



STUDENTS' SCIENTIFIC WORK IN CONDITIONS OF E-LEARNING: REFLECTION OF UNIVERSITY STUDENTS

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Abstract: *Considering the challenges of the present, contemporary universities pay significant attention to providing an effective electronic environment. Such an environment creates all the necessary conditions for multifaceted students' activities, with a predominant emphasis on scientific activities. It is precisely this factor that defines the relevance of the researched issue. The objective of the scientific search was to facilitate the implementation of reflective practices by undergraduate students and graduates in order to determine the key indicators of their scientific work throughout their e-learning experience. The following research methods were used: analysis, synthesis, specification, systematization, and generalization of scientific data regarding the specifics of students' scientific work during e-learning; analysis of the reflection papers written by the university students titled: "My Scientific Work During University Years: What It Was Like"; mathematical calculations of the results. Therefore, scientific work conducted under conditions of e-learning revealed a range of indicators (15 items in total) in students' self-analysis, including 12 positive indicators and 3 negative ones. The specified indicators should be considered in the organization of various forms of scientific students' work in the university educational environment. The prospects for further research are seen in the clarification of the influence of online form of education on the students' independent work.*

Keywords: students' scientific work; the electronic environment of a modern university; E-learning, students' reflection; indicators of scientific students' work during online education

INTRODUCTION

Modern transformation processes taking place in the higher education system of Ukraine are aimed at ensuring the improvement of professional training for future specialists. Primarily, these processes are intended to make them competitive in the labour market not only within the country but also in the European Union countries, as stated in the “EDUCATION 4.0: Ukrainian sunrise” program (2022). The program “EDUCATION 4.0: Ukrainian Sunrise” (2022) outlines the need for the application of new learning technologies aimed at developing technological skills among university students. According to the program, the priority is the digital transformation of education and science, which involves the development of a digital educational infrastructure that provides the area of the free Internet, access to content without restrictions, the development of a digital space in educational institutions with the use of modern digital tools (cloud library, electronic textbooks, online educational process, etc.) (EDUCATION 4.0: Ukrainian sunrise, 2022).

Considering the challenges characteristic of today’s realities, the university education system in different countries has accumulated experience in organizing student’s education in both traditional and modern forms. These include e-learning (Al Rawashdeh et al., 2021; Nikou & Maslov, 2021; Wagiran et al., 2022; Wickramanayaker, Hewaarachchi, & Brown, 2021), also known online learning (Dumford & Miller, 2018; Hamdan & Amorri, 2022; Stoian et al., 2022; Yang & Cornelius, 2004). *Since the definitions of these terms are identical – acquiring education using information technology and the internet – they will be used interchangeably and synonymously in our research* (thus, we consider *e-learning* and *online learning* as equivalent notions in the paper).

The organization of the educational process in higher education is a multifaceted phenomenon as it encompasses various components such as academic work, research work, students’ internship, etc. Scientists Castro-Rodríguez (2022), Ferrero (2020) and Van Eeden, Eloff, & Dippenaar (2021) single out the scientific work of students as a priority, because it contributes to the development of students’ critical thinking, ability to produce creative ideas, and search for non-standard solutions. In fact, this is what distinguishes the personality of a modern competitive specialist.

Any changes, including in the form of education at universities, have corresponding consequences. Therefore, determining the influence of e-learning on students’ implementation of scientific work tasks has become a pressing problem. The experts in assessing the quality of getting educational services are the students themselves (Moroz et al., 2018), so it is important to consider their positions to improve the quality of higher education.

Based on the above-mentioned relevance of the topic and its scientific argumentation, the **purpose of the study** was to organize a reflection (as a method of self-analysis) among undergraduate students (specialty 012 Preschool Education) from two Ukrainian universities. This reflection aimed to determine the primary indicators (both positive and negative) carrying out scientific work during e-learning.

The following **main research questions** have been identified:

1. determination of the theoretical foundation of the essence of students' research work in the context of E-learning;
2. determination of approximate components of students' scientific work in the context of E-learning;
3. analysis and presentation of the results of the students' reflection on the features of their scientific work, which took place during online studying (during quarantine restrictions related to COVID-19 and martial law in Ukraine – from February 24, 2022).

Research Hypothesis: student research conducted under the conditions of university e-learning may achieve qualitative results. While not aiming to ascertain the effectiveness of using a range of all electronic means and resources it is important to diagnose the actual state from the perspective of students' self-analysis as consumers of educational services.

1. THEORETICAL BASIS OF THE ESSENCE OF STUDENTS' SCIENTIFIC WORK IN THE CONTEXT OF E-LEARNING

Modern Ukrainian scientists (Karimov et al., 2022; Moroz et al., 2018; Morze, Kuzminska, & Liakh, 2017) increasingly emphasize the necessity to improve the quality of future specialists' professional training within the university educational system, which requires the study and scientific reevaluation of various forms of student education organization, particularly in the online format. Given the ongoing transformation of higher education in Ukraine, aligning with European standards, there is a significant focus on enhancing students' scientific work (Lokhvyytska, 2023) and understanding various aspects of the educational process.

In global scientific research and practice (Hamdan & Amorri, 2022; Liu, 2019; Nikou & Maslov, 2021; Stoian et al., 2022; Wagiran et al., 2022; Wickramanayaker, Hewarachchi, & Brown, 2021), significant advancements of e-learning in universities have been extensively presented. The organization of E-learning has been strengthened due to the implementation of quarantine measures in many countries. It has been proven that online learning contributes to broadening awareness regarding the application of information and communication technologies. It also develops skills in solving non-standard problems and tasks, which, in turn, enhances professionally significant qualities among students to achieve their set goals (Aesaert & van Braak, 2018; Morze, Kuzminska, & Liakh, 2017; Yang & Cornelius, 2004).

Several research studies (Dumpit & Fernandez, 2017; Fernández-Márquez, Leiva-Olivencia, & López-Meneses, 2017; Karimov et al., 2022; Wagiran et al., 2022) have explored the impact of e-learning on the development of students' motivation and volitional efforts in acquiring relevant knowledge. These studies highlight the stimulation of intensive independent search and choice of information sources from different resources, the activation of cognitive activity in solving tasks related to the study of subjects using computer technology, and the acquisition of computer thinking skills. This can be interpreted as the development of a holistic set of personal qualities in students. Researchers Dumford & Miller (2018) noted that online

courses develop analytical thinking and a desire to learn more by discovering new Internet resources that present scientific material in an appropriate way. Additionally, according to Al Rawashdeh et al. (2021), e-learning increases the possibility of communication among all participants of the educational process, enhancing their mobility and efficiency in activities.

Castro-Rodríguez (2022) and Ferrero (2020) emphasise the importance of creating a research environment in universities, where students have the opportunity to experiment with their scientific ideas. This process not only contributes to their professional development but also promotes personal growth and development. They demonstrate independence, perseverance, creativity, and responsibility in their scientific inquiry. They engage in interactions with others, discussing their own research projects, which directly impacts their development as professionals (Nurpratiwi, Amaliyah, & Romli, 2022; Wickramanayaker, Hewarachchi, & Brown, 2021). The implementation of research tasks that occur online facilitates the development of students' ability to navigate the information space, get relevant information, and operate it effectively. It stimulates their personal interests and needs, aligning with the demands of a modern high-tech society (Becher, 2022; Bellei & Munoz, 2021; Van Eeden, Eloff, & Dippenaar, 2021).

Thus, students' scientific work in the context of e-learning is characterized by enhanced attributes such as *informativeness*, *individuality*, and *activity*. These attributes will be considered as components for conducting empirical research. However, in the presented scientific studies there are no results regarding the characteristics of the strengths and weaknesses of e-learning from the students' point of view, which will be carried out on the basis of their self-analysis.

2. METHODS OF THE RESEARCH

A set of methods was used to conduct the presented research. In particular, to determine the theoretical foundations of the essence of students' scientific work in the conditions of e-learning and to clarify the peculiarities of organizing students' scientific work in the environment of a modern university, a theoretical review of thematic sources was conducted, including their analysis and synthesis, specification and systematization for the identified scientific provisions. While analysing the students' works: "My scientific work in the university years: what it was like" quantitative and qualitative analysis of the obtained results and their mathematical analysis were implemented. To summarize the primary research findings and draw conclusions, we applied the method of generalization.

During the empirical research, we employed the reflection method, which was presented to the respondents in the form of composing a reflection paper. The foundations for applying the reflection method were based on the scholarly ideas of Chang (2019), Liu (2019), and Nurpratiwi, Amaliyah, & Romli (2022). These researchers (Chang, 2019; Nurpratiwi, Amaliyah, & Romli, 2022) identified reflection as a valuable approach during online learning and team collaboration (as evidenced by our study, particularly when performing tasks related to scientific work within a group setting). Written reflection allows an individual to gain insights into their own activi-

ties, self-awareness, and draw relevant conclusions (Liu, 2019). Self-analysis through reflection is one of the most accessible and universal methods for individuals to conduct self-assessment, evaluate their own achievements, and recognize their own shortcomings (Chang 2019). Thus, reflection as a self-report promotes awareness of the problem and stimulates the search for ways to solve it, activating personal capabilities (Nurpratiwi, Amaliyah, & Romli, 2022).

In line with our scientific position, we believe that reflection, as a method for collecting research data, will be effective. Self-analysis conducted in this manner, without external pressure, but in a free form, offers respondents a wide range of opportunities to objectively assess the real state of education during e-learning. This enables them to identify both positive and negative indicators related to the implementation of students' scientific work tasks.

Based on the systematization and generalization of the scientific provisions presented in the Chapter "Theoretical foundations of the essence of the scientific work of students in the conditions of e-learning", students received a brief instruction on the description of self-analysis in the work "My scientific work during my university years: what it was like". This was done in order to direct their reflection towards highlighting how the informational-cognitive support was provided (*the informational component*) and whether it contributed to satisfying personal needs, interests, aspirations, and motivation for seeking scientific truth (*the personal component*), as well as whether it was possible to fully accomplish the assigned tasks of scientific work online (*the activity-based component*).

3. RESEARCH RESULTS: ANALYSIS OF THE STUDENTS' REFLECTION "MY SCIENTIFIC WORK DURING THE UNIVERSITY YEARS: WHAT IT WAS LIKE"

The research was conducted at the end of the 2022-2023 academic year (from April to – June 2023) in the graduating departments of two Ukrainian universities – Psychology and Pedagogy of Preschool Education at Hryhorii Skovoroda University in Pereiaslav and Preschool Education at Bohdan Khmelnytsky National University of Cherkasy. A total of 137 fourth-year graduate students (both full-time and part-time) obtaining a Bachelor's degree in the field of 012 Preschool Education participated in it. Since both higher educational institutions are state establishments, the organization of the educational process is identical.

The purpose of applying reflection in conducting an empirical study was to gain insights into students' understanding and definition of positive and negative aspects of online learning during their engagement in scientific work tasks. The scientific work of the students covered the following types: mastering the educational component "Basics of Scientific Research"; preparation of term papers, scientific projects; participation in scientific workshops, creative problem groups, various scientific events (seminars/webinars, conferences, round tables, symposia, etc.), student Olympiads, competitions of student scientific works of various levels, etc. Undergraduate students who graduated in the 2022-2023 academic year had different forms of educa-

tion (offline, online and mixed) during their studies at the university. They entered universities in September 2019, and in March 2020, due to the COVID-19 epidemic, quarantine restrictions were introduced, which led to the transition to online education. The situation became even more complicated with the beginning of the full-scale invasion of Russia on the territory of Ukraine from February 24, 2022, when the shelters had not yet been properly prepared and equipped. These factors led to the fact that students in these years of study gained as much experience as possible in getting education in the online format.

For the research, the method of reflection was used by the preparation of the students' reflection papers: "My scientific work during the university years: what was it like". At the beginning of the experiment, students were given the following instructions: "*Do a self-analysis of what your scientific work was like during your studies at the university. Indicate your own achievements and gaps regarding the informational, personal and activity-based components of the scientific work carried out. Outline the positive and negative aspects of the online format of obtaining an education in relation to the students' scientific work*".

All respondents' reflections were prepared anonymously to conduct an objective analysis of the results.

Analysing the content of students' reflection papers allowed us to make the following generalizations: it revealed the key characteristics of the scientific work conducted during online learning – in terms of *information* – the ability to find and analyse scientific sources, the desire to be aware of modern scientific problems, the desire for scientific research through study of new scientific developments; regarding the *personal* – the ability to conduct scientific research, the desire to increase the level of one's own scientific activity and positioning oneself as a scientist at various events; in terms of *activity-based* – the ability to independently conduct scientific research on the psychological and pedagogical problems of teaching preschool children, the readiness of future specialists to apply the results of scientific research in practical pedagogical activities, the activation of one's own scientific potential through participation in various types of scientific activity.

The calculations presented, conducted during both quantitative and qualitative analysis of the students' works, are visually represented in Figure 1 and Figure 2. In particular, Table 1 presents a list of positive indicators of students' scientific work conducted in an online format.

As can be seen from the quantitative indicators presented in Figure 1, the largest number of respondents indicated that they received thorough professional training during the study, which took place in an online format, 86.86% (n=119). Example: "*I was able to constantly be in learning mode in order to gain enough knowledge in the electronic environment of the university. I think that I am ready to fulfil my professional duties to the full extent and will even be able to immediately choose a topic for my own scientific and experimental work at the workplace*".

The scientific orientation of the educational process was noted by 78.83% (n=108) of students, whose papers include the following arguments: "*I feel that my knowledge gained during the training on how to organize scientific work gave me the basic level necessary for their practical implementation*".



Figure 1. The list of positive indicators of students' scientific work conducted in online format (according to the results of the students' reflection)

Source: Own work.

66.42% (n=91) of the respondents pointed out that the e-learning provided a competency-based approach, who noted that they “*feel fully prepared for independent professional activity, because during the implementation of practical tasks of scientific work, they carried out analytical and synthetic research, with “explained the essence of a scientific problem, engaged in its evaluation and learned to find solutions”.*

As a positive thing, the students noted that information and communication skills are developed during e-learning. Such a respond was recorded by 64.23% (n=88) of respondents, who emphasized that “*they mastered the skills of using various gadgets, learned to quickly find information on various Internet sites, especially the resources of e-libraries were useful”.*

61.31% (n=84) of students indicated their activity in using web resources. In particular, they noted: “*Many times I had to use Google to search for the right scientific event – a webinar or a conference, so that it corresponds to my topic and it would be possible to present the results obtained during the research”.*

Scientific work of students in the conditions of e-learning contributed to the development of their interaction skills in the virtual space. 59.12% (n=81) of respondents mentioned this as positive indicator in their works. For example: *“I was a little scared at first, but later, thanks to the acquired knowledge, I started communicating in Internet groups that were dealing with the same scientific issue as me. We started to exchange ideas, shared opinions on how to organize such a thematic study in an appropriate way”*.

During online training, positive indicators were recorded regarding such an indicator as the motivational and volitional activity of students during the performance of scientific work tasks. In particular, it was 56.93% (n=78). The following expressions of reflection are present in the works of the respondents: *“It seems to me that when we studied online, we were just obliged to complete all the tasks on the “Fundamentals of Psychological and Pedagogical Research”, because there were all the conditions for this, despite frequent air-raid signals. I would be ashamed not to complete the task, because there is more time to prepare on the distance, you just have to not be lazy”*.

In the process of analysing the students' reflection papers, the financial and economic benefit of online participation in scientific events was singled out as a claim. This was noted by 54.01% (n=74) of respondents. For example: *“Internet conferences are cheaper, we use them to test our scientific works and do not spend money on public transport and paying for accommodation and meals. Participation in scientific events held online is a budget option, where you can prove yourself as a novice scientist”*. Similar to the indicator mentioned above, there is also a mention of a wide geographical area, which was indicated by 48.91% (n=67) of students. In their reflection works, there are the following considerations: *“If I speak English well, I can take part in Internet conferences that interest me in their topic, which are held in any country, of course, except for the aggressor's country and those that support it. In the online format, I took part in the International Competition of Scientific Papers, and if it was held only in face-to-face format, I would not have been able to go to”*.

The indicator, which was pointed out by 45.98% (n=63) of students is unanimous – it is a wider spectrum regarding the possibility of participation in scientific work conducted online. In particular, the following considerations were expressed: *“I will improve my skills in delivering a scientific report precisely through participation in a remote form, because I am not as afraid as doing it live in the public. In order to improve my professional level, I plan to participate in seminars and conferences, which will be held online”*.

Another positive aspect mentioned in the students' reflection papers is the specified and operational connection in the scientific work organized during online education. This was noted by 40.87% of the respondents (n=56). Some students argued: *“We had electronic educational and methodical materials, multi-access to them was provided. Interactivity was constantly maintained, online communication took place thanks to social networks, when it was not possible to communicate in person, we kept in touch through Viber, Telegram”*.

Convenience (time and place of stay) was called the final positive indicator in the presented list, submitted from the largest number of choices. It was chosen by 30.66%

(n=42) of the analysed students' reflection papers. In particular, these students expressed the following opinions: *“Modern realities require us to be mobile, and conducting online scientific events provides such an opportunity. It is very convenient when you join a webinar or conference from any location. You don't need to spend extra time commuting, turn on the computer and you can take part in the discussion of the scientific problem you are investigating”*.

However, in addition to the positive aspects of scientific work, which took place in the conditions of e-learning, students also noted some negative aspects. Figure 2 presents a list of these negative indicators related to students' scientific work conducted in an online format based on the results of the students' reflection.

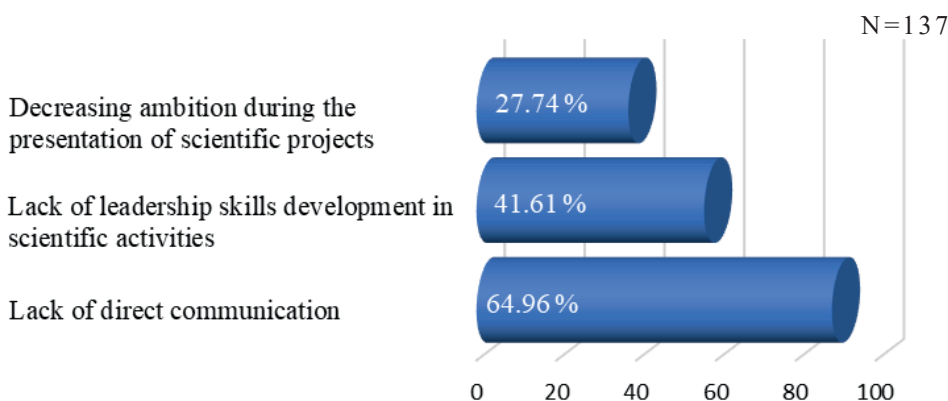


Figure 2. The list of negative indicators of students' scientific work conducted in online format (according to the results of the students' reflection)

Source: Own work.

Among the weak points, as shown in Figure 2, graduate students noted a decrease in ambition during the presentation of scientific projects, which was recorded in the works of 27.74% (n=38) of respondents. In their opinion, *“only a live discussion with elements of debate, which can fully take place in classroom conditions, and not in front of monitors, makes it possible to prove the legitimacy of the expressed scientific hypothesis. An online speech will not replace an offline speech, because it is not possible to achieve that degree of scientific conviction”*.

Among the negative aspects, 41.61% (n=57) of students also included the lack of leadership skills development in scientific activity when it is held online. Their argument was that *“the protection of scientific work on the Teams platform did not fully contribute to showing the advantages of the conducted research. It is difficult to reveal the specifics when you read dry comments in the chat, and there is no ability to demonstrate scientific proof of the facts”*.

The indicated negative indicators are closely related to another one, which is indicated by the majority of respondents, 64.96% (n=89), which is a lack of face-to-face communication. The students noted that *“online communication does not give the emotional colour that is present in real life. The interlocutor's reaction is sometimes*

even incomprehensible. In direct communication, the basis for establishing contacts in further joint scientific activity is created, but this does not happen online”.

Thus, having systematized the obtained results of the conducted empirical research, we can claim that in relation to scientific work, learning in an online format had a number of advantages, which were pointed out by students, although certain negative aspects of this process were also noted. Namely:

- The *informational component* positively included the development of students' scientific orientation (78.83%, n=108), development of information and communication skills (64.23%, n=88), stimulation of activity in the use of web resources (61.31%, n=84), activation of interaction skills in the virtual space (59.12%, n=81) and the ability to establish operational communication (40.87%, n=56). No signs of weak points regarding the informational component of students' scientific work in online learning conditions were found.
- As for the positive aspects of the *personal component*, the respondents noted the development of professional readiness (86.86%, n=119) and the formation of motivational and volitional activity (56.93%, n=78). However, some weak points were also recorded: according to the students, during e-learning, to some extent there is a decrease in ambition during the presentation of scientific projects (27.74%, n=38), there is no opportunity to develop leadership skills in scientific activity (41.61%, n=57) and, unfortunately, the participants of scientific events are limited in face-to-face communication (64.96%, n=89).
- With regard to the *activity-based component*, according to the research data, exclusively positive characteristics were established: the implementation of the competence approach in the process of obtaining an education (66.42%, n=91), significant financial and economic benefits of participation in scientific activities (54.01%, n=74), wide geographic coverage of topics of scientific interest (48.91%, n=67), a wider range of possible participation in scientific events (45.98%, n=63), as well as the convenience of joining scientific events both in terms of time and place of stay (30.66%, n=42).

Considering the above, we have identified a significant number of positive indicators, compared to the negative ones, expressed by students regarding their scientific work in online learning. This suggests that students' education in this format is quite effective, and therefore, both offline and online educational processes contribute to the high-quality professional training of specialists in the specialty 012 Preschool education.

Since they were obtained in the reflection papers “My scientific work during university years: what it was like” the results of students' reflection on positive and negative indicators of online learning during their conducting of scientific work tasks are a presentation of only a limited sample of respondents from two universities of Ukraine, the data cannot be generalized. However, the application of such a method made it possible to diagnose the real state of students' scientific work in the conditions of e-learning, as outlined by the **hypothesis confirmed in the process of conducting an empirical study.**

DISCUSSION AND CONCLUSION

Considering modern challenges, significant changes are taking place in the system of university education, aimed at strengthening the quality of future specialists' professional training in the labour market. An important component in the educational process is students' scientific work (Castro-Rodríguez, 2022; Ferrero, 2020; Lokhvytska, 2023; Van Eeden et al., 2021), which has undergone certain transformations in the conditions of e-learning. That is why, the aspect of its effectiveness in the real organization of the educational process in the e-learning environment of the university was the subject of discussion.

The goal of the study, which was fully achieved, was to find out the opinions of undergraduate students on the first educational level (bachelor) about the positive and negative aspects they faced while conducting scientific work during online education. The research problems were addressed as follows:

- (1) On the basis of the conducted theoretical review of the raised problem, it was found out that in its essence the students' scientific work in the conditions of e-learning has a number of specific features, which consist in the modernization and dynamic improvement of their scientific and research activities through the use of modern information and communication technologies and new organizational forms.
- (2) It has been established that in student research conducted in e-learning, it is advisable to distinguish informational, personal, and activity-based components.
- (3) Based on their reflections in the works titled 'My Scientific Work During the University Years: What It Was Like', undergraduate students shared their experiences of conducting scientific work, which primarily occurred online due to quarantine restrictions related to COVID-19 and martial law in Ukraine, starting from February 24, 2022. The respondents identified several positive indicators related to the informational and activity-based components. However, they also mentioned some negative aspects in the personal component. These identified indicators should be considered when organizing various forms of scientific work for university students. Given that students' scientific work emphasizes independence, **further scientific research** will focus on assessing the impact of e-learning on students' ability to carry out independent work.

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