Stimulation of students' research activity in the conditions of distance education

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Article Info

ABSTRACT

The purpose of the article is to analyze the research activity of students in the context of distance education in order to identify factors that influence its formation. The work highlights the practical aspects of stimulating students' research activity. The work uses the methods of questionnaires, testing, and the method of expert evaluations. Statistical analysis was carried out using chi-square, Pearson's coefficient. The study was based on a pedagogical experiment. It was determined that the students within the experimental group exhibited a markedly higher degree of research engagement than the control group. Specifically, the mean research activity scores in the experimental group were 75% for the need for achievement, 68% for the need for recognition, 82% for the need for curiosity, 61% for the need for control, and 42% for the need for distinction. Overall, it can be contended that motivation plays a crucial role in fostering research endeavors in the conditions of distance education. The obtained results can be used to improve the research activity of students. Potential future studies could focus on conducting a comprehensive exploration of certain aspects, such as the incentives behind research endeavors and enhancing cognitive abilities through research activities.

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1. INTRODUCTION

Relevance of the study. Currently, the foremost objective of the higher education system is the training of personnel capable of navigating the changing world of technology while simultaneously fostering a capacity for creativity and innovation across various domains. The ongoing transformations within the global economy and rapid technological advancement have necessitated an elevation in standards about professional qualifications, competence, creative aptitude, and social engagement among specialists. In light of recent events such as the worldwide pandemic outbreak and widespread invasion threats, educational institutions in Ukraine are compelled to enhance their efficacy regarding distance learning practices [1].

Distance learning is a formalized system specifically designed for remote education that utilizes electronic devices. Implementing distance educational technologies in the academic setting yields indisputable benefits, particularly in enabling students to master the course material despite temporal, spatial,

and physical barriers. Nonetheless, one of the critical challenges posed by distance education is its higher drop-out rate as compared to traditional forms of instruction [2]. Time and space constraints between teachers and learners prevent the organization of full-fledged educational interaction among participants in this learning mode [3]. In distance education, students are tasked with independently devising their own study plans, determining the sequence in which they engage with course materials, and selecting methods for comprehending and assimilating educational information. However, students who exhibit low levels of engagement may struggle to activate their full potential for subjectivity and participation in the learning process [4]. As a result of this scenario, several researchers have noted a decrease in success rates among such individuals as well as instances where students discontinue their studies altogether. Consequently, investigating factors that affect student involvement in educational activities and developing strategies to enhance their engagement through distance education technologies has gained particular relevance [5]. From this perspective, it is crucial to outline several significant definitions to understand the impact of distance education on students' research activity. General competencies pertain to universal knowledge, abilities, and skills a learner must acquire for productive educational pursuits. Professional competencies refer to the specific knowledge, skills, and abilities that enable learners to tackle professional tasks successfully [6].

Research competence is a crucial aspect of professional competences. To fully comprehend the challenges of its formation, it is imperative to first define the term "research competence". Once the essence and content are grasped, appropriate conclusions can be drawn for effective work. After analyzing psychological and pedagogical literature, it was discovered that there lacks a universal or specific definition of "research competence". It can be interpreted as possessing the ability and skills to scrutinize and assess scientific information [7]. Furthermore, research competence is the capacity that embodies both the process and outcome of creative mental activity, coupled with research and design endeavors. Moreover, this quality of personality encompasses a comprehensive ability to objectively evaluate problems while transforming them into specific tasks using skills for conducting research work. These combined definitions facilitate the construction of a research methodology designed to cultivate this proficiency while discerning its diverse constituents throughout the research endeavor [8].

Mamun *et al*. [9] explores the creation of online reference modules for students in self-directed and research-based learning. The authors make an important contribution to developing and implementing interactive learning environments in the online format. The scholars examine the methods and principles of instructional design for creating successful online modules, promoting self-development and student inquiry. Modern requirements for developing higher education systems are highlighted in the work of [10]. In this article, the author considers important requirements for developing the higher education system, especially because of the impact of the coronavirus disease (COVID-19) pandemic. The current state of higher education and the need to adapt to changes in the crisis is analyzed. The work is important for understanding the challenges facing the higher education system.

To understand the relevance of the development of distance education, it is important to pay attention to the work of [11]. In this article, the authors compare barriers to implementing distance learning and e-exams during the COVID-19 pandemic. Various factors that influence the success of these processes are addressed, and important conclusions for improving the learning environment in crisis conditions are provided. The work of researchers [12] examines emotional intelligence's influence on the learning process's effectivenesss. In particular, the article examines the role of emotional intelligence in learning foreign languages in a higher educational institution. The authors detail the relationship between the development of emotional intelligence and students' academic success, offering an engaging methodology for acquiring linguistic proficiency.

Ou *et al*. [13] examine the intricacies associated with elaborating the educational materials tailored to distance learning. The article outlines a framework for constructing video lessons optimized for online education that rests on seven key principles. The authors scrutinize critical elements in generating video content conducive to successfully implementing virtual courses. Features of the transition from face-to-face to distance education are discussed in the work of [14]. The author investigates teachers' perception of the transition from classroom instruction to online teaching. Challenges and benefits of this process are analyzed, and recommendations are offered for enhancing the quality of online learning.

Yin *et al*. [15] sets out to consider the possibilities and advantages of using artificial intelligence and virtual reality in distance education in mathematics. The author highlights the problems of using these technologies and emphasizes the need to adapt the educational process to modern realities. One of the key topics discussed in the article is the possibility of creating interactive learning environments that enable students to perceive and understand mathematical concepts more effectively. Artificial intelligence and virtual reality can facilitate the creation of interactive tasks and scenarios that develop critical thinking and help master complex mathematical concepts. Zhao *et al*. [16] examine the impact of technological environments and virtual experiences on student continued participation in massive open online courses

(MOOCs). They use the "stimulus-organism-response" model to analyze the factors influencing students' decisions to continue their MOOC studies. The results of this study can be useful for understanding and increasing students' continued participation in online courses.

Vasylenko *et al*. [17] examines the influence of interactive technologies on the development of research competence of psychology students. The author considers the possibilities of using interactive technologies to intensify research activities and instill analytical skills. The research can be useful for teachers and psychologists who work on forming research skills in students. Demyanenko [18] delves into a crucial facet of contemporary education the implementation of open educational spaces to cultivate pedagogical experts. The author advances and elaborates on their original context-competence model for teacher training, grounded in accessibility and openness to educational resources. The study emphasizes the notion of contextuality in education, signifying that learning must be contextualized within specific settings and practical tasks relevant to students' forthcoming professional pursuits. The above teacher training model considers the specifics of the modern learning environment, where the role of independent learning and access to information through open access to knowledge is growing.

A critical take-away from these analyses is that within the framework of the conducted research, there are unsolved questions that should be taken into account in future scientific works. In particular, it is important to probe deeper into the influence of various aspects of the technological environment on the effectiveness of learning in online courses, given the diversity of the student audience and their individual characteristics. There is a pressing need to delve deeper into the interplay between interactive technologies and the development of research proficiency in students. Specifically, it is crucial to determine optimal strategies for leveraging such technologies to enhance outcomes. Given the open educational space, it is critical to investigate how teaching professionals' training models impact their subsequent professional activity and interaction with students within pedagogical contexts. Consequently, exploring the aspects of technological influence on learning, assessing interactive technologies' role in fostering research competencies, and evaluating the impact of open educational spaces on cultivating professional capabilities remains a research area worth further investigation. The purpose of the research is to study the research activity of students in the conditions of distance education to reveal the features and influential factors that contribute to its growth. Research objectives: i) investigation into the impact of cognitive factors on students' research performance in a distance learning environment; ii) Study of academic success in the conditions of distance education; and iii) study of the role of motivation in the development of students' research activity.

2. METHOD
2.1. Design

Engaging in research is an exceedingly crucial aspect of students' scholarly and individual growth as it promotes active study and understanding of educational material, develops critical thinking and analytical skills. Moreover, research activity helps students gain practical experience in tackling real problems and tasks in their field. The study of the impact of distance learning on students' research activity was broken down into several successive stages as shown in Table 1.

Table 1. Stages and methods of research on the influence of cognitive components on students' academic success and research activity

Research stage	Tasks and methods	Time frame	Subjects
1. Ascertaining stage	- Selection of methods for determining motivation. - Identifying the level of academic success. - Formation of control and experimental groups.	March 2022 to May 2022	254 students of 3-4 years of study representing different faculties.
2. Search stage	- Determining the distance learning effectiveness in the process of stimulating students' research activity. - Identifying the correlation between motivation and research activity. - Processing of test results, summarizing.	May 2022 to July 2022	254 students of 2-4 years of study representing different faculties: 118 students in the control group and 136 students in the experimental group.
3. Analytical stage	- Study of the directionality of changes in cognitive components. - Processing of the obtained results. - Conclusions based on research findings.	July 2022 to May 2023	254 students of 1-4 years of study representing different faculties

It is worthy to note that research activity not only contributes to the deepening of knowledge but also increases the motivation of students to study, as they take an active part in their educational process.

Furthermore, it fosters the cultivation of ingenuity, autonomy and enterprise, which are fundamental attributes in achieving both vocational and personal fulfillment. Research activities also help students develop critical thinking and analytical skills as they learn to evaluate information, connect concepts, and formulate their hypotheses. This contributes to the formation of students' deep understanding of the subject and the ability to solve complex problems independently. In addition, research can stimulate collaboration and communication between students and faculty, which fosters a collective intellectual environment where ideas are shared and improved. Thus, research activity is an important element of the educational process, which contributes to the comprehensive development of students and their preparation for the challenges of the modern world.

2.2. Participants

Within the current research framework, the group of respondents under study is confined solely to students. The chosen sample adheres to a uniform structure and satisfies the criteria of representativeness. The overall number of participants amounts to 254, with 124 being male and 130 females; these figures satisfy the methodological requisites and objectives of the study within the context of systemic theory about mental resilience and adaptive functioning. The study was conducted based on the Vinnytsia Mykhailo Kosybynsky State Pedagogical University, Kyiv Institute of the National Guard of Ukraine, Lviv National Academy of Arts and Khmelnytskyi National University. Students of the 3rd to 4th years of study from different faculties, who study remotely participated in the study. Such a choice of students corresponds to the goals and objectives of the research. In addition, an expert group, which consisted of 10 teachers, was created. The survey of respondents using a questionnaire was conducted via remote data collection. Students were divided into two groups control (128 people) and experimental (126 people). Students of the experimental group were invited to take an active part in research activities. Students of the control group studied regularly. We will put forward two research hypotheses as follows: Null hypothesis (H0): no statistically significant differences exist between the control and experimental groups regarding academic success and motivation to study. Alternative hypothesis (H1): statistically significant differences are evident between the two groups regarding their academic success and motivation to study.

2.3. Instruments

The study participants engaged in remote testing via the Google Forms platform. Data was collected and analyzed using Microsoft Excel and SPSS Statistics 18.0 software, with all findings presented as a percentage of total survey respondents. Cronbach's alpha coefficient served as a reliable tool for measuring questionnaire reliability.

2.4. Data collection

The study of cognitive components, the selection of criteria for evaluating research activity was based on analyzing various factors that can impact the development of a student's professional competencies. These factors can be categorized into five groups: motivational, cognitive, operational, emotional-volitional, and ethical-reflexive. These groups are interrelated and interact with each other to reflect different qualitative characteristics of the student's holistic personality. To conduct this research, a questionnaire was utilized. Cronbach's alpha coefficient for this method was 0.74, which indicates the method's reliability, reliability and verifiability for pedagogical research.

The Ritchie-Martin learning motivation test [19] is designed to evaluate students' overall drive to learn. The test comprises a set of thirty questions, each requiring a "yes" or "no" response. Each affirmative answer that aligns with the established criteria earns one point toward the final score, which reflects the individual's level of motivation for studying.

Study of the directionality of changes in cognitive components. Gaining insights into the cognitive mechanisms that underlie task performance and overall mental functioning is crucial for effective studying. In order to comprehensively analyze students' academic performance and research endeavors, it is vital to discern the direction of changes in their cognitive components [20].

The method of expert evaluations of students' academic performance and research activity. A team of experienced educators with ample expertise in teaching and assessing students was engaged to evaluate the academic performance of the participants. The experts meticulously examined academic accomplishments (including grades, written assignments, and other educational tasks) within the distance education context. Regarding research endeavors, various factors such as involvement in research initiatives, publications and conference participation were considered by the specialists when assessing each group's academic performance.

2.5. Analysis of data

The χ^2 criterion, which was determined by (1):

$$\chi 2 = (f1 - f2)2/(f1 + f2) \tag{1}$$

where f 1 i f 2 are the frequencies of the compared samples. Cronbach's alpha coefficient is calculated according to (2):

$$\frac{N}{N-1}\left(\frac{\sigma_x^2 - \sum_{i=1}^{N}\sigma_{Y_i}^2}{\sigma_x^2}\right) \tag{2}$$

where σ_x^2 is the variance of the score of the entire test; $\sigma_{Y_i}^2$ is the dispersion of element i. Values in the range of 0.7-0.8 are considered satisfactory.

Statistical correlation was utilized for analyzing the acquired data. The correlation coefficient was determined through the implementation of the Pearson test [21]:

$$r_{xy} = \frac{\sum(x_i - \ddot{x})*(y_i - \dot{y})}{\sqrt{\sum(x_i - \ddot{x})^2*\sum(y_i - \dot{y})^2}} \tag{3}$$

where x_i is the value of variable X; y_i is the value of variable Y; ẍ is the arithmetic mean for variable X; and ẏ is the arithmetic mean for variable Y.

2.6. Ethical criteria

The research design is based on principles of individual respect, gender equality, non-discrimination, research validity assurance, professionalism and unbiased findings. All stages of the study strictly adhere to widely accepted academic ethical standards for research work. Each respondent was explicitly informed about the crucial aspect of honesty in answering the test questions. Before conducting the research, preliminary consent was obtained from all respondents regarding processing of their data and publication of study results in scientific literature.

3. RESULTS AND DISCUSSION

The cognitive components of students in the control and experimental groups were studied, as shown in Figure 1. Each component (motivational, cognitive, operational, emotional-volitional, ethical-reflective) is represented as a percentage where a higher indicator denotes a greater level of that component. The results indicate that the experimental group outperformed the control group regarding motivation and cognition while the latter displayed superior levels of emotional-volitional components. The ethical-reflective and operational components yielded similar results for both groups.
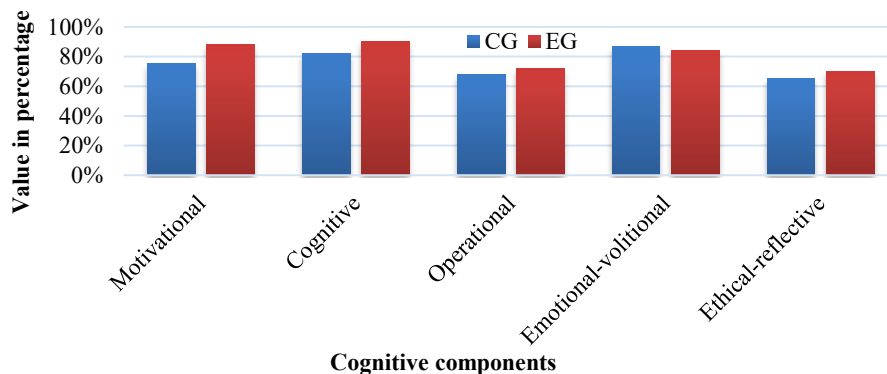

Figure 1. Students' cognitive components at the beginning of the study

Analyzing the data of Figure 1, several important observations can be made. It is noted that the motivational and cognitive components in the experimental group are higher, which may indicate the positive impact of utilizing interactive technologies and intelligent systems on the motivation and cognitive

development of students. This can be useful for improving academic performance and research activity of students. The emotional-volitional component is more pronounced in the control group, which may indicate a difference in emotional state and self-regulation between the groups. This difference can be due to various factors that affect students in the learning process. As far as the ethical-reflective and operational components are concerned, the results of both groups are similar and there are no significant differences between them. The obtained results indicate that the use of technologies not only can contribute to increasing students' motivation and cognitive development, but also can affect their emotional and volitional characteristics. It is imperative to thoroughly examine the underlying factors contributing to these disparities and formulate effective tactics for optimizing these facets within the educational framework. Figure 2 presents the dynamics of students' academic performance in the control and experimental groups. These data will facilitate a more precise exposition of the distance education impact on the educational process.
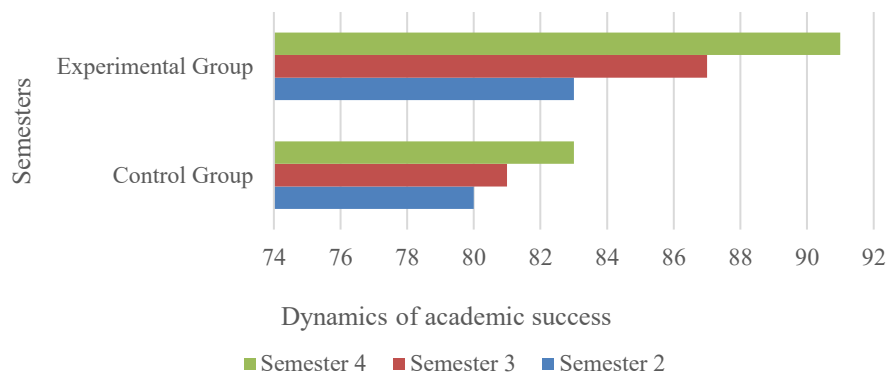
Figure 2. The dynamics of students' academic performance in the control and experimental groups during three semesters

The chi-square value for comparing academic performance between the control and experimental groups after three semesters is 2.15 ($p < 0.05$), indicating a statistically significant difference in academic performance between these two groups of students. Based on the study's results, it is possible to observe certain dynamics in students' success in both groups. Accordingly, students in the experimental group have higher grades on average compared to the control group in all three semesters. This may indicate a positive impact of the use of interactive technologies and intelligent systems on students' academic performance.

The dynamics of students' academic performance indicate several important aspects. First, the experimental group's average grades experienced a notable increase over the course of three semesters. This is compelling evidence that incorporating interactive technologies and intelligent systems into academic settings significantly bolsters student achievement. Second, a smaller increase in grades is visible in the control group. This may indicate the absence of a positive effect on academic performance. These results indicate a potentially positive effect of the use of distance education in stimulating research activity on students' academic success and the possibility of further research in this direction. To understand the dynamics of students' research activity in the conditions of distance education, it is worth paying attention to their motivation. Table 2 presents the motivational profile of students in the control and experimental groups.

Table 2. Motivational profile of students in the control and experimental groups according to the Ritchie-Martin motivational profile method

Group	Need for achievement (%)	Need for recognition (%)	Need for distinction (%)	Need for engagement (%)	Need for control (%)
Experimental group	75	68	42	82	61
Control group	62	56	38	68	53
Mean value	68.5	62	40	75	57

As shown from the Table 2, the mean values for all five components of the motivational profile are higher in the experimental group than in the control group. This may indicate that the students of the

experimental group have more pronounced motivational components aimed at achievement, recognition, engagement and control over results. According to the test results, the p-value (0.053) is more significant than the usual significance level of 0.05. Therefore, the null hypothesis (Hypothesis 0) cannot be rejected at the significance level of 0.05. This means there are no statistically significant differences between the experimental and control groups, according to the Ritchie-Martin motivational profile technique results. Table 3 presents the Pearson correlation between student motivation and change in academic performance for the control and experimental groups.

Table 3. The correlation between students' motivation and academic performance (Pearson's correlation coefficient)

Group	Need for achievement	Need for recognition	Need for distinction	Need for engagement	Need for control
Control group	$r = 0.32$	$r = 0.25$	$r = 0.18$	$r = 0.29$	$r = 0.21$
Experimental group	$r = 0.35$	$r = 0.27$	$r = 0.21$	$r = 0.32$	$r = 0.23$

Table 3 shows positive correlations between various components of student motivation and changes in academic performance for both groups. Correlation coefficients (r) indicate how strongly the motivation variable is related to change in academic performance. Overall, the correlations are weak to moderate, indicating that students' motivation may influence their academic performance, but this influence is insignificant. Analyzing Table 3 of Pearson correlation coefficients for student motivation and academic performance in the control and experimental groups shows a positive correlation between various aspects of student motivation and academic performance. This indicates that students with higher motivation tend to achieve better academic results. The highest level of correlation is observed between the need for engagement and academic success in both groups. This may suggest that students with greater interest in the subject matter are more prone to attaining high academic results.

In the case of the control group, the correlation between the need for recognition and academic performance is also noted as significant. In the experimental group, a similar effect is observed between the need for achievement and academic performance. These results may indicate the importance of motivational factors, such as engagement and the desire to succeed, in influencing students' academic achievement. Motivation plays an important role in the development of students' research activity, especially in the context of contemporary remote learning. Works of Belanger *et al*. [22] and Blizak *et al*. [23] point out that distance education is becoming increasingly popular, but along with it come challenges related to a decrease in student motivation. Several factors determine the ratio of students' motivation and research activity. First, motivation is determined by students' aspirations and objectives regarding their academic pursuits. This study showed that students who are clearly aware of their educational and professional goals are more motivated to succeed in their educational activities. However, the works of [4] and [24] point to the determining role of only intrinsic motivation. The authors refute that external motivation can substantially influence students' research activity.

Another crucial aspect to consider is the framework of the remote learning program. It is imperative to consider the works of Rudina [25] and Demirdağ [26]. If the course is organized in a way that encourages students' active engagement and allows them to explore issues that interest them, this can positively affect their motivation. The obtained results confirm that students who participate in research projects and have the opportunity to choose topics for their research are more actively involved in the educational process and develop excellent research skills.

However, it is crucial to consider that students' motivation may fluctuate based on their circumstances and external factors. It is worth noting that in this context, support from teachers and fellow students is indispensable, as discussed by Ali [27] and Chiu [28]. Importantly, students who feel supported and have a sense of belonging to a group usually have stable motivation and are more prone to developing research skills.

It can be said that students' motivation is a pivotal factor that affects the development of their research activity in the conditions of distance education. Students who have clear educational and professional goals, a willingness to explore independently, and develop their skills tend to attain enhanced academic achievement [29]. The organization of the educational process also plays a crucial and significant function in stimulating students' research activity, allowing them to actively engage with the subject matter and determine the trajectory of their investigative endeavors [30].

Considering these factors, instructors and educational institutions can encourage the advancement of students' research endeavors by creating incentives for their learning, providing support and promoting the development of their motivational resources. To that end, various pedagogical approaches and technologies

can be used to maintain and enhance the students' motivation during distance education. The results of this study have important theoretical and practical implications for the realm of educational and scholarly pursuits. From a theoretical point of view, the present research will contribute to understanding and substantiating the impact of interactive technologies on forming students' research competencies. The study's findings can reveal the mechanisms by which interactive technologies contribute to the development of research skills and foster students' activity in the educational process.

The study provides educators and academic institutions valuable insights on integrating interactive technologies into the educational process. The research findings can be employed by educators to refine their teaching practices and bolster students' research activity. Furthermore, information about open educational space could prove advantageous for universities and learning establishments that plan to expand their scope of distance learning offerings while upholding standards of excellence in instruction.

Owing to the restricted sample size, there is a likelihood that the research findings may not encompass the complete spectrum of diversity within the student population. It should also be considered that some aspects, such as research activity and emotional intelligence, are subjective and can be perceived differently. In addition, the short-term nature of the analysis may not allow obtaining a complete picture of the impact of interactive technologies on the formation of research competencies in the long term. Results may also be affected by external factors (active hostilities) that are difficult to control. The utilized research methodologies may not be unique and may already be used in other studies, potentially yield replicated outcomes, as they may have been previously utilized in similar investigations. Therefore, to acquire more precise and widely applicable results, the sample size should be expanded, subjective factors should be studied in more detail, and the influence of external factors should be considered in further studies.

4. CONCLUSION

The relevance of the research topic lies in the need to train workforce that can proficiently adjust to technological advancements and function as creators and innovators in various fields. The global scenario, particularly in light of the pandemic crisis and a large-scale invasion, has underscored the criticality of enhancing the efficiency of remote learning in Ukrainian academic establishments. Conclusions based on the research findings. The study confirmed that student' motivation is a key factor in their academic performance during distance learning. Students who exhibit higher levels of motivation tend to excel academically. Utilizing remote technologies and intelligent systems can stimulate students' research activity, thereby catalyzing learning and enhancing research skills. The study showed that the stimulation of research activity should consider students' individual traits since different motivational components may impact academic achievement differently. This research underscores the need for further exploration into distance learning and promoting research activities, emphasising leveraging new technologies and methods to enhance education. Field of application. The findings of this study hold great potential for higher education institutions (HEIs) as well as educational platforms to enhance their distance learning offerings. The data collected can be used to design more efficacious courses, teaching methodologies, and approaches aimed at equipping students with the skills necessary to tackle future challenges. Furthermore, these results may be leveraged by developers of distance learning tools and platforms seeking to optimize their products. Prospects for future research. Further studies can examine individual factors, such as the impetus behind research engagement and cognitive aptitudes that foster this pursuit. Additionally, future research may concentrate on refining techniques for measuring students' research activity by devising novel methods to assess this aspect.

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
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