

THE EFFECTIVENESS OF VIRTUAL MUSEUMS IN ENHANCING STUDENT INTER- EST IN HISTORY LEARNING

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ABSTRACT

Aim. The objective of this study is to assess the effectiveness of utilizing virtual museums in the context of students' study of history.

Methods. To achieve this goal, a survey was conducted among history students from leading universities in Kazakhstan, such as Al-Farabi Kazakh National University, A. Baitursynov Kostanay Regional University, and L. N. Gumilyov Eurasian National University. The article also shows the educational potential of the virtual archaeological museum of the Kazan Federal University, which allows for a more detailed study of the early period of the Middle Volga region.

Results. As a result of the research, 82% of students noted that virtual museums provide sufficient information for successful history learning. Regarding student engagement in the learning process using virtual museums, an average score of 7.4 out of 10 was recorded, indicating a high level of student interest in applying this teaching method. Furthermore, 91% of respondents believe that virtual museums contribute to a more captivating study of history, emphasising the importance of utilizing technology to create engaging educational environments.

Conclusion. The study also revealed that students recognize a high level of depth of understanding of the material (76%) and the effectiveness of virtual museums compared to traditional methods (58%). These results underscore the potential of virtual museums in enhancing the quality of education. The obtained results furnish valuable practical recommendations for the field of education. Virtual museums, based on positive student feedback, can be effectively integrated into history curricula.

Keywords: digital technologies, education informatization, globalization, historical artifacts, Kazakhstan, Middle Volga region history, virtual museums

INTRODUCTION

In the modern world, where digital technologies have become an integral part of education, virtual museums emerge as a promising educational platform, fostering a profound understanding of global historical and cultural heritage (Daniela, 2020). Within the framework of international trends in the globalization of education informatization, a central tendency has become the “human-centric” approach, emphasizing the importance of integrating technology and education (Luo & Yan, 2022). Virtual museums have become a key element of this symbiosis, providing students with the opportunity for deep immersion into the historical legacy of humanity through the utilization of digital resources (Taranova, 2020). The application of digital technologies in education on a global scale highlights the development of interactive educational environments. Virtual museums play a crucial role in this evolution by granting access to extensive collections of historical artifacts and scenarios. This access thereby stimulates an active educational process (Atamuratov, 2020).

In a multicultural context, the rapid development of information technologies sets new standards for education, and virtual museums serve as an innovative tool contributing to the transformation of traditional teaching methods and knowledge acquisition in various fields, including the study of history (Povroznik, 2020a). Contemporary educational practices in different countries actively integrate virtual museums into historical study programs (Díaz Granados, 2020). For instance, using augmented reality to create digital museum exhibitions enriches students’

earning experiences, enabling them to interact with historical artifacts and events in a virtual environment (Alakhtar, 2020).

One example of the integration of digital technologies into museum and educational spheres is the Google Arts & Culture project, providing access to numerous virtual exhibitions and collections from museums worldwide. It allows the exploration of historical artifacts, artworks, and even virtual tours to iconic locations in an online mode (Luo & Yan, 2022). Another example is the Louvre virtual museum, offering online tours and access to the museum's collection (Ev-rard & Krebs, 2018).

In a similar manner, the virtual archaeological museum of Kazan Federal University in a 3D format continues the trend of digital transformation in the field of archaeology, enriching the educational experience and research opportunities for a broad audience. The virtual archaeological museum of Kazan Federal University presents a unique collection of artifacts and exhibits, spanning the chronological period from the Paleolithic era to the Middle Ages. The virtual space showcases artifacts from the Paleolithic era in France, collections from the Koban culture of the North Caucasus, as well as items from the early Iron Age and the medieval period. This interactive platform allows users to delve into the rich history of the Middle Volga region through spatial 3D reproduction of archaeological findings.

In 2021, Kazakhstan entered a new phase in the country's educational informatization strategy with the introduction of the national project Quality Education Educated Nation, and the COVID-19 pandemic accelerated the digital transformation of museums, facilitating the integration of digital technologies into the educational process (Nurtazina & Nahbaeva, 2022). Concerning the digitization of education in Kazakhstan, attention is focused on the creation of educational scenarios in which virtual museums serve as a means to cultivate a deep and comprehensive understanding of history. This emphasis is driven by the aspiration to provide students not only with access to information but also the opportunity to interact with cultural heritage through modern technologies (Kasimova, 2021; Lunga & Zhanguzhinova, 2023).

In the context of integrating virtual museums into the educational process of Kazakhstan, the Kostanay Region stands out for its unique educational landscape (Klimenko & Klimenko, 2018; Suraganova & Taikenova, 2023). This region is distinguished as a leader in the utilization of virtual museums, closely collaborating with local educational institutions (Suraganova & Taikenova, 2023; Zholbarys, 2018). Furthermore, the initiative *Ruhani Jańǵyru*

(Spiritual Renewal) is actively supported and developed in the region – a national project launched to foster a spiritual culture in the era of digitization (Badzhkova & Kareva, 2018). The creation of interactive exhibitions, virtual tours, and educational programs in synergy with the Spiritual Renewal initiative

in the Kostanay Region contributes to the preservation and promotion of the region's cultural heritage in the era of digital progress (Omarova et al., 2022).

A notable example of such an interactive educational approach in the region is the Kostanay Memorial Museum of Ibray Altynsarin (Ryschanova, 2016). The museum plays a key role in preserving national spirituality and cultural traditions through the use of innovative technologies. The virtual tours and interactive forms of excursions presented in the museum not only expand students' knowledge but also stimulate their active engagement with historical heritage (Ternovaya, 2020; Titova, 2021). The utilization of digital technologies in the museum reflects the region's commitment to actively engaging with its historical heritage and enhancing student's educational experience, providing them with effective tools for developing a deep understanding of the history and culture of their region (Ryschanova, 2013; Ternovaya, 2020).

Due to the unique dynamics of the Kazakhstani experience in integrating virtual museums into the educational process, combining cultural nuances and technological advancements, this investigation into the role of virtual museums in students' history learning within the context of the Kazakhstani state strategy for education informatization is relevant. It can provide a deeper understanding of the impact of digital technologies on educational practices and the formation of students' knowledge.

LITERATURE REVIEW

Virtual museums constitute a significant component of global educational transformation, and their role takes center stage, becoming the subject of systematic investigation in the field of students' history learning (Díaz Granados, 2020). Questions regarding how these innovations interact with traditional teaching methods and how virtual museums influence educational processes are pressing within the context of worldwide scientific research. In global research practices, digital transformation and the informatization of education stand as crucial directions in contemporary scientific inquiry. In the study of the global evolution of education and the rapid development of digital technologies, researchers note that virtual museums occupy a vital position in the modern educational process, offering innovative methods for studying history (Yildirim et al., 2018).

Researchers emphasize the significance of integrating virtual museums into the educational process due to their ability to provide students with opportunities for interactive engagement with historically significant materials (Kamariotou et al., 2021). In the global scientific literature, it is also noted that virtual museums not only grant students access to unique resources but also create interactive learning scenarios. Such innovative methods facilitate a deeper understanding of history as a discipline, encouraging active student engagement in the educational process

(Marasco, 2020; Stoddard, 2018). The role of virtual museums in students' history learning involves providing access to unique resources, establishing interactive educational environments, enriching traditional teaching methods, fostering a more profound and memorable comprehension of the material, and stimulating students' interest in the study of history (Challenor & Ma, 2019). Additionally, in the global scientific literature, it is acknowledged that virtual museums create unique educational environments, promoting a multi-dimensional understanding of historical events. The inherent virtual tours and interactive exhibits activate students' visual perception, contributing to better assimilation of the material (Daniela, 2020; Pourmoradian et al., 2021).

According to the research by Nadezhda Povroznik, virtual museums successfully integrate into online education, providing students with opportunities for virtual excursions and learning, thereby preserving the interactivity of the educational process (Povroznik, 2020b).

Research in the field of virtual museums emphasizes that their impact on history education within the context of educational transformation is a significant theme. In the work of Osman Okumuş and Ahmet Vurgun, it is noted that virtual museums complement traditional methods, providing students with new perspectives in studying historical facts (Okumuş & Vurgun, 2021). The researcher highlights that these innovations contribute not only to a deeper mastery of the material but also stimulate students' creative thinking. In Luz Díaz Granados' research, the importance of virtual museums in providing access to historical resources is emphasized, especially in the conditions of remote learning, such as during periods of epidemics. It is noted that virtual museums are a key element, enriching students' educational experience by offering a wide range of interactive materials (Díaz Granados, 2020). The role of virtual museums in fostering students' critical thinking in the study of history, the development of analytical skills, and the ability to critically evaluate historical events are also highlighted in the works of global researchers (Attwood, 2021; Challenor & Ma, 2019; Marasco, 2020). In this context, the virtual museum of Kazan Federal University is recognized by researchers as a modern educational tool, supporting access to historical resources during periods of distance learning and pandemics (Kazan Federal University, 2023). It plays a crucial role in enriching students' educational experiences. The virtual platform offers a diverse range of interactive materials, allowing students to immerse themselves in archaeological and historical collections, even when located remotely. Additionally, this virtual resource provides a unique opportunity for students to develop analytical skills and critically evaluate historical events. By combining contemporary educational requirements with extensive access to educational resources, it underscores the role of virtual museums in the modern educational paradigm (Gordeeva, 2021; Khasimzyanova & Khovanskaya, 2022; Khusainova & Lukoyanova, 2018).

In the research, it is highlighted that Kazakhstan's experience serves as a vivid example of how digital innovations actively influence education, creating unique opportunities for a more effective learning process through the integration of virtual museums' digital resources into the educational environment (Abubakarova et al., 2021; Lunga & Zhanguzhinova, 2023). According to the study by Daniyar Kusainov and Gulmira Otepova, virtual museums are effectively applied to teaching history in Kazakhstani educational institutions. The research emphasizes that such an approach contributes to activating students' interest in the subject by providing access to interactive materials and learning scenarios (Kusainov & Otepova, 2023). Scientific works note that virtual museums are integrated into the educational process, offering students the opportunity to explore historical artifacts through interactive online exhibitions and other innovative educational practices, thereby contributing to the development of students' comprehensive knowledge in the context of history studies in Kazakhstan (Kusainov & Otepova, 2023; Suraganova & Taikenova, 2023). Particularly, researchers highlight the Kostanay region as a pioneer in the development of virtual museums in Kazakhstan, underscoring the region's significance in the cultural and educational sphere (Klimenko & Klimenko, 2018; Suraganova & Taikenova, 2023; Zholbarys, 2018). In this context, it is emphasized that the Kostanay Memorial Museum of Ibray Altynsarin actively employs modern technologies to preserve and popularize the historical and cultural wealth of the region. The museum's interactive tours and cultural enlightenment initiatives not only align with pedagogical standards but also successfully stimulate students' and the public's interest in Kazakh culture (Ryschanova, 2016; Titova, 2021). The pivotal role of this museum in preserving the spirituality and cultural traditions of the country in the era of globalization and digitization is noted, which is highly relevant in the context of studying the history and culture of Kazakhstan in contemporary society (Ryschanova, 2013, 2016; Ternovaya, 2020).

Global studies actively discuss that expanding educational opportunities through virtual museums requires attention to the quality of education, data integration, and resource openness. It is noted that the openness of data and the development of intelligent information technologies in virtual museums can contribute to reducing educational disparities and creating a more accessible educational environment (Daniela, 2020; Taranova, 2020).

Thus, numerous studies confirm that virtual museums have become an integral part of modern education, enriching the process of history learning for students and promoting their active engagement in the educational process. The results of contemporary research indicate the significant role of virtual museums in the educational process, providing access to information, fostering critical thinking, and creating unique educational scenarios for students. These innovations are widely implemented in the field of education to make the study of history more accessible, engaging, and effective.

PROBLEM STATEMENT

The study aims to assess the effectiveness of using virtual museums in the process of students learning history. The main objectives of this research are:

- To analyze the level of student engagement in the history learning process when utilizing virtual museums and evaluate their perception of this teaching method.
- To determine the specific impact of using virtual museums on students' interest in studying history.
- To evaluate the effectiveness of virtual museums in enhancing students' understanding of historical events.
- To compare the results of using virtual museums as an additional method of studying history with traditional methods such as textbooks and lectures.
- To identify the problems and prospects encountered by students when using virtual museums in the course of studying history.

METHODS AND MATERIALS

Research Design

During this study, a survey was conducted among students majoring in history who, for the first time, incorporated the use of virtual museums as an additional resource for studying history into their educational process. The survey aimed to identify the characteristics and effectiveness of the impact of virtual museums on students' history learning. The survey questionnaire developed by the authors of this research is provided in Appendix 1.

An interview was also conducted among respondents to study the educational potential of virtual museums in comparison with traditional teaching methods using the example of the archaeological museum of Kazan Federal University as part of the study of the early period of the Middle Volga region. The interview questions compiled by the authors of this study are presented in Appendix 2.

Sample

The research sample consisted of 200 students aged 20 to 25 studying at the history faculties of the following universities: Al-Farabi Kazakh National University (Almaty), A. Baitursynov Kostanay Regional University (Kostanay), and L.N. Gumilyov Eurasian National University (Nur-Sultan). Respondents were selected through simple random sampling from the total population of students in these universities' history faculties (aged 20 to 25) who indicated that they had not previously used virtual mu-

seums in their learning process. The study was conducted over 35 days (from March 1, 2023, to April 6, 2023).

Survey

To collect data on students' perceptions and the effectiveness of using virtual museums in the process of studying history, a structured survey was developed (see Appendix 1). The survey comprised 9 questions, addressing various aspects of the impact of virtual museums on the educational process. These aspects included the perception of the informational content of virtual museums for studying history, engagement when using virtual museums, interest in studying history, the experience of understanding historical events after using virtual museums, and the depth of understanding the material. Additionally, questions covered the effectiveness of virtual museums compared to traditional methods of studying history, satisfaction with the results of learning history using virtual museums, and challenges encountered when using virtual museums compared to traditional teaching methods.

Statistical Processing

The statistical analysis of the research results was conducted using the SPSS-12.0 software. The statistical margin of error for the survey results does not exceed 1.4%.

Research Limitations

The study only encompasses students from the history departments of three universities in Kazakhstan, which may limit the generalizability of the results to other groups and regions. Additionally, the degree of candor among students in responding to survey questions may be impeded by self-reporting factors, introducing an element of subjectivity in data interpretation.

Ethical Issues

During the research process, strict adherence to the principles of ethics and respect for the rights and well-being of participants was maintained. All research participants were informed about the research objectives, their rights, and the voluntary nature of their participation. Before the survey, each student provided their consent to participate in the study. To ensure confidentiality, participants' data was anonymized and could

not be used for identification. The research results will be presented considering general statistics, without disclosing the personal data of individual participants. The personal data of research participants remains securely stored and is handled by the Republic of Kazakhstan Law No. 94-V On Personal Data and its Protection (Law RK No. 94-V, 2013) dated May 21, 2013. The research was approved by the Kazakhstan Educational Research Association (KERA).

RESULTS

The survey results revealed that 82% of students believe that virtual museums provide an adequate amount of information for successful history study, while 18% of respondents expressed concerns about the lack of substance in virtual museums. A significant majority of students are satisfied with the information provided by virtual museums, indicating the potential of this teaching method but emphasizing the importance of careful selection and structuring of materials in virtual museums. Thus, virtual museums can be effective provided they offer high-quality information that contributes to a profound understanding of historical events. These findings underscore the necessity for continuous updating and improvement of content in virtual museums to meet the diverse information needs of students.

It was also identified that the average level of student engagement when using virtual museums was 7.4 out of 10. The obtained results indicate a high level of student engagement in the learning process through the use of virtual museums, which may contribute to more effective material assimilation and stimulate interest in history study. These findings underscore the importance of creating engaging and interactive teaching scenarios in virtual museums to maximize the potential of this educational tool.

As a result of the study, it was noted that 91% of students believe that virtual museums contribute to a more interesting and engaging study of history. The overwhelming majority of respondents positively assessed the interesting and engaging nature of learning through the use of virtual museums, confirming that virtual museums not only provide information but also create a stimulating learning environment. The engaging format of education in virtual museums can significantly boost students' motivation to study history, and the use of interactive historical materials in virtual museums can make the educational process more appealing and captivating for students.

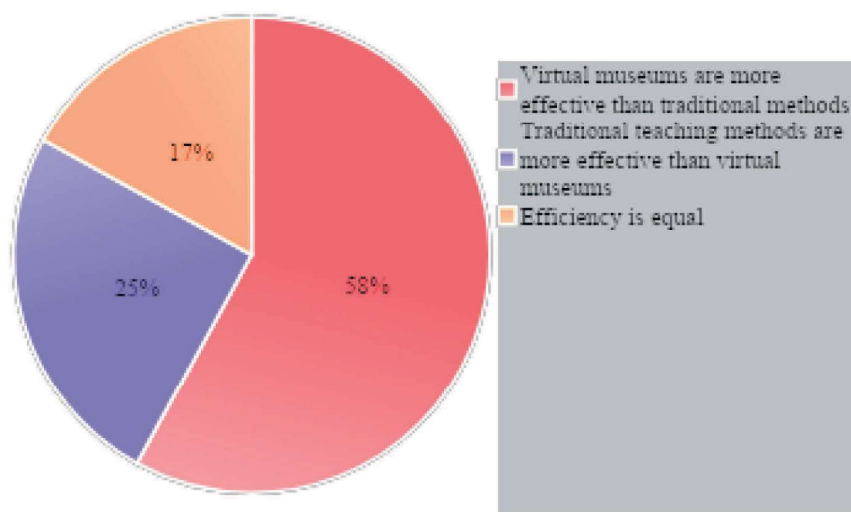
Students highly appreciated their experience of understanding historical events after using virtual museums. The high rating of the experience in understanding historical events indicates that virtual museums effectively contribute to a profound perception of the material and provide students with the opportunity to immerse themselves in historical contexts, likely fostering a deeper assimilation of information. The memorable experience underscores the importance of visual and interactive elements in virtual museums, capable of making the study of history more immediate and memorable for students.

As a result of the conducted research, it was also determined that virtual museums helped 76% of students achieve a deeper understanding of the history material. This result supports the idea that virtual museums not only provide information but also create an environment conducive to a more profound mastery of content. The interactive features of virtual museums are likely to empower students to delve more thoroughly into the material, thereby impacting the extent of knowledge acquisition.

Thus, 58% of respondents believe that virtual museums are more effective than traditional methods, 25% claim that traditional methods are more effective, and 17% consider the effectiveness to be equivalent. The majority of students express a preference for virtual museums, noting their high effectiveness compared to traditional teaching methods. This indicates that virtual museums not only meet but also exceed students' expectations in terms of history education. However, there is a segment of students who prefer traditional methods, which may be attributed to individual preferences or prior learning experiences. The diversity of opinions underscores the need to consider individual student needs when constructing educational programs that incorporate virtual museums. The level of effectiveness of using virtual museums compared to traditional teaching methods in enhancing students' understanding of historical events is demonstrated in Figure 1.

Figure 1

The level of effectiveness of using virtual museums compared to traditional teaching methods in terms of enhancing students' understanding of historical events.



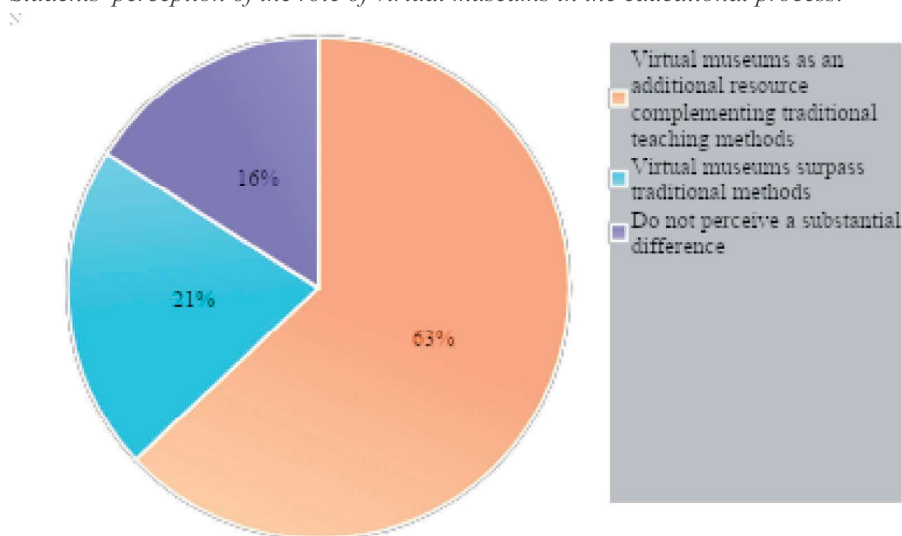
Source. Own research.

During the research, it was also revealed that the majority of students (63%) recognize the role of virtual museums as an additional resource complementing traditional

teaching methods, indicating the need for integrating various educational approaches for more effective history education. Additionally, a significant portion of students (21%) believe that virtual museums surpass traditional methods, highlighting a high appreciation for virtual museums as a tool for a deeper and more engaging study of history. However, 16% do not perceive a substantial difference, which may reflect the diversity of preferences and perceptions among students regarding teaching methods. This emphasizes the importance of individualizing teaching approaches and considering various student needs. The students' perception of the role of virtual museums in the educational process is illustrated in Figure 2.

Figure 2

Students' perception of the role of virtual museums in the educational process.

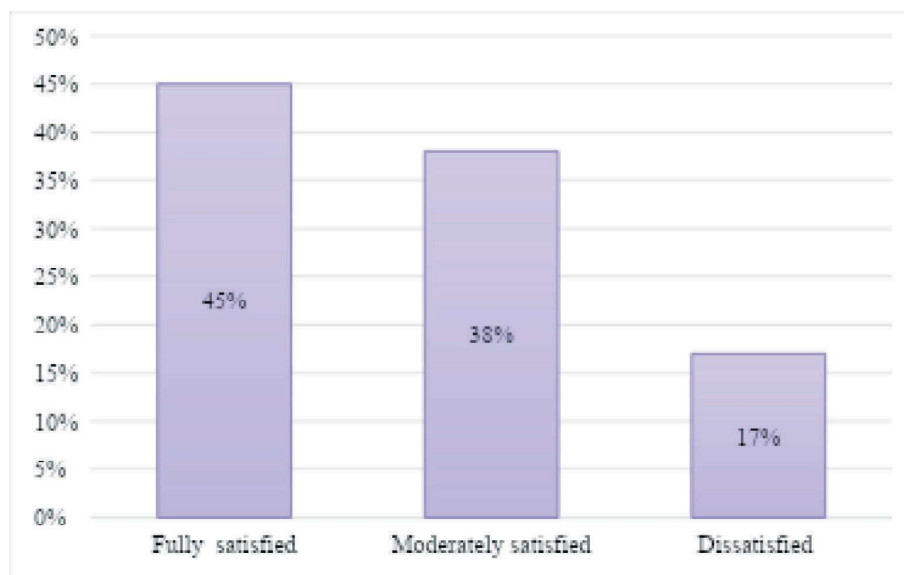


Source. Own research.

It was also identified that 45% of students are fully satisfied with the results of studying history using virtual museums, 38% of students are moderately satisfied, and 17% of students remain dissatisfied with the learning outcomes. The majority of students expressed a satisfaction level ranging from moderate to high, indicating a positive perception of the use of virtual museums in the educational process. However, students who remained dissatisfied with the results of studying history through virtual museums may have encountered difficulties that require additional attention and correction in the methods of using virtual museums. It is important to consider the feedback from these students for the continuous improvement of the educational process. The level of students' satisfaction with the results of studying history using virtual museums is illustrated in Figure 3.

Figure 3

Level of satisfaction among students with the results of studying history using virtual museums.



Source. Own research.

During the study, it was also identified that the majority of students (77%) perceive virtual museums as a convenient tool for studying history. This indicates a positive perception of the interface and interaction with virtual museum platforms. However, 23% expressed concerns about technical difficulties they encountered during the learning process using virtual museums. Students providing feedback on technical challenges may face issues such as slow loading times, technical glitches, or limited access to virtual resources. These difficulties can have a negative impact on the overall experience of using virtual museums. To enhance the effectiveness of integrating virtual museums into the educational process, attention should be directed toward addressing technical issues and ensuring the stable operation of platforms. Furthermore, feedback from students facing challenges can be a valuable resource for further improving the technological aspects of virtual museums.

The results of a study of the educational potential of the virtual archaeological museum of the Kazan Federal University demonstrate that this resource contributes to a more in-depth and understandable study of the early period of the Middle Volga region. Students noted that thanks to the virtual museum, they received a unique opportunity to interact with archaeological finds and artifacts of this period, which significantly enriched their understanding of the history of the region. Students paid special attention to the possibility of a more detailed examination of exhibits dating back to the early period of the Middle Volga region, such as Paleolithic and Mesolithic

materials, as well as artifacts from the Bronze and Iron Ages. They noted that thanks to the virtual space of the museum, they could more closely examine specific artifacts, such as tools, utensils, and learn more about their historical and cultural context. Comparing this virtual museum with traditional teaching methods, students noted that the virtual environment allows them to more fully immerse themselves in the atmosphere of the early period of the Middle Volga region and better understand the life and customs of the society of that time. They also emphasized that the virtual museum provides a unique opportunity for visual and spatial perception of material, which makes the learning process more fun and effective. Respondents also highlighted the importance of the accessibility of a virtual museum, especially for those who study the history of the region remotely or are unable to visit archaeological sites in person. An important aspect noted by students is the interactivity of the virtual museum, which allows them not only to observe the exhibits, but also to interact with them. For example, the ability to rotate artifacts in three-dimensional space allows students to view them from all angles and gain a more complete understanding of their shape and structure. In addition, students appreciated the opportunity to use additional materials and resources provided by the virtual museum, such as text descriptions and interactive maps, which allowed them to obtain additional information and deepen their knowledge of the history of the region. The study also found that the use of the archaeological museum of the Kazan Federal University as an additional educational resource contributes to the development of students' independent study and research skills. They noted that by being able to independently select exhibits to study and deeply analyze the material, they could develop their critical thinking and analytical skills. Thus, the study emphasizes the significance of the virtual archaeological museum of the Kazan Federal University in the context of studying the history of the early period of the Middle Volga region and its important role in enriching the educational process of students.

DISCUSSION

The results of this study provide valuable insights into the effectiveness of using virtual museums in the process of history learning among students. Upon comparing the findings of this study with those of similar research, both specific similarities and differences were identified in various aspects of the investigated subject.

For instance, our study corroborated the findings of Nadezhda Povroznik (2020b) regarding the significance of thematic informational content in virtual museums for the successful study of history. Both observations underscore that students perceive virtual museums as adequately informative, aligning with the understanding that effective learning in virtual museums depends on high-quality and substantive information. In contrast to the research by Soyeon Kim and Seulgi Hong (2020), where

the emphasis was on perceiving virtual museums as entertainment tools, our study focused on evaluating their informativeness for educational purposes. As a result, students in our study highly rated the level of information in virtual museums, indicating the presence of substantive educational content. This may suggest a diversity in the perception of virtual museums depending on the context of use. In our study, the average level of student engagement in using virtual museums for history learning was highly praised by respondents. This result aligns with the findings of the research by Farikah Farikah et al. (2023), which also identified a high level of student engagement in the educational process when utilizing virtual resources.

Additionally, in our study, the overwhelming majority of students noted that virtual museums contribute to a more interesting and engaging study of history. This result aligns with the findings of the research by Juming Jiang and Luke Fryer (2024), where a high level of student interest was also observed when utilizing virtual educational resources. Both observations confirm that in different contexts of using virtual museums, students perceive them as engaging and interesting educational resources. Furthermore, in our study, respondents highly evaluated their experience of understanding historical events after using virtual museums, highlighting the depth of perception and a memorable experience. This result is similar to the findings of the studies by Damiano Aiello et al. (2019) and Olesia Dyshko et al. (2021), where it is also noted that virtual museums contribute to better assimilation and understanding of historical material. Such consistency in results allows us to assert that the use of virtual museums can indeed influence a deeper and more conscious understanding of historical events, supporting the concept of their effectiveness as an educational tool.

Our study revealed that more than half of the students consider virtual museums to be more effective for studying history than traditional teaching methods. This corroborates the findings of the research conducted by Rasuljon Atamuratov (2020) and Viktoriia Tserklevych et al. (2021), where the advantage of virtual museums in the educational process was also noted. This aligns with the notion that the interactivity and visualization offered by virtual museums contribute to a more effective comprehension of material compared to traditional teaching methods. Nevertheless, our work also demonstrates that 17% of respondents do not perceive a significant difference in effectiveness between virtual museums and traditional methods. This may serve as a cautionary note against overstating the superiority of one method over the other, emphasizing the need to consider the diversity in students' preferences and learning styles.

Regarding the question of whether virtual museums complement or surpass traditional teaching methods, our study revealed that 63% of respondents perceive the use of virtual museums as a complement to traditional methods. This finding aligns with the results of Linda Daniela's research (2020), emphasizing the importance of a blended approach in education. Additionally, during our study, it was identified that some students encounter technical difficulties while learning through virtual mu-

seums. This aspect resonates with Maila Rahiem's research (2020), which underscores that technical issues can pose a barrier to the effective utilization of virtual resources in education.

The obtained results support the concept of virtual museums as an effective and engaging educational tool. The research position aligns with Mayer's multimedia learning theory, emphasizing the importance of visualization, interactivity, and personalized approaches in education (Moreno & Mayer, 1999; Wang et al., 2023). These findings contribute to enriching the understanding of the impact of virtual museums on the educational process, supplementing existing knowledge about contemporary teaching methods and their reception by students. Thus, the study represents a significant contribution to the field of education, confirming the effectiveness of virtual museums in the context of historical education and expanding our knowledge of the influence of modern educational technologies.

CONCLUSIONS

This study revealed a high level of student satisfaction with the use of virtual museums in the process of studying history. More than 80% of respondents positively evaluate the informativeness of virtual museums, emphasizing their significance for a deeper understanding of the material. The average level of student engagement reaches 7.4 out of 10, indicating a pronounced interest in this educational format. It was identified that 91% of students believe that virtual museums contribute to a more interesting and engaging exploration of history. The assessment of the experience of understanding historical events after using virtual museums is also high, confirming their effectiveness in assimilating educational content. Regarding the effectiveness of using virtual museums compared to traditional methods, more than half of the students consider virtual museums to be more effective. In addition, the study demonstrated that the virtual archaeological museum of the Kazan Federal University plays a significant role in enriching the educational process of students and contributes to a deeper and more effective study of history, including the history of the early period of the Middle Volga region. These results lend practical significance to the study in the context of enriching the educational process.

The scientific significance of this study lies in confirming that virtual museums are not only effective but also in demand among students, enhancing their interest and engagement in the learning process. The obtained results offer broad perspectives for application in various educational domains. They can be successfully integrated into university and school curricula, enriching students' educational experiences. The effectiveness of virtual museums in fostering an engaging study of history opens new horizons for the creation of interactive lessons, contributing to a better assimilation of material. In the field of educational technologies, the research findings can be

incorporated into the development of new virtual educational environments, fostering the creation of interactive and adaptive platforms. This has the potential to increase the accessibility of education, particularly in the context of distance learning. The obtained results can also be valuable for educational institutions developing history courses, as the study provides a foundation for optimizing educational programs, considering students' preferences and needs. Furthermore, the research findings may be sought after in creating recommendations for educational institutions seeking to optimize their programs in line with modern student needs. The application of these results can contribute to the overall development of the education system, ensuring a more qualitative and contemporary learning experience. Prospects for further research include a deep analysis of specific elements of virtual museums that most effectively impact learning, as well as the examination of the long-term outcomes of using virtual museums in the dynamics of the educational process.

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APPENDIX

Appendix 1

Survey Text: “Effectiveness of Studying History Using Virtual Museums”

1. Do you believe that virtual museums provide sufficient information for studying history?

- Yes
- No

2. Rate your level of engagement when using virtual museums for studying history on a scale from 1 to 10, where 1 is not engaged at all, and 10 is highly engaged.

3. Do you think virtual museums contribute to a more interesting and engaging study of history?

- Yes
- No

4. Share your experience in understanding historical events after using virtual museums. (Free-form response)

5. Do you believe that virtual museums have helped you gain a deeper understanding of historical material?

- Yes
- No

6. What is your opinion on the effectiveness of virtual museums compared to traditional methods (textbooks, lectures) in studying history?

- Virtual museums are more effective
- Traditional methods are more effective
- Equally effective

7. Do you think the use of virtual museums complements or surpasses traditional teaching methods?

- Complements
- Surpasses
- Do not see a significant difference

8. How satisfied are you with the results of studying history using virtual museums?

- Completely satisfied
- Satisfied
- Not satisfied

9. Were there any difficulties when using virtual museums compared to previous teaching methods? (Free-form response)

Appendix 2

Interview questions about the educational potential of the virtual archaeological museum of the Kazan Federal University

1. What were your first impressions of using the virtual archaeological museum of the Kazan Federal University to study the early period of the Middle Volga region?
2. Compare your engagement and interest in the virtual museum material with your experience learning through traditional teaching methods (lectures, textbooks, etc.).
3. What specific aspects of using a virtual museum have you found most useful for studying the early period of the Middle Volga region compared to traditional methods?
4. Do you think using a virtual museum affects your understanding of the historical events of this period?
5. Compare the effectiveness of the virtual museum in improving your understanding of the early Middle Volga period with traditional teaching methods.
6. What is your overall conclusion about how the virtual museum complements or surpasses traditional methods of teaching the history of this period?
7. Have you encountered any difficulties or limitations when using the virtual museum compared to traditional teaching methods?