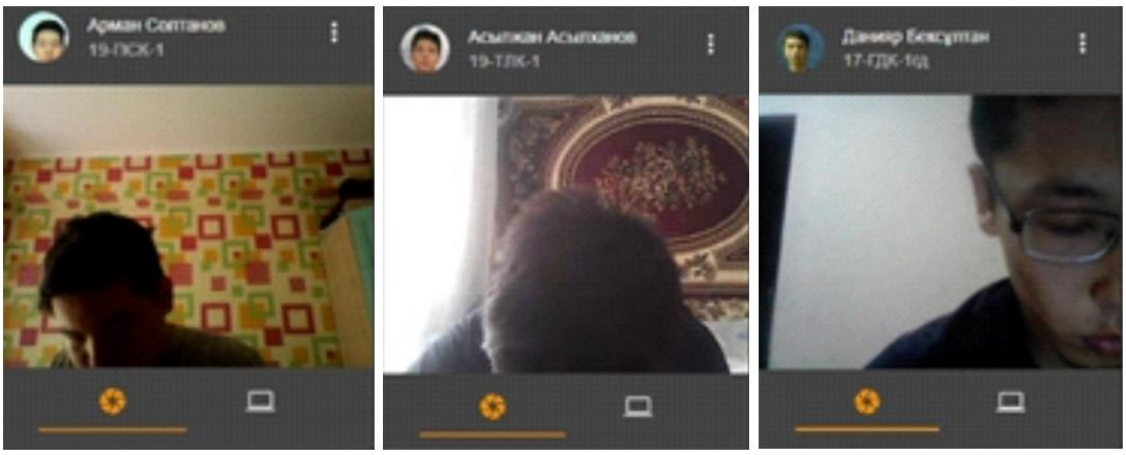

Figure 1. Identification of violations during the exam

The online proctoring system focuses on two main components viz. Webcam to record a video of the student's appearance at the exam, which can later be viewed by the examiner/proctor.

The examiner/proctor can potentially look at any pranks, whether cheating occurs during the exam or not. The second component is a lock that prevents students from opening other tabs in web browsers. This is also known as blocking the computer or browser [8].

The systems used today are not 100 % accurate. This requires human oversight to handle false positives and help resolve complaints. Thus, systems can be constantly trained to improve AI performance in the back-end [9].

Online education and problems of student authentication. With the rapid growth of online learning, students increasingly need easy and flexible access to learning content anytime, anywhere they choose. Confirming the identity of students and the authenticity of their work is becoming increasingly important to reduce academic abuse and for the purposes of quality assurance in education [10].

Information security is concerned with ensuring the confidentiality, integrity and availability of information in all its forms.

There are many tools and methods that can support information security management. But a system based on biometrics has evolved to support some aspects of information security.

Using biometric data, teachers and professionals can determine how actively students are involved in learning activities.

Biometric software uses fingerprints, faces, irises, voices, signatures, student typing patterns, or a combination of these, to confirm that the person on the other side of the computer screen is the intended recipient of the assessment [11].

These systems exploit physical or behavioral characteristics that are unique to the individual and often require the creation of a biosignature sample database that can be accessed and compared during an examination (Berkey & Halfond, 2015).

Biometrics in universities is being used to automate time-consuming tasks. For example, attendance checks are performed using a fingerprint scanner, saving valuable learning time. The traditional process usually takes a significant amount of time, which is otherwise spent on

something valuable [12].

Iris recognition is an innovative and secure biometric authentication method. Artificial intelligence is making this technology more accessible for use in security cameras, smartphones, and other access control and security products. Such identification reduces the risk of failure of face recognition systems [13].

It is believed that it is impossible to falsify identification data using this method. The fact is that, in addition to the individual pattern of the iris, the human eye has unique reflective characteristics (due to the state of tissues and natural humidity), which are taken into account in the process of reading information.

Most iris recognition systems in educational institutions are used instead of presenting student ID cards. Recognition is usually completed in less than one second, and the high resolution and quality of the resulting images reduce the number of bias and bias errors [14].

When it comes to administering online exams, most higher education institutions face a problem of student behavior.

The main events that should be recorded during the exam:

– the absence of the face of the student in front of the camera;
– unknown person in front of the camera;
– conversation or noise;
– mute microphone or low volume;
– new keyboard style;
– the window with the exam page is not expanded to full screen;
– switch focus to another application or tab.

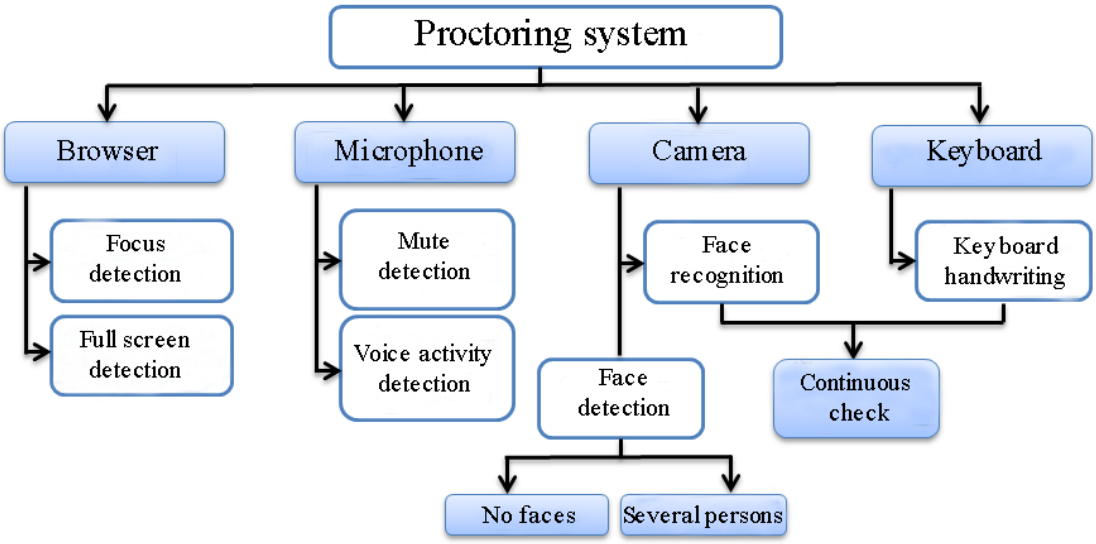

Figure 2. Violation detection system

Artificial intelligence-based proctoring analysis helps to intelligently filter students who violated proctoring restrictions without opening each report.

The automatic behavior recognition system belongs to the class of real-time systems. This means that the correctness of its functioning depends not only on the logical correctness of the calculations, but also on the time during which these calculations are performed. At the same time, the most significant criterion for the effectiveness of the designed system (as a pattern

recognition system) is the reliability of the recognition results [15].

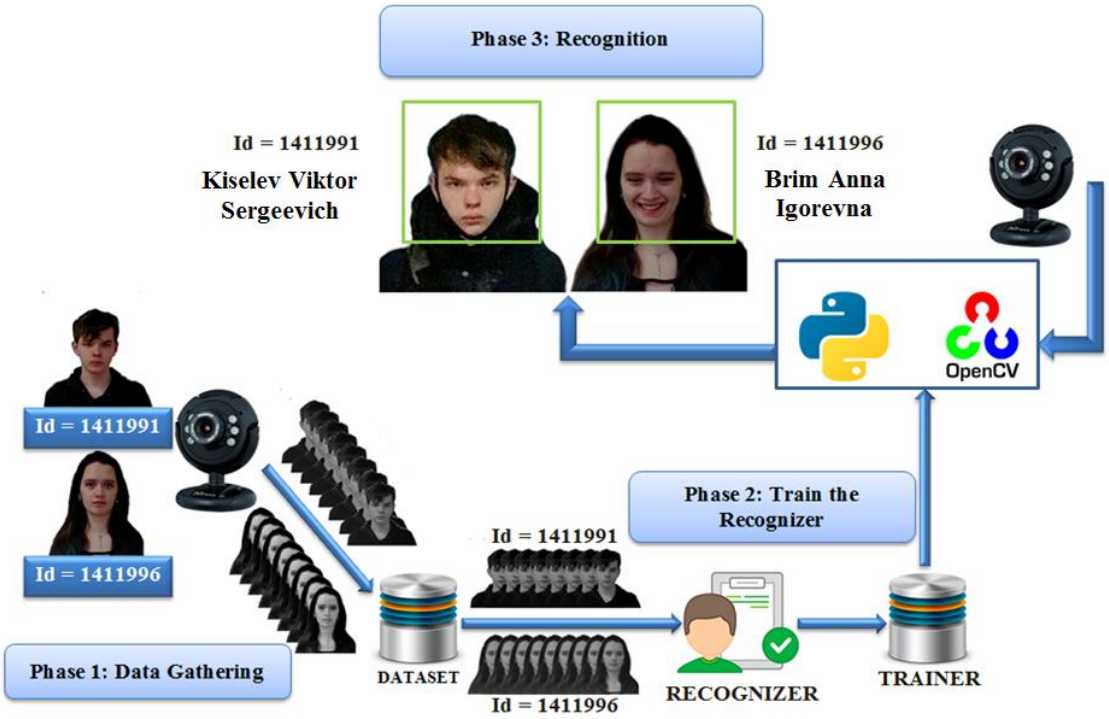

Figure 2. Violation detection system [16]

Preparing a system for facial recognition involves several vital steps that precede the actual recognition process.

These steps are pivotal in ensuring the proper operation and achieving a high level of accuracy for the system. Here's a comprehensive overview of each stage:

1. Collection and Preparation of the Training Dataset:

– The initial phase entails gathering an extensive training dataset comprising facial images. These images should exhibit diversity, representing various faces and encompassing different environmental conditions, including variations in lighting, poses, and facial expressions.

– Equally important is the labeling of images, signifying the provision of precise information about the location of faces within each image.

2. Image Pre-processing:

– Following the collection of images, they undergo essential pre-processing procedures. This includes the removal of noise, enhancement of contrast, and the alignment of images. The primary objective is to enhance data quality and standardize it.

– Feature Extraction:

– Subsequently, the next step revolves around the extraction of distinctive features or characteristics that will serve as the basis for facial identification and recognition. These features may encompass information pertaining to facial geometry, textural attributes, and more.

3. Training the Facial Recognition Model:

– The extracted features are harnessed to train a machine learning model responsible for executing facial recognition tasks. This model can take the form of a neural network, Support Vector Machine (SVM), or employ alternative techniques.

– Training the model hinges on utilizing labeled data to instruct it on recognizing faces and

their unique attributes.

4. Model Testing and Validation:

– Following the training phase, the model proceeds to undergo rigorous testing and validation procedures. These assessments gauge its capability to accurately recognize faces when presented with new, previously unseen data.

– This stage facilitates the evaluation of system performance and allows for necessary adjustments and fine-tuning.

5. Integration and Optimization: The ongoing pursuit of optimization is imperative, as it forms the bedrock for the continuous refinement of the system's capabilities, both in terms of speed and accuracy, when dealing with facial recognition tasks.

– The concluding phase centers around the seamless integration of the facial recognition system into specific applications or equipment, such as security systems.

– Ongoing optimization efforts remain critical to continually enhance the system's speed and accuracy in facial recognition tasks.

Preparing a database for facial recognition systems is a complex task that includes two key aspects. The first aspect is to obtain images that will be suitable for further processing by a facial recognition system.

To achieve this goal, it is necessary to capture faces under controlled conditions, which minimizes external factors affecting image quality.

Under controlled conditions, the angles of rotation, tilt, and deflection of the head are limited to obtain standardized and uniform images. This process requires special equipment and lighting to ensure optimal shooting conditions. Particular attention is also paid to emotional facial expressions, which are customized and monitored to ensure consistency and reliability of the database.

The second aspect involves labeling or annotating the resulting images. This annotation is important information added to each image so that the facial recognition system can correctly identify the face in the photo. It may include various details such as gender, age, identification number and other characteristics that may be useful in further analysis. So, preparing a database for facial recognition systems is a complex and multifaceted process that requires careful work.

A controlled environment and specialized equipment are used to produce first-class images, and careful annotations ensure accurate facial identification. Emotional expressions also play a role in this procedure, increasing the reliability of the database and its usefulness in facilitating facial recognition system functionality.

Controlled settings and specialized equipment are used to produce top-quality images, and careful annotations ensure the highest accuracy of facial recognition. Emotional expression also plays a vital role in this action process, increasing the reliability of the database and its usefulness for the effective operation of the facial recognition system.

Face recognition methods.

Usually each method has its own basis, which is an integral part of this method and without which it cannot function. The basis of the Viola-Jones method consists of so-called Haar primitives. These primitives represent the division of a certain rectangular region into sets of rectangular subregions of different shapes.

The original version of the Viola-Jones algorithm used only primitives without rotations, and to calculate the feature, the sum of the brightness of the pixels of one subregion was compared with the sum of the brightness of the pixels of another subregion.

As the method evolved, 45-degree tilted primitives and asymmetrical configurations were proposed. In addition, instead of the usual difference, it was proposed to assign a certain weight to each subregion, and the feature value was calculated as a weighted sum of the pixel

brightness of different regions.

These improvements have expanded the capabilities of the Viola-Jones method and made it possible to more accurately identify various characteristics of objects in images.

$$L(x,y)=\sum_{i=0}^{x}\sum_{j=0}^{y}I(i,j) \tag{1}$$

This equation considers the intensity of the current pixel in the original image, denoted as I(i, j), where (i, j) represent the coordinates of the pixel. In this context, the formula quantitatively describes the level of brightness or luminosity associated with a specific pixel position.

Therefore, this expression is used to determine the brightness of a pixel at position (i, j) within the original image, where I(i, j) serves as a numeric value representing the intensity of that pixel.

By diligently following these preparatory stages, a facial recognition system can be effectively primed for optimal performance, ensuring reliable and accurate face identification across various scenarios and conditions.

R: 56 G: 24 B: 13	R: 54 G: 22 B: 11	R: 55 G: 23 B: 12	R: 55 G: 23 B: 12	R: 54 G: 22 B: 11	R: 47 G: 20 B: 3
R: 52 G: 22 B: 11	R: 47 G: 17 B: 6	R: 46 G: 16 B: 5	R: 45 G: 15 B: 4	R: 44 G: 14 B: 3	R: 41 G: 14 B: 0
R: 52 G: 22 B: 11	R: 45 G: 15 B: 4	R: 42 G: 12 B: 1	R: 39 G: 9 B: 0	R: 38 G: 8 B: 0	R: 38 G: 11 B: 0
R: 60 G: 30 B: 19	R: 51 G: 21 B: 10	R: 46 G: 16 B: 5	R: 42 G: 12 B: 1	R: 40 G: 10 B: 0	R: 41 G: 14 B: 0
R: 70 G: 40 B: 29	R: 60 G: 30 B: 19	R: 54 G: 24 B: 13	R: 49 G: 19 B: 8	R: 46 G: 16 B: 5	R: 45 G: 18 B: 1
R: 87 G: 58 B: 44	R: 73 G: 45 B: 31	R: 60 G: 32 B: 18	R: 53 G: 25 B: 11	R: 52 G: 24 B: 10	R: 54 G: 27 B: 6

Figure 3. Area of a pixel in the destination image

To solve the problem of recognizing faces in video recordings, it is proposed to use an algorithm that is based on the already mentioned algorithm for recognizing faces in images and the Viola-Jones method. In this context, we chose the Viola-Jones method to detect objects in a video stream. This method is the most popular among existing methods for detecting faces in

images. It is characterized by high execution speed and sufficient accuracy of results.

The algorithm we propose is based on the same principle that is used in recognizing faces in static images. It uses a set of characteristics or features of faces that can be extracted from images to identify a face. The Viola-Jones method in this context helps to efficiently scan the video stream and find objects that match these features.

However, it is worth noting that although the Viola-Jones method is fast, it may have certain limitations under complex conditions such as lighting changes, face rotations, and other factors. In such cases, additional processing of the results or the use of additional methods may be required to improve recognition accuracy.

Overall, the proposed algorithm is an effective solution for the problem of face recognition in video recordings, and its application can be especially useful in applications where it is necessary to quickly identify faces in real time.

Conclusion.

In this article, topical issues and prospects for the use of proctoring technologies in the modern educational environment were considered.

The study showed that the use of proctoring improves the quality of assessment of students' knowledge and skills, providing a more objective and reliable assessment of their progress. At the same time, some technical and ethical aspects have been identified that require additional attention from educational institutions.

The use of proctoring technologies in modern education is not only a revolutionary step in ensuring academic integrity, but also a response to the challenges that modern educational environments present.

Regardless of the format of training - online, distance or traditional - proctoring becomes a reliable ally of teachers and students, providing fairness, trust and quality in the process of knowledge assessment.

The exponential development of technology has led to the emergence of a variety of proctoring methods - audio and video surveillance, biometric data, voice identification and many others.

Each method has its own advantages and limitations, and the choice of technology depends on the educational goals, technical capabilities and preferences of educational institutions.

The use of proctoring also provides a unique opportunity to improve the educational process, analyze data on student behavior and results, optimize teaching methods and tailor programs to the needs of each individual.

However, despite all the benefits, proctoring raises questions about data privacy, ethics and technical reliability. Therefore, the introduction of these technologies requires a balance between achieving academic integrity and respecting the rights of students.

In conclusion, it can be argued that proctoring technologies are already changing the face of education, enriching it with innovations and creating new opportunities for learning and assessment.

However, their effective implementation depends on the understanding and cooperation of all participants in the educational process – teachers, students, administration and developers. This is an issue that requires continued research and dialogue in order to strike the best balance between innovation and the values on which modern education is built.

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