FORMING POSITIVE MOTIVATION OF HIGHER EDUCATION STUDENTS FOR RESEARCH ACTIVITIES

FORMANDO MOTIVAÇÃO POSITIVA DE ESTUDANTES DO ENSINO SUPERIOR PARA ATIVIDADES DE PESQUISA

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Abstract. Scientific research is crucial for academic and professional success. However, many students and postgraduates need more motivation to build their scientific careers. This article aims to address the issue of forming positive motivation among higher education students towards research activities. The technology that fosters positive motivation among higher education seekers towards research activities considers various ways and methods for achieving this goal. The research analyses current theoretical approaches, empirical data, and educational best practices. The proposed view on motivation formation for scientific research encompasses individual and institutional aspects, including the role of mentorship, resource availability, organisation of educational programs, and involvement in real research projects. The article discusses different approaches to stimulating interest and engaging students in scientific activities. It recommends using individual and collective methods, creating a conducive research environment, and utilising external motivational mechanisms. The authors evaluate the effectiveness of these strategies and offer practical recommendations for their implementation in educational institutions. The article determines the levels of positive motivation among higher education seekers towards research activities before and after implementing the proposed technology during a pedagogical experiment. Additionally, it discusses the significance of creating a research culture in educational institutions that will encourage active student participation in research activities and promote their long-term professional development.

Keywords: positive motivation, higher education students, research activity, professional training, higher education institutions, vocational education.

Resumo. A investigação científica é crucial para o sucesso académico e profissional. No entanto, muitos estudantes e pós-graduados necessitam de mais motivação para construir as suas carreiras científicas. Este artigo

tem como objetivo abordar a questão da formação de motivação positiva entre estudantes do ensino superior para atividades de pesquisa. A tecnologia que promove a motivação positiva entre os candidatos ao ensino superior para atividades de investigação considera várias formas e métodos para atingir este objetivo. A pesquisa analisa abordagens teóricas atuais, dados empíricos e melhores práticas educacionais. A visão proposta sobre a formação da motivação para a pesquisa científica abrange aspectos individuais e institucionais, incluindo o papel da mentoria, a disponibilidade de recursos, a organização de programas educacionais e o envolvimento em projetos reais de pesquisa. O artigo discute diferentes abordagens para estimular o interesse e envolver os alunos em atividades científicas. Recomenda o uso de métodos individuais e coletivos, a criação de um ambiente de pesquisa propício e a utilização de mecanismos motivacionais externos. Os autores avaliam a eficácia destas estratégias e oferecem recomendações práticas para a sua implementação em instituições de ensino. O artigo determina os níveis de motivação positiva entre os candidatos ao ensino superior para atividades de investigação antes e depois da implementação da tecnologia proposta durante uma experiência pedagógica. Além disso, discute a importância de criar uma cultura de investigação nas instituições de ensino que incentive a participação activa dos estudantes em actividades de investigação e promova o seu desenvolvimento profissional a longo prazo.

Palavras-chave: motivação positiva, estudantes do ensino superior, atividade de investigação, formação profissional, instituições de ensino superior, ensino profissional.

1. INTRODUCTION

Developing positive motivation among higher education students towards research activity is crucial in modern education and the academic community. It is vital for several reasons, including the advancement of science and technology, academic growth and career prospects, addressing global challenges, attracting talented students, and enhancing the prestige of education. Research activity is a driving force for progress and innovation across various fields of knowledge. Active participation in research contributes to developing critical thinking, analytical skills, teamwork abilities, and other valuable skills. These skills are valuable in academic and industrial spheres and can lay the foundation for a successful career in science, teaching, industry, or the public sector. Contemporary challenges, such as climate change, pandemics, and energy security, require an interdisciplinary approach and scientific research to address them. Researchers who are motivated can make a significant contribution to finding solutions to these problems.

Universities and research institutes actively supporting research can attract talented and ambitious students. It enhances the educational institution's reputation and contributes to the influx of funding and resources. Student involvement in research work can enhance the prestige of higher education, making it more attractive to potential applicants and society. Increased student interest and participation in research activities can contribute to the development of critical thinking skills, data analysis, teamwork, and other key competencies that may be useful in their future careers. Increasing interest in research activity is essential, but it is equally important to form positive student motivation. It can help them realise the prospects and opportunities for career advancement in science and research. Expanding the number of interested students can contribute to improving research projects and works, ultimately leading to scientific discoveries and innovations.

The development of positive motivation among higher education students towards research activity is crucial for the growth of society's intellectual capital and the personal development of future specialists.

Purpose of the study

This research aims to encourage positive motivation among higher education students towards research activities. It will help to stimulate their interest, develop their scientific potential, prepare them for career advancement, and enhance the quality of their research

work. The development of positive motivation among higher education students towards research activities can be multifaceted and depends on factors such as increasing student interest and participation in research, fostering the development of students' scientific potential, preparing for career advancement, and improving the quality of research work.

Objectives of the study

1. To analyse the existing literature and research on the formation of positive motivation of higher education students for research activities.
2. To review the ways and means of forming a positive motivation of higher education students for research activities.
3. To outline the pedagogical technology for implementing positive motivation in higher education students for research activities.
4. To propose methods for assessing the formation of positive motivation of higher education students for research activities.

2. LITERATURE REVIEW

Forming positive motivation among higher education seekers towards research activity is essential as it contributes to the development of scientific talent and societal progress overall (Tran et al., 2022; Castriconi, 2023). Authors emphasise the importance of creating a stimulating environment in educational institutions that encourages interest in research activity (Jiang et al., 2023; Landberg, & Partsch, 2023). It may involve organising research groups, holding seminars and conferences, as well as providing access to modern equipment and literature (Babenko et al., 2023; Batsurovska, 2021). Researchers highlight the importance of mentoring and support from experienced scientists (Blau et al., 2020).

Mentors often inspire students and postgraduates to be engaged in research, helping them identify their interests and develop professional skills (Bin et al., 2022; Espina-Romero et al., 2023). The authors also focus on demonstrating scientific research's practical significance in motivating students (Castaño-Muñoz, & Rodrigues, 2021; Cui, 2019). Seeing how their work can yield tangible results and contribute to science or society can enhance their motivation for research activity (Grynova et al., 2022).

Attention is also drawn to the importance of establishing a system of rewards and recognition for students involved in research (Li et al., 2021). It may include scholarships, awards, publications, and teaching opportunities (Popova, & Rina, 2020). Authors suggest integrating research activity directly into the educational process so that students can gain professional experience and apply their knowledge in practice (Poyasok et al., 2019).

It is also essential to consider students' individual interests and motives (Popescu et al., 2019). Not all students are equally interested in research, so it is essential to create flexible programs that allow each student to develop according to their interests and goals (Chen, 2022). Overall, forming positive motivation towards research activity requires a comprehensive approach that considers the diversity of students' needs and motivations, as well as creates conditions for their successful development in the scientific field.

3. METHODS

The following methods were used to study the issue of forming the positive motivation of higher education students for research activities.

Questionnaires and surveys. A common method that allows to identify the motives, interests and needs of higher education students in research activities. Questionnaires and surveys may include questions about preferences in research, interest in participating in research projects, and assessment of the current incentive to research.

Focus groups. This method allows gathering a small group of higher education students to discuss and analyse their motivation and perception of research activities. Focus groups help to identify stronger motivations and reasons for research interest.

Qualitative interviews. Conducting in-depth interviews with individual higher education students allows a more detailed examination of their motivations and views on research. This method can be beneficial for identifying individual factors that influence motivation.

Quantitative research. The use of statistical methods of data analysis to study correlations between various factors (e.g., parents' education level, access to scientific resources, participation in scientific events) and the motivation of higher education students to be engaged in research.

Longitudinal studies. Conducting research over time allows tracking changes in the motivation and interest of higher education students in research under the influence of various factors, such as the educational programme, participation in research projects, and pedagogical methods.

4. RESULTS

Forming positive motivation among higher education seekers towards research activity is crucial for developing the scientific community and innovative economy. Scientific research plays a vital role in societal development and increasing knowledge levels. Figure 1 illustrates the technology of forming positive motivation among higher education seekers towards research activity, which is based on pathways and methods of motivation formation. The proposed technology's implementation involves providing practical experience opportunities, teacher and research supervisor support, creating a stimulating environment, holding motivational events, raising awareness of the value of scientific work, supporting publication of results, and creating competitive programs and scholarships.

Providing students with opportunities for practical experience in research is a crucial aspect of their education, particularly in higher education institutions. There are several ways to offer such opportunities, including scientific clubs and societies, research internships and programs, scientific conferences and symposiums, research competitions and grants, research laboratories, scientific-practical courses, and scientific journals and publications.

Universities can establish scientific clubs and societies to facilitate student discussions on current topics, idea proposals, and independent research under the guidance of experienced research supervisors. Developing specialised research programs, where students can select projects based on their interests and work on them under the supervision of experienced teachers and researchers, is a relevant way to gain practical experience. Encouraging students to publish their research results in scientific journals can help them gain recognition and disseminate their ideas. Providing students with opportunities for practical experience in research activities can help them develop critical thinking and teamwork skills and gain valuable experience that will benefit their future academic or professional careers.

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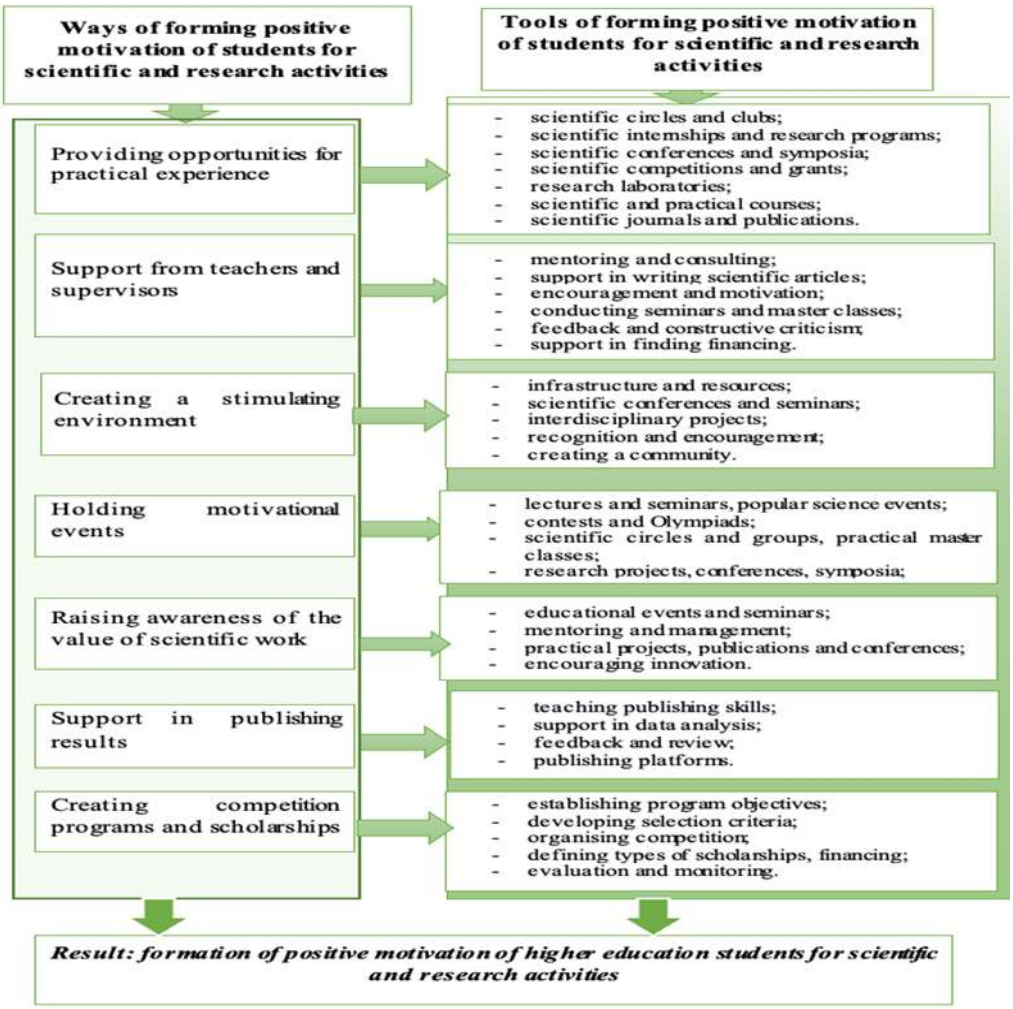

Figure 1. Technology of Forming Positive Motivation of Higher Education Students for Research Activities

Active support and mentorship from experienced researchers can significantly enhance the motivation of students and postgraduates towards research activity. They can provide support through mentoring and counselling, assisting with scientific article writing, conducting seminars and workshops, and offering feedback and constructive criticism. Additionally, they can provide encouragement, motivation, and support in seeking funding. Research supervisors and teachers can act as mentors and consultants, guiding students in identifying research directions, developing methodologies, analysing data, and interpreting results. They can also provide access to literature and information resources, laboratories, equipment, and other tools necessary for conducting research. The authority and support of research supervisors can serve as an incentive for students to continue their research.

To create a stimulating research environment for students, a comprehensive approach and various tools are required. These tools include infrastructure and resources, scientific conferences and seminars, interdisciplinary projects, recognition and encouragement, and community building. It is also essential to ensure that students have access to experienced research supervisors who can assist them in selecting research topics and directions. Providing students with opportunities to obtain grants or scholarships to finance their research projects can be a powerful incentive for active research activity.

Providing students with access to necessary resources, such as library databases, laboratories, equipment, and software, and organising regular scientific conferences, seminars, and discussion forums where students can present their research, exchange

experiences with colleagues, and receive feedback from experts, can be a powerful tool for fostering positive motivation. Educational institutions must constantly strive to create a stimulating environment for student research activity. It requires attention and effort but can significantly enhance students' motivation and interest in science.

Organising motivational events for students to engage in research activities, such as lectures and seminars, popular science events, contests and Olympiads, scientific clubs and groups, practical workshops, research projects, conferences, and symposiums, interactive events can significantly increase interest in this field and stimulate active participation in research activities. Organising lectures and seminars and inviting leading specialists in relevant fields to conduct workshops and discussions can enhance students' interest in specific research topics. Popular science lectures and meetings with successful scientists and researchers can contribute to disseminating practical experience and serve as a vivid example of motivation. Organising scientific contests and Olympiads and creating scientific clubs or groups where students can discuss their ideas, receive feedback from teachers and peers, and conduct joint research can stimulate students to conduct research.

Conducting practical workshops on research methods, including data analysis, literature review, experimentation, and organising student conferences and symposiums, provides a platform for students to present their research results and exchange experiences with colleagues. Interactive events such as intellectual games, quests, and creative projects promote the development of creative thinking and generate interest in science.

Educating students and postgraduates about the significance of scientific research for the development of society and solving real-world problems can help them realise the value of their participation in scientific activities. Special lectures, seminars, and workshops can be held to teach students about the importance of scientific research, contributing to opportunities for personal and professional growth. Encouraging students to publish their research results in scientific journals and participate in scientific conferences can help them understand how their work can contribute to the academic community and be recognised by experts in the field.

Stimulating collaboration and idea exchange among students from different fields of knowledge can help them understand how scientific work intersects with other areas and how their research can have numerous applications. Supporting students in seeking innovative approaches to problem-solving and conducting research can contribute to fundamental societal changes and improvements. Organising a system of evaluation and feedback will enable students to understand the results they have achieved through their scientific research and how they can improve them.

Supporting the publication of scientific articles and participating in scientific conferences and symposiums can help students and postgraduates receive feedback from the scientific community, develop skills such as publication skills, data analysis, feedback, and peer review, and see the results of their work in the press. Conducting seminars, courses, and workshops on writing scientific articles, formatting, and publication layout can improve the quality of the publication process in scientific journals.

Providing access to online platforms for publishing articles designed for students and novice researchers, as well as organising competitions, awards, and events, can encourage students to engage in active scientific activities and publish the results of their research. Encouraging student participation in scientific conferences and symposiums, where they can present their research and receive feedback from colleagues and experts, and supporting the publication of students' results are essential in shaping their scientific potential and preparing them for further careers in the scientific field.

Introducing competitive programs and scholarships for the most active and promising researchers can stimulate interest and motivation in scientific activities. The main stages for

this task include defining program goals, developing selection criteria, organising competitions, determining types of scholarships and funding, and evaluating and monitoring progress. Criteria for selecting competition participants and scholarship recipients may include academic achievements, participation in research projects, publications, and recommendations from teachers and research supervisors. The development of the competition procedure, including submission deadlines, criteria for evaluating applications, and the composition of the jury, should adhere to the principles of transparency and fairness in the selection process.

Scholarships may vary depending on the program's needs and goals, including academic achievement, support for specific scientific directions, and conference participation. Evaluating the program's effectiveness and impact on students' research activity should be based on participant feedback to make improvements and adjustments.

The proposed technology results in the formation of positive motivation among higher education seekers towards scientific research activities. A pedagogical experiment was conducted in the study involving 143 higher education seekers. The control group consisted of 71 students, while the experimental group consisted of 72 students.

Table 1 presents the levels of positive motivation towards scientific research activities in the control (CG) and experimental groups (EG) at the beginning and end of the experiment. The table includes the percentage and number of higher education seekers who acquired positive motivation in both groups before and after the experiment. Higher education seekers can be motivated to engage in scientific research activities at high, sufficient, and low levels.

Table 1. Levels of Forming Positive Motivation of Higher Education Students for Research Activities

Level	Before the experiment				After the experiment			
	%, (EG)	Quantity, (EG)	%, (CG)	Quantity, (CG)	%, (EG)	Quantity, (EG)	%, (CG)	Quantity, (CG)
High	8	6	10	7	34	25	16	11
Sufficient	37	26	41	29	51	36	42	30
Low	55	40	49	35	15	11	42	30
In total	100.0	72	100.00	71	100.00	72	100.00	71

Before the experiment, there were no significant differences in the percentage values of positive motivation formation among higher education seekers towards scientific research activities. However, after the experiment, the indicators of the experimental group, who were taught using the proposed technology, significantly differed from those of the control group.

Figure 2 compares the formation of positive motivation towards scientific research activities among higher education seekers in the control and experimental groups before the experiment.

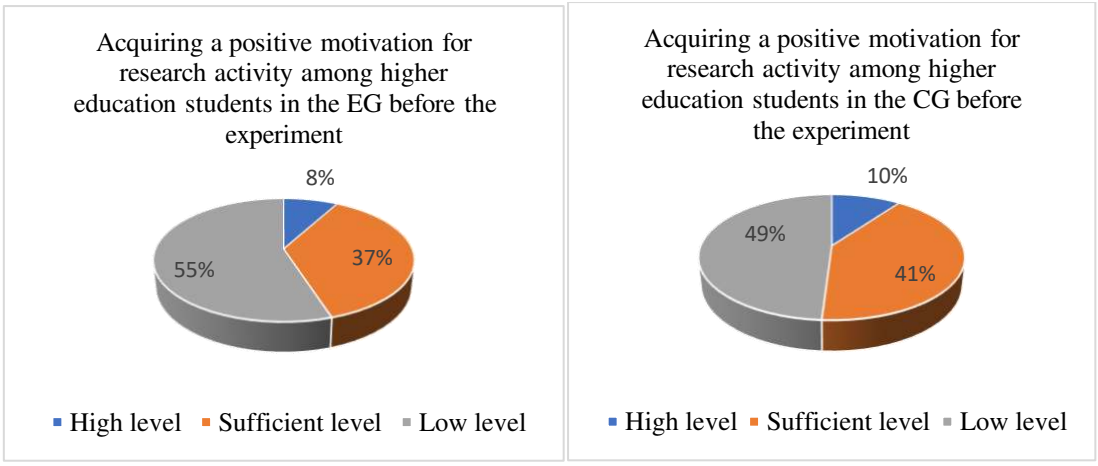

Figure 2. Contrasting the Formation of Positive Motivation of Higher Education Students for Research Activities in the Control and Experimental Groups before the Experiment

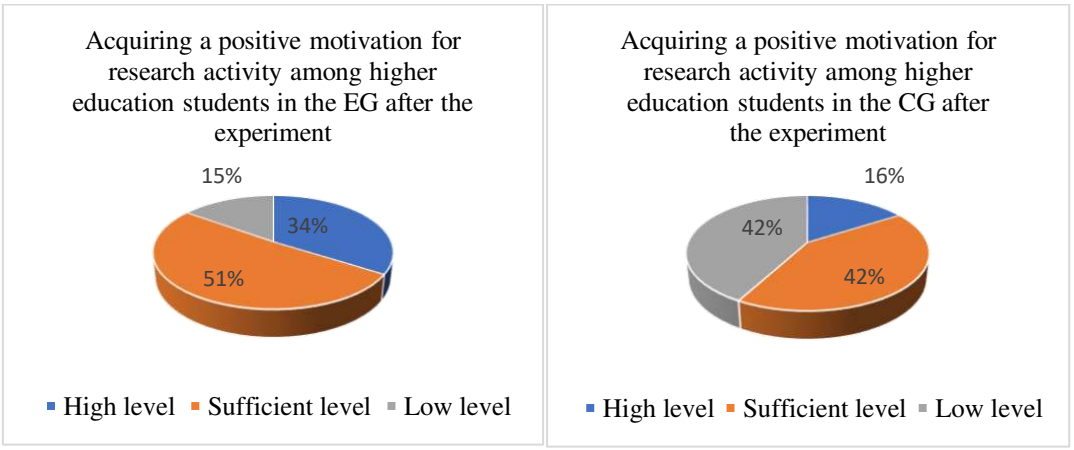

Figure 3. Contrasting the Formation of Positive Motivation of Higher Education Students for Research Activities in the Control and Experimental Groups After the Experiment

Figure 3 illustrates the difference between the formation of positive motivation of higher education students for research activities in the control and experimental groups after the experiment.

Following the implementation of the proposed technology, the indicators in the experimental group showed significant differences. Specifically, the indicators of the high level increased by 26%, the sufficient level increased by 14%, while the indicators of the low level decreased by 40%. In contrast, the control group did not show any significant differences. It demonstrates the effectiveness of the proposed technology in fostering positive motivation among higher education students for research activities.

5. DISCUSSION

Developing positive motivation among higher education students towards scientific research activities is crucial to enhancing scientific potential in society. To achieve this goal, it is essential to consider several factors and principles, such as the significance of scientific research, a stimulating environment, support and encouragement, integration into the educational process, skill and competency development, and an individualised approach (Mebert et al., 2020; Menezes et al., 2021). Demonstrating the value of scientific research activity and its potential to benefit society is crucial for students and prospective students (Ivaskiv, & Neroda, 2019). Motivation can be enhanced by highlighting how their research

can contribute to science, technology, or societal issues. Creating a supportive and stimulating environment for scientific work is critical to fostering positive motivation. Access to modern laboratories, equipment, mentorship, and research publication opportunities are essential for scientific research (Post et al., 2019; Yilmaz, 2021).

Integrating research into the educational process can provide students with early research experience (Wang et al., 2021). It can be achieved through course projects, summer schools, internships, etc. To excel in scientific research, students must develop essential analytical and critical thinking, communication, and teamwork skills. Offering opportunities to cultivate these skills will foster motivation for scientific activity. As students have diverse interests and goals, it is crucial to provide a personalised approach to stimulate scientific activity (Li et al., 2022). It may include choosing a research topic and working with a specific academic supervisor. However, forming positive motivation among higher education seekers towards scientific research has advantages and disadvantages.

Advantages of participating in scientific research activities include the development of analytical and critical thinking skills, the ability to systematise and generalise information, increased career opportunities, and professional skill development (Yang et al., 2019; Wang et al., 2020). Experience in scientific work can increase the likelihood of higher education seekers being admitted to prestigious study programs, obtaining scholarships, and pursuing careers in scientific and academic fields. Students engaged in scientific research gain skills in working with databases, conducting experiments, analysing data, and writing scientific articles, which can benefit their future professional activities.

Disadvantages of participating in scientific research include the need for temporary and financial resources, uncertainty of results, limited access to resources, and lack of motivation. Students with other commitments or financial constraints may need help to invest significant time and money in scientific research. Additionally, scientific activity is often associated with uncertainty of results and possible failures, which may discourage some higher education seekers (Horváth, 2023).

Not all universities have sufficient resources to support scientific research, which may limit students' participation opportunities. Some students may need to see the value of scientific activity for their future career or personal development, which can reduce their motivation to participate (Ulappa et al., 2022; Liu, 2024). Overall, fostering a positive motivation among higher education students towards scientific research activity is an essential aspect of their educational and professional development, despite some drawbacks.

6. CONCLUSION

Effective motivation formation starts with generating interest in scientific research. Universities and research institutes can create stimulating environments, such as scientific seminars, conferences, and courses, to engage students and young researchers. Leadership and mentoring are crucial in forming motivation. Young researchers require support and guidance during the execution of their research projects. In addition to interest, students must possess the necessary skills for successful research. It includes training in research methods, data analysis, results publication, and scientific works presentation. Higher education seekers need to have opportunities for self-realisation in the scientific field. It may include participation in scientific competitions, obtaining grants, and presenting their work at international conferences.

Universities and research institutes should support and encourage research activity among students and young researchers. It can be achieved through the allocation of financial and infrastructural resources, as well as the creation of motivational programs and scholarships. Higher education seekers need to understand how their scientific work can contribute to the development of science and society, helping them to see the purpose and value of their

activities. A comprehensive approach is required to successfully motivate higher education seekers towards scientific research activities. It includes stimulating interest, providing support from educational and scientific organisations, developing professional skills, and creating opportunities for self-realisation.

REFERENCES

Babenko, D., Dotsenko, N., & Gorbenko, O. (2023). Technology of creation term papers in electrical engineering disciplines in the online learning environment. *IEEE 5th International Conference on Modern Electrical and Energy System (MEES*), 1-5. https://doi.org/ 10.1109/MEES61502.2023.10402391.

Batsurovska, I. (2021). MOOCs in the system of E-learning of Masters in Electrical Engineering. *IEEE International Conference on Modern Electrical and Energy Systems (MEES)*, 1-4. https://doi.org/10.1109/MEES52427.2021.9598641.

Blau, I., Shamir-Inbal, T., & Avdiel, O. (2020). How does the pedagogical design of a technology-Enhanced collaborative academic course promote digital literacies, self-Regulation, and perceived learning of students? *The Internet and Higher Education, 45*, 100722. https://doi.org/10.1016/j.iheduc.2019.100722.

Bin, H., Zhang, Y., Zhu, Z., Lin, Y., Zhan, Y., & Ma, J. (2022). Research on the influence of collaborative mind mapping strategy in smart classroom on college students' scientific research problem-solving ability and learning Aanxiety. *International Symposium on Educational Technology (ISET)*, 23-27. https://doi.org/10.1109/ISET55194.2022.00014.

Castaño-Muñoz, J., & Rodrigues, M. (2021). Open to MOOCs? Evidence of their impact on labor market outcomes. *Computers & Education, 173*, 104289. https://doi.org/10.1016/j.compedu.2021.104289.

Castriconi, R., Placidi, L., Avanzo, M., Cirio, R, Gallo, P, Mazzilli, A., Milano, A., Rancati, T., Russo, P. & Garibaldi, C. (2023). Survey on the interest and commitment of AIFM members to scientific activities (SicAS). The initiative of the FutuRuS working group. *Physica Medica, 110*, https://doi.org/102589. 10.1016/j.ejmp.2023.102589.

Chen, D. (2022). Practice on the data service of university scientific research management based on cloud computing. *World Automation Congress (WAC),* 424-428. https://doi.org/10.23919/WAC55640.2022.9934710.

Cui, Y. (2019). Second classroom model for cultivating intercultural communication competence of practicality-oriented talents considering state transition matrix. *International Conference on Robots & Intelligent System (ICRIS)*, 376-381. https://doi.org/10.1109/ICRIS.2019.00101.

Grynova, M., Shvedchykova, I., Soloshych, I., Bunetska, I., & Soloshych, S. (2022). Project approach in the formation of scientific and research competence of students of energy specialties. *IEEE 4th International Conference on Modern Electrical and Energy System (MEES)*, 1-4. https://doi.org/10.1109/MEES58014.2022.10005742.

Espina-Romero, L., Guerrero Alcedo, J., & Ossio, C. (2023). 7 topics that business ecosystems navigate: Assessment of scientific activity and future research agenda. *Heliyon, 9*, e16667. https://doi.org/10.1016/j.heliyon.2023.e16667.

Horváth, L. (2023). Model organised theoretical and experimental research in collaborative space. *IEEE 17th International Symposium on Applied Computational Intelligence and Informatics (SACI)*. https://doi.org/10.1109/SACI58269.2023.10158625.

Ivaskiv, R., & Neroda, T. (2019). Designing the integrated multi-user media platform for educational and scientific research support: Activating of student cognitive activity through team work in academic library creative space. *IEEE 14th International Conference on Computer Sciences and Information Technologies (CSIT)*, 39-43. https://doi.org/10.1109/STC-CSIT.2019.8929880.

Jiang, D., Dahl, B., Chen, J., & Du, X. (2023). Engineering students' perception of learner agency development in an intercultural PBL (Problem- and Project-Based) team setting. *IEEE Transactions on Education, 66*(6), 591-601. https://doi.org/10.1109/TE.2023.3273177.

Landberg, M., & Partsch, M. (2023). Perceptions on and attitudes towards lifelong learning in the educational system. *Social Sciences Humanities Open, 8*, 100534. https://doi.org/10.1016/j.ssaho.2023.100534

Li, H., Majumdar, R., Chen, M.-R., & Ogata, H. (2021). Goal-oriented active learning (goal) system to promote reading engagement, self-directed learning behavior, and motivation in extensive reading. *Computers Education, 171*, 104239. https://doi.org/10.1016/j.compedu.2021.104239

Li, H., Tang, Y., & Huang, G. (2022). STEAM curriculum design and practical research: training students' scientific advanced thinking ability. *10th International Conference on Information and Education Technology (ICIET)*, 244-249. https://doi.org/10.1109/ICIET55102.2022.9779031.

Liu, X., Wu, X., & Zhang, W. (2024). A new DEA model and its application in performance evaluation of scientific research activities in the universities of China's double first-class initiative. *Socio-Economic Planning Sciences, 92*, 101839. https://doi.org/10.1016/j.seps.2024.101839.

Mebert, L., Barnes, R., Dalley, J., Gawarecki, L., Ghazi-Nezami, F., Shafer, G., & Yezbick, E. (2020). Fostering student engagement through a real-world, collaborative project across disciplines and institutions. *Higher Education Pedagogies, 5*, 30-51. https://doi.org/10.1080/23752696.2020.1750306

Menezes, F., Rodrigues, R., & Kanchan, D. (2021). Impact of collaborative learning in electrical engineering education. *Journal of Engineering Education Transformations, 34*, 116-117. https://doi.org/10.16920/jeet/2021/v34i0/157117

Popova, M., & Rina, N. (2020). Transdisciplinary system for student youth educational and research activities support. *IEEE 15th International Conference on Computer Sciences and Information Technologies (CSIT),* 320-323. https://doi.org/10.1109/CSIT49958.2020.9321894.

Popescu, D., Roibu, H., Abagiu, M.-M., Popescu, R., Popescu, L.-C., & Petrisor, A. (2019). Research as a part of education – a case study of engaging students in research activities. *29th Annual Conference of the European Association for Education in Electrical and Information Engineering (EAEEIE)*, 1-7. https://doi.org/10.1109/EAEEIE46886.2019.9000437.

Post, L. S., Guo, P., Saab, N., & Admiraal, W. (2019). Effects of remote labs on cognitive, behavioral, and affective learning outcomes in higher education. *Computers & Education, 140*, 103596. 1 doi: 0.1016/j.compedu.2019.103596

Poyasok, T., Bespartochna, O., & Dniprovska, T. (2019). Formation of scientific and research competence of future electrical engineers. 2019 IEEE International Conference on Modern Electrical and Energy Systems (MEES), 450-453. doi: 10.1109/MEES.2019.8896518.

Tran, V. D., Pham, D. T., Nguyen, H., Pham, T., Nguyen, C., Nguyen, T. H., & Dewey, R. (2022). Involvement of pharmacy students in scientific research activities in Vietnam. *Currents in Pharmacy Teaching and Learning, 14*. https://doi.org/10.1016/j.cptl.2022.06.004.

Ulappa, A., Stieha, V., Smith, D. B., & Oxford, J. T. (2022). Gateway scholars program - reducing barriers to STEM for undergraduate students through scholarship and supportive programs. *International Conference on Computational Science and Computational Intelligence (CSCI),* 2129-2132. https://doi.org/10.1109/CSCI58124.2022.00384.

Wang, N. et al. (2020). Cultivate students' innovation ability based on the follow-up study of contest problems. *International Conference on Big Data and Informatization Education (ICBDIE),* 199-202. https://doi.org/10.1109/ICBDIE50010.2020.00052.

Wang, J., Tigelaar, D. E. H., & Admiraal, W. (2021). Rural teachers' sharing of digital educational resources: From motivation to behavior. *Computers & Education, 161*, 104055. https://doi.org/10.1016/j.compedu.2020.104055

Yang, X., Zhao, G., Zhao, Q., & Yan, X. (2019). The Relationship between students' scientific epistemological beliefs and their performance of knowledge integration in web-based inquiry. *Eighth International Conference on Educational Innovation through Technology (EITT),* 19-24. https://doi.org/10.1109/EITT.2019.00013.

Yilmaz, M. (2021). Undergraduate in-class research experience for computer architecture students. *International Conference on Computational Science and Computational Intelligence (CSCI),* 1001-1007. https://doi.org/10.1109/CSCI54926.2021.00218.