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# PSYCHOLOGICAL READINESS OF TEACHERS FOR THE ORGANIZATION OF STUDENT STEM PROJECTS

Ⓐ *This article investigates the psychological readiness of teachers to organize student STEM projects in general secondary education institutions. The relevance of the issue is highlighted by the state policy aimed at strengthening scientific and technical education, particularly the need to rebuild the country after the Russian-Ukrainian war.*

*The study presents the results of an online survey of 15 teachers of the natural and mathematical cycle, which summarize the problems into three main groups: professional training, material and technial base, and scientific and methodological support.*

*Key factors influencing psychological readiness were identified, including the level of preparation for innovative methods, self-assessment, the importance of professional development, and support from colleagues and the administration.*

**Keywords:** *psychological readiness; teachers; STEM education; student projects; professional development*

## ПСИХОЛОГІЧНА ГОТОВНІСТЬ УЧИТЕЛІВ ДО ОРГАНІЗАЦІЇ STEM-ПРОЄКТІВ УЧНІВ

Ⓢ *Досліджено психологічну готовність педагогів до впровадження STEM-навчання в закладах загальної середньої освіти. Проаналізовано результати опитування вчителів природничо-математичного циклу на основі виокремлення трьох ключових чинників впливу на їхню педагогічну діяльність: професійну підготовку, матеріально-технічну базу та науково-методичний супровід.*

*Висвітлено роль проєктного менеджменту як інструменту подолання освітніх втрат учнів, зокрема через використання вчителями відповідних методик. Особливу увагу приділено психологічним бар'єрам у педагогічних працівників, а також методам їх подолання через створення професійних спільнот, систему мотивації та поступову інтеграцію STEM-елементів у навчанні учнів.*

*Доведено, що системна підтримка з боку адміністрації та неперервний професійний розвиток педагогічних працівників є вирішальними для формування впевненості вчителів у реалізації інноваційних освітніх проєктів.*

**Ключові слова:** *психологічна готовність; учителі; STEM-освіта; учнівські проєкти; професійний розвиток*

***The relevance of the problem in general and its connection with important practical tasks.*** The formation of teachers' research competencies and students' research competencies in general secondary education institutions (GSEIs) are integral components of the formation of modern education aimed at realizing the abilities of participants in the educational process in solving important practical problems. According to the Concept for the Development of Science and Mathematics Education (STEM Education), approved by the Cabinet of Ministers of Ukraine (CMU) on 05.08.2020, No. 960-р [3], the main tasks for its implementation include mastering by participants of the educational process (PEP) the means of cognitive and practical activity, developing skills of practical and creative application of acquired knowledge. According to the order of the Ministry of Education and Science of Ukraine (MES) of 09.10.2024 №1438 "On the implementation of an innovative educational project at the

all-Ukrainian level on the topic "Scientific and methodological support of STEM education in educational institutions" in September 2024 – December 2027" [6] The state policy is aimed at strengthening the development of scientific and technical areas of education, which is due to a number of reasons, one of which is the need to rebuild the country after the end of the Russian-Ukrainian war.

***Analysis of previous studies and publications.*** The idea of forming research skills of PES by means of STEM education is not new. The general aspects of its implementation are devoted to the research of the authors [4], who define advantages, problems, and opportunities of the conceptual foundations of the New Ukrainian School (NUS), peculiarities of professional activities of teachers in the development of STEM education; methodological principles of project and research activities of the UOP. Innovative ideas about the prospects of STEM, the peculiarities of using project technologies, the problems of preparing teachers for their use in practice are revealed in the publications of I. Tymofeeva and O. Hnatiuk [8], Y. Matviichuk [5]. The study of the role of STEM education in the formation of creativity and innovative thinking of students, their active practical activity and creative experiment are reflected in the scientific materials of N.V. Andrushchenko, E.P. Sirik, O.M. Shevchenko [1]. STEM education is often considered in conjunction with project management in order to combine students' research activities with national and patriotic education, deepen students' knowledge of the history of Ukraine, form national identity and develop a sense of pride in their country, as reflected in our publication [2]. Thus, the study of the role of STEM education in the formation of PBL competencies is an urgent issue of the present, which requires further comprehensive and integrated study.

***Highlighting the previously unresolved parts of the general problem to which this article is devoted.*** One of the areas of STEM education implementation in general secondary schools is the introduction of project management for primary school students (grades 4) and students in grades 5-9 as an extracurricular course to overcome educational losses. The program of this course was developed by the team of the MriyDiy Educational Foundation as part of a project from the United Nations Children's Fund (UNICEF) [7] and is designed for a two-month period of study for students. Among the project management tools, the MriyDiy team suggests using the following: brainstorming, Gantt chart, problem tree, stakeholder map, 5 Why method. According to the plan of the proposed course, students will study the following topics: familiarization with the concept of "project", team formation and project ideas, brainstorming, defining project goals and objectives, project planning and resources, project budget and resource mobilization, project risks and evaluation, and project presentation. Teaching students project management in accordance with the course plan developed by the MriyDiy team involves appropriate teacher training. However, in addition to direct teacher training through offline and online courses, there is a need to identify the psychological readiness of teachers to teach project management as one of the areas of STEM education in general secondary education.

***Formulation of the objectives of the article.*** The aim of the study is to monitor the psychological readiness of teachers to implement STEM education in general education institutions.

***Presentation of the main research material.*** To achieve this goal, we will analyze the results of an online survey of a group of teachers (15 people) of the natural and mathematical cycle of Chernihiv Gymnasium No. 35. The results of the survey can be summarized into three main groups of problems:

1. Readiness and professional training of teachers.

2. Material and technical base as a factor of psychological confidence.

3. Scientific and methodological support as a psychological resource.

1. The assessment of teachers' psychological readiness to implement STEM education shows a heterogeneity in the level of teachers' confidence and experience. According to the survey, 73.3% of teachers consider themselves fully prepared to implement STEM projects, and 26.7% are partially prepared. These data emphasize the importance of supporting teachers in the process of organizing STEM education, in particular through training and professional development.

The psychological readiness of teachers also depends on their participation in professional development courses. Half of the surveyed teachers have already taken STEM courses, but there are those who have not yet had this experience. This indicates the need not only for technical training, but also for psychological support to help teachers overcome barriers of uncertainty and doubts about their own abilities.

2. The availability of material and technical resources is an important element that affects the psychological readiness of teachers to organize STEM projects. The survey has shown that all respondents have access to resources such as 3D printers and 3D pens, which is a positive factor for the implementation of STEM elements. However, despite this, insufficient funding and the lack of some equipment remains one of the key problems identified by teachers.

In order for teachers to feel confident in their ability to organize student STEM projects, it is important to provide them not only with the necessary technical tools, but also with the confidence to use these tools effectively. Improving facilities and developing training materials can reduce stress and uncertainty among teachers, increasing their willingness to innovate.

3. Methodological support and availability of scientific and methodological materials are also important factors in teachers' psychological readiness to implement STEM projects. According to the survey, there are in-house developments such as clubs and electives and methodological recommendations. However, teachers continue to feel the need for additional methodological support and recommendations for the effective implementation of STEM approaches.

The lack of confidence in their own abilities may be partly due to the insufficient level of preparation of teachers to work with innovative approaches. Methodological recommendations and professional STEM communities can become a psychological resource that will help teachers feel more competent in the new environment by creating a network of support and experience exchange.

Thus, the psychological readiness of teachers to organize student STEM projects is a complex phenomenon that depends on three important factors: professional training, logistical support, and scientific and methodological support.

In this article, we will focus on one of the determining factors in ensuring the psychological readiness of teachers to organize student STEM projects, namely, the professional training and development of teachers. Regardless of the availability of technical resources and methodological support, teachers' confidence in their knowledge and skills plays a key role in implementing STEM education. Without proper preparation, which includes in-service training and continuous professional development, teachers may feel uncertain and fearful of innovation. Therefore, the focus should be on creating conditions for continuous learning and development of teachers, which will increase their readiness and effectiveness in working with STEM projects.

What aspects influence the psychological readiness of teachers in terms of their professional training and development? In our opinion, the following aspects can be included:

1) The level of teachers' preparation for innovative teaching methods.

It is important to analyze how ready teachers are to implement new educational approaches, including STEM education. Teachers who have completed professional development courses have a better chance of successfully implementing STEM projects, as they gain not only theoretical knowledge but also practical skills in working with innovative technologies. In this context, we can draw attention to the differences in the training of teachers who have taken professional development courses and those who have not had such an opportunity.

2) Self-assessment of teachers' readiness to implement STEM education.

The psychological readiness of teachers to innovate often depends on how they assess their own capabilities in this area. In the survey, the majority of teachers indicated that they are fully prepared or partially prepared to implement STEM education. This can be seen as a positive aspect, but it is also important to find out why some teachers feel partially ready and what they need to be fully confident in their abilities.

3) The importance of professional development and training.

It is necessary to consider how pedagogical development through ongoing trainings, seminars, and courses can contribute not only to improving professional knowledge but also to increasing the psychological readiness of teachers to work with STEM projects. Training provides teachers with the tools to effectively use new methods, technologies, and approaches, which in turn increases their confidence.

4) Support from the administration and colleagues.

An important factor in psychological readiness is the support that teachers receive from their colleagues and administration. If a teacher sees that his or her efforts to implement STEM education are supported, it has a positive impact on his or her psychological state and motivation. We can focus on the role of administrative support as a factor that shapes teachers' positive attitudes toward innovation.

5) Motivation and interest of teachers in STEM education.

Teacher motivation is also a key aspect of readiness. Psychologically prepared teachers who are interested in developing new teaching methods are more enthusiastic about organizing STEM projects. However, for many teachers, this can be a new and unusual experience that requires changes in teaching approaches and additional efforts to master new technologies.

6) Obstacles to professional development.

We cannot ignore the difficulties that teachers may face when taking a professional development course or other professional training. Problems may include lack of access to courses, lack of time due to workload, or budget constraints. This can affect the psychological readiness of teachers, as they feel a lack of support in their professional development.

7) Psychological barriers to implementing new methods.

In addition to purely professional aspects, it is worth paying attention to the psychological barriers that teachers face when implementing STEM education. These may include fears of novelty, lack of time, or self-doubt. Since the STEM approach requires a new approach to teaching, it is important for teachers to realize how these changes may affect their usual ways of working.

We support the opinion of [4], and believe that "a teacher's readiness for innovative professional and pedagogical activity is a special personal state that implies the presence of a teacher's motivational and value attitude to professional and pedagogical activity, possession of effective ways and means of achieving pedagogical goals, and the ability to pedagogical creativity and reflection". In other words, the process of introducing new ideas often encounters resistance due to the conservative approach of educators who adhere to traditional ideas about their profession. They believe that a teacher should have a perfect command of their subject knowledge, and consider everything else unnecessary. To overcome such obstacles, teachers need not only to clearly justify a new idea, but also to show courage in implementing it.

In order for teachers to achieve this state of overcoming psychological barriers, the following ways of overcoming them can and should be offered (tabl.1):

*Table 1*

**Strategies for Enhancing Teachers' Psychological Readiness for STEM Education Implementation**

| Support and Development Measures | Motivational and Methodological Resources |
|---|---|
| Providing professional support and professional development | Psychological counseling and support for colleagues |
| Integrating STEM into daily practice through small steps | Supporting professional reflection through scientific and methodological materials |
| Creating a positive learning environment and team culture | Motivation through recognition of achievements and results |

Regular courses, trainings, and seminars for teachers aimed at developing skills in STEM education help to remove the fear of novelty. Creating programs that combine theoretical content with practical tasks will help teachers gain the necessary knowledge and confidence. It is also important to organize the exchange of experience between teachers through professional communities or support groups.

Introduce psychological support programs for teachers, including counseling and training to overcome stress and psychological strain. It is also important to organize opportunities for teachers to share experiences and support each other in the

process of implementing new teaching methods. This will help teachers to develop internal motivation and self-confidence.

Instead of trying to implement large and complex projects at once, you can start with small steps. These can be small research tasks, integrating STEM elements into regular lessons, or creating small group projects. This approach allows teachers to gradually adapt to new methods and not feel overwhelmed.

Developing and providing teachers with access to scientific and methodological materials and guides will help increase their confidence in professional reflection. The use of methodological recommendations and developments will provide teachers with a clear understanding of effective methods of organizing STEM projects, which will avoid uncertainty about the results and improve the quality of their teaching.

Developing cooperation between teachers, encouraging them to work in teams, and creating an atmosphere of mutual support will help overcome feelings of isolation and promote creative approaches to STEM projects. Working together helps teachers overcome barriers, exchange ideas and experiences, and increases their psychological readiness.

Regular recognition of teachers' and students' achievements in implementing STEM projects stimulates additional motivation. This can be either public recognition of achievements at the level of the educational institution or at higher levels (city, regional,

national). Teachers who see the results of their work feel proud of their achievements, which increases their motivation to continue working.

***Conclusions from this study.*** The psychological readiness of teachers to organize STEM projects depends on professional training, material and technical support, and methodological support. For the successful implementation of STEM education, it is important to create conditions where teachers feel competent, confident and motivated. This includes the provision of resources, teaching materials, a favorable psychological climate, support from colleagues and administrators, and recognition of their work. Only under these conditions can effective implementation of STEM education and preparation of students for modern challenges be achieved.

***Prospects for further research.*** Further research can be aimed at developing and testing effective methods and tools for psychological preparation of teachers for the implementation of STEM education, as well as at studying the impact of various factors (e.g., work experience, level of education, motivation) on the psychological readiness of teachers to organize student STEM projects. It is also important to study the impact of teachers' psychological readiness on students' performance in STEM projects and to develop recommendations for improving the effectiveness of STEM education based on the results obtained.

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