DEVELOPMENT AND IMPLEMENTATION OF SPECIALIZED ONLINE COURSES ON SCIENTIFIC RESEARCH ACTIVITIES FOR HIGHER EDUCATION STUDENTS

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In recent years, there has been a growing emphasis on fostering research skills among students in higher education institutions. Recognizing the importance of equipping students with research competencies, the development and implementation of specialized online courses on scientific research activities have emerged as effective educational initiatives. Among Ukrainian and foreign scholars engaged in research on the development of online learning, the following should be noted: V.E. Bykov, Y.A. Zhuk, M.I. Zhaldak, R.S. Gurevich, V.F. Sholokhovich, V.G. Afanasyev, Y.M. Baturin, D. Bell, N. Wiener, L.M. Zemlyanova, M.M. Mazur, A.D. Ursul, R.O. Brien, P. Ross, and S.D. Kuznetsov. This report aims to discuss the process of creating and introducing such courses for higher education students.

Organizing scientific research activities in an online environment requires the use of special tools and methods that allow for effective collaboration and remote research. Here are some of them:

1. Virtual resources and libraries. The use of virtual resources and electronic libraries is an integral part of modern scientific research. Thanks to the accessibility of electronic databases and online journals, researchers can quickly and conveniently access current scientific publications and data for analysis [2; 8]. For example, platforms such as Google Scholar, PubMed, and Scopus have become invaluable tools for literature searches and sources for scientific research. Google Scholar provides a vast database of scientific articles, allowing researchers to quickly find relevant publications by keywords and topics. PubMed specializes in medical scientific research, offering access to a wide range of medical literature. Scopus, with its extensive database of scientific journals and citations, enables the analysis of scientific activity and relationships within academic circles. The use of these tools allows higher education students to focus on the essential aspects of their research, minimizing the time required to search and review large volumes of literature. Additionally, the availability of digital resources promotes collaboration between researchers from different countries and institutions, facilitating knowledge exchange and the development of scientific research.

2. Online collaborative platforms have become an essential tool for the scientific community, promoting effective communication and teamwork among researchers. Platforms such as Google Docs, Microsoft Teams, and Slack provide higher education students with the ability to communicate, share documents, and collaborate on projects in real-time, regardless of their location.

Google Docs, for example, allows students to jointly edit documents, comment on them, and make changes, providing a convenient and effective way to collaborate. Microsoft Teams and Slack offer interactive communication methods, such as chats, video conferences, and file sharing, which facilitate discussions and teamwork on projects. Using these platforms not only eases communication and collaboration but also enables researchers to effectively manage projects, set deadlines, and track progress. Furthermore, these platforms create opportunities for collaboration between researchers in different time zones and locations, ensuring flexibility and open exchange of ideas within the scientific community.

3. Videoconferencing and online meetings are becoming increasingly popular among researchers as a convenient and effective way to interact and share information. Using videoconferencing platforms such as Zoom, Skype, or Microsoft Teams, researchers can hold meetings, discuss research results, and conduct scientific presentations even in a remote format. These platforms allow participants in remote meetings to communicate in real-time via video and audio connections, share screens and documents, and conduct virtual scientific discussions. They enable higher education students to easily communicate with colleagues from around the world, share their research findings, and interact even in a remote mode.

Online meetings save time and resources that would otherwise be spent on travel to conferences or meetings. They also promote broader access to scientific information and interaction opportunities for researchers, regardless of their location or geographical distance. This approach increases the scale and diversity of scientific exchange, contributing to the acceleration of scientific progress.

4. Electronic tools for data analysis play an exceptionally important role in the modern research environment. With specialized programs such as R, Python, SPSS, or SAS, higher education students can perform in-depth statistical analysis and data research directly in the online environment. These tools allow for a variety of analytical tasks, from basic statistical calculations to complex machine learning models. They provide students and faculty with the tools to identify patterns, trends, and relationships in datasets, enabling them to make informed conclusions and effective decisions.

One of the advantages of using electronic tools for data analysis is their extensive functionality and ability to automate many analytical processes. This allows higher education students to effectively use their time and resources, focusing on interpreting results and solving problems rather than on routine data processing tasks. Using these tools, higher education students can also easily communicate and collaborate in real time, sharing data, code, and analysis results. This fosters collective intellectual work and promotes the rapid advancement of scientific research. Finally, the use of electronic tools for data analysis opens up new opportunities for real-time data exploration and quick decision-making based on updated information. This is especially important in today's fast-paced world, where the speed of response to changes can determine success or failure. 5. Virtual laboratories and simulation tools. For scientific research requiring the use of laboratory equipment or the conduction of experiments, virtual laboratories and simulation tools, such as Labster or Virtual Labs, can be used to conduct research in a virtual environment.

Virtual laboratories provide higher education students with the ability to conduct experiments and study reactions without physical access to complex hardware. This is particularly useful in situations where real laboratories may be unavailable or limited for various reasons, such as time, cost, or access restrictions to specialized equipment.

These simulation tools allow for the creation of virtual models of complex systems and processes, enabling researchers to study their behavior, test hypotheses, and conduct numerous experimental variations without the need for time and resources spent on real experiments. This makes efficient use of scientific resources and contributes to rapid progress in scientific research.

Moreover, the use of virtual laboratories increases the accessibility of education and scientific research, allowing higher education students, scientists, and researchers worldwide to study new concepts and conduct experiments remotely. This is particularly important in the context of the modern world, where remote access to education and science is becoming increasingly significant. Thus, virtual laboratories and simulation tools open up new possibilities for scientific research, fostering innovation, efficiency, and accessibility in the scientific field.

6. Online surveys and research. For data collection from research participants, online surveys and questionnaires can be used through services such as Google Forms, SurveyMonkey, or Qualtrics.

Overall, the use of these tools and methods allows higher education students to effectively organize and conduct research in an online environment, ensuring a high level of collaboration, resource access, and maintaining the quality of scientific research. These tools provide the ability to quickly create and distribute survey questionnaires and analyze the collected data in real time. They allow higher education students to easily configure different types of questions, segment participants, and track response metrics. One of the advantages of using online surveys is their broad accessibility and ability to engage a wide range of participants from different geographical areas. This makes it possible to conduct large-scale studies with a significant number of participants, reflecting a diversity of opinions and experiences.

Moreover, the use of online surveys helps maintain the quality of scientific research by allowing researchers to easily monitor and control the data collection process, avoid errors during data entry, and ensure the confidentiality and anonymity of participants. Overall, the use of online surveys and research enables higher education students to effectively organize and conduct research in an online environment, ensuring a high level of collaboration, access to resources, and maintaining the quality of scientific research. 7. Specialized scientific platforms. There are specialized online platforms designed to facilitate scientific research. Platforms such as ResearchGate, Academia.edu, and Mendeley aim to support scientific research and foster the scientific community. These platforms provide higher education students with the opportunity to publish their scientific works, promoting the dissemination of knowledge and information within academic circles. Additionally, they create a space for discussing research results, exchanging ideas, and establishing contacts with other researchers both within and across different fields.

One of the key features of these platforms is the ability to find co-authors for collaborative projects and research. This encourages collaboration among researchers from different countries and institutions, allowing them to combine expert knowledge and resources to achieve higher scientific results. Through these platforms, higher education students can also maintain their professional profiles, where they can publish their scientific achievements, including publications, conferences, and other activities. This allows tracking the readiness of higher education students for research activities and ensures greater transparency and openness in the academic sphere. Overall, specialized scientific platforms open up new opportunities for collaboration and knowledge exchange in the scientific community, promoting the development of science and innovation. Their role in facilitating communication, collaboration, and the dissemination of knowledge is becoming increasingly important in the modern scientific world.

8. Projection and interactive tools are becoming essential for modern data analysis and visualization of research results. Platforms such as Tableau, Power BI, and Google Data Studio provide higher education students and instructors with powerful means to create dynamic interactive visualizations, allowing for a deeper understanding and exploration of data. These tools enable the creation of various charts, diagrams, maps, and other visual elements that can be easily customized and viewed in real time. They also provide the ability to interact with the data through filtering, sorting, and adding additional parameters, which allows analyzing different aspects of the data and discovering new connections and patterns.

One of the key advantages of interactive tools is their ability to quickly create complex visualizations without requiring extensive programming or design efforts. This allows higher education students and instructors to rapidly visualize data and present it to colleagues and stakeholders in an understandable form.

Moreover, interactive visualizations make data analysis more accessible and engaging for a broad audience. They allow demonstrating complex relationships and interactions in the form of simple and attractive graphical representations, which aids in better understanding and decision-making based on data.

Therefore, the use of projection and interactive tools for data visualization and analysis is an important component of the modern scientific and analytical process. They enable the quick and effective presentation of complex data and deep analysis of information for making informed decisions. 9. Collaborative document tools are becoming an integral part of the scientific process, especially when higher education students are working together on scientific articles, reports, or projects. Platforms such as Overleaf and Authorea provide convenient and powerful tools for jointly editing and commenting on documents in real time. Thanks to these tools, multiple authors can simultaneously work on the same document without the need to send files back and forth or use complex version control systems. Each participant can see the changes made by others, as well as add their comments and edits, which allows for efficient coordination of collaborative work and avoids conflicts in changes.

Moreover, these platforms often provide advanced functionalities for text formatting, adding mathematical formulas, inserting images and links, making them ideal for writing scientific texts. They also offer the capability of automatic bibliography generation using standards such as BibTeX, simplifying the process of preparing scientific articles for publication. Overall, collaborative document tools enhance efficiency and productivity in the collective work of scientific teams. They make the process of jointly creating and editing documents more convenient, faster, and easier, allowing higher education students to focus on the substantive aspects of scientific work.

10. Project management systems for scientific research. To effectively manage scientific projects, specialized project management systems such as Asana, Trello, or Jira can be used. These systems provide convenient and powerful tools for efficient project management, enabling higher education students and their teams to organize and execute tasks in the most effective way. These systems allow for the distribution of tasks among project participants, setting deadlines, and tracking the progress of work in real time. Each participant can see their tasks, deadlines, and assigned timeframes, helping maintain focus and organize the workflow.

Additionally, these platforms provide the capability to create task lists to which descriptions can be added, files attached, comments made, and various color labels used for task categorization. This creates a structured and organized knowledge base and information that is easily accessible to all project participants. Furthermore, these systems also provide convenient tools for communication and interaction within the team. They allow higher education students to exchange messages, discuss project details, and resolve issues in real time, enhancing teamwork and enabling quick responses to changes.

Thus, using project management systems helps ensure structure, organization, and efficiency in research work, contributing to achieving successful results and meeting set goals.

11. Social networks and forums. Some scientific communities actively use social networks and forums to discuss ideas, share experiences, and collaborate. For instance, Reddit hosts numerous scientific subforums where higher education students can share their discoveries. Subreddits on Reddit are dedicated to various fields of science and research. They provide higher education students with opportunities to share their findings, discuss current issues, and seek advice from other community members. These platforms create a space for open exchange of ideas and knowledge, fostering the development of scientific research and the community as a whole. Besides Reddit, there are other social networks and forums specializing in scientific discussions, such as ResearchGate or Academia.edu. These platforms offer higher education students the opportunity to publish their scientific works, communicate with colleagues, and establish new contacts in the academic environment. Using social networks and forums within the student scientific community promotes the rapid dissemination of ideas, facilitates discussion and resolution of current problems, and enhances collective intellectual work. Such platforms help make science more accessible, open, and transparent, increasing the chances of achieving new scientific discoveries and advancements.

These tools and methods create extensive opportunities for organizing and conducting scientific research activities for higher education students in an online environment. They help researchers collaborate, share ideas and research results, and study and analyze data remotely.

The development of specialized online courses begins with careful planning and curriculum design. Course developers collaborate with subject matter experts to identify key competencies and learning objectives [1, 3, 4, 6, 7]. The curriculum is designed to cover various aspects of scientific research, including research methodologies, literature review, data analysis, and ethical considerations. The material needs to be divided into lessons or modules and determine in advance how the success of students will be assessed (figure 1).



Figure 1 – One of the steps (IV) in carrying out a research master's project

The content of the courses is structured to cater to the diverse needs and backgrounds of higher education students.

It is necessary to assess competition and understand what already exists, and what exactly you can offer to make the course in demand and interesting for the students who choose it.

Interactive modules, multimedia resources, and practical exercises are incorporated to enhance engagement and learning outcomes. Additionally, the courses may include case studies, guest lectures, and collaborative projects to provide real-world experiences and foster critical thinking skills. It is very important to provide support to students during the course, for example, through forums, email, or online chats. After launching the course, it is necessary to organize feedback from students and use it to improve the course in the future.

Once developed, the specialized online courses are integrated into the existing academic programs of higher education institutions. Students are provided access to the courses through the institution's learning management system (LMS) or online platform. Course instructors facilitate learning by guiding students through the course materials, providing feedback on assignments, and facilitating discussions.

Assessment methods in specialized online courses may include quizzes, assignments, research projects, and peer evaluations. Continuous assessment allows instructors to monitor students' progress and provide timely feedback. Additionally, periodic evaluations are conducted to assess the effectiveness of the courses in achieving their learning objectives and addressing students' needs.

The development and implementation of specialized online courses on scientific research activities offer a valuable opportunity for higher education students to enhance their research skills and competencies. By providing flexible and accessible learning experiences, these courses empower students to engage in meaningful research and contribute to the advancement of knowledge in their respective fields.

By providing students with research competencies, educational institutions prepare them for the demands of the professional world and enhance their competitiveness across various industries. Lifelong learning is important. Learning is a lifelong journey, and research skills are necessary for continuous growth and development. In an era of rapid technological advancement and information overload, people need to have the ability to critically evaluate information, discern credible sources, and adapt to new knowledge. By fostering the development of research competencies, educational institutions empower students to become self-directed learners who can independently explore new topics, pursue their interests, and stay informed in an ever-changing world.

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ABSTRACT

Higher education institutions around the world are increasingly recognizing the importance of integrating research activities into their academic programs. Research skills are crucial for students not only in their academic pursuits but also in their future careers. However, traditional classrooms may not always provide sufficient opportunities for the comprehensive development of these skills. Online courses offer a flexible and accessible platform for delivering specialized training in research activities.

Keywords: specialized online courses, scientific research activities, accessible platform, virtual laboratories, social networks, forum, collaborative document tools, videoconferencing/