

## FACTORS OF SELF-EDUCATIONAL COMPETENCE DEVELOPMENT OF TEACHERS AND STUDENTS OF A TECHNICAL UNIVERSITY BASED ON STEM EDUCATION<sup>1</sup>

*The article examines the role of STEM education (Science, Technology, Engineering, and Mathematics) in developing self-educational competence in teachers and students at technical universities. It emphasizes the importance of self-education in the modern world, where rapid changes require continuous updating of knowledge and skills for future professionals to maintain competitiveness and efficiency in the current job market. The article highlights the relevance of self-educational competence in the context of globalization and the information society, where the ability to independently acquire new knowledge and adapt to changing conditions is vitally necessary. In this regard, the author proposes a comprehensive approach to the implementation of STEM education, which includes the integration of interdisciplinary knowledge, practical experience, and the use of innovative teaching methods. The article's author asserts that such an approach contributes not only to the development of professional competencies but also to the formation of flexible thinking, critical analysis, and creativity.*

*To support the presented theses, the article provides results of empirical studies that demonstrate the positive impact of STEM education on the self-education process. The author analyzes various strategies and methods of self-education for teachers and students that can be integrated into the educational process of technical universities and recommends ways to optimize curricula to enhance the effectiveness of self-educational activities.*

*The objectives of the article are as follows: to analyze the significance of self-educational competence in the modern educational space and its importance for the professional development of individuals, to characterize the main components of self-educational competence and their role in personal and professional development, and to consider the role of STEM education in the development of self-educational competence of teachers and students at a technical university.*

**Key words:** *self-education, competence, teachers, students, technical university, STEM education, motivation, innovative projects.*

The topic of self-educational competence of teachers and students is becoming increasingly relevant in the modern educational space. In the context of rapid changes occurring in the world, higher education institutions face the necessity of constantly updating knowledge and skills, which requires a high level of self-educational activity from educators and the student community.

Self-education as a competence implies an individual's ability to independently acquire new knowledge, skills, and abilities, which is a necessary condition for professional development and maintaining the relevance of the education received. It becomes key in the conditions of living in an information society, where information quickly becomes outdated, and technologies develop at a rapid pace.

For teachers, self-education is a fundamental requirement of the profession, as they must not only impart knowledge but also be an example of educational motivation and independent intellectual development. A teacher who systematically engages in self-education can more effectively adapt to changes in curricula, implement innovative teaching methodologies, and be more competent in their subject area. Students, on the other hand, also need to develop self-educational competence in order to successfully compete in the job market and be prepared for continuous professional growth.

Higher education institutions should pay special attention to the formation of skills in independent learning, critical thinking, analysis, and synthesis of information, which will allow graduates to be self-sufficient in their intellectual development.

The relevance of self-educational competence is also intensified by globalization processes. We live in a world where knowledge and experience of other cultures and economies are becoming more accessible than ever before, which requires educational institutions and their students to be ready for intercultural communication and collaboration.

Overall, self-education is important not only for individual development but also for the progress of society as a whole. Educational institutions that support and stimulate self-educational activity make a significant contribution to the formation of an innovative, creative, and competitive society. Investments in the development of self-educational competence are investments in the future, which will ensure the sustainability and flexibility of the educational system, as well as its relevance to the challenges of the modern world.

Features of STEM education in the modern educational space: STEM education is characterized by an integrated approach to learning scientific disciplines, where the emphasis is on the practical application of knowledge and the development of critical thinking. It fosters the formation of a comprehensive understanding of real-world problems and requires individuals to take an active stance in their learning and independent problem-solving.

**The purpose of the article** is to analyze the theoretical foundations of self-educational competence and the role of STEM education in the development of this competence in teachers and students of a technical university.

Self-educational competence is the ability of an individual to independently plan, organize, and carry out the learning process with the aim of self-improvement and professional development. In the context of STEM

<sup>1</sup> Статтю подано мовою оригіналу.

education, this means the ability of teachers and students to integrate cutting-edge technologies, scientific methods, and engineering solutions into their educational and professional paths.

STEM-education promotes the development of self-educational competence at several levels:

Firstly, it stimulates interest in learning through practical application of knowledge and solving real-world problems.

Secondly, it requires continuous updating of knowledge to keep pace with rapid changes in science and technology.

Thirdly, STEM education develops the ability to think critically and analyze, which are key components of self-educational competence. Students learn to ask questions, investigate problems, and seek new ways of solving them, which encourages independent learning and continuous development.

Fourthly, the integration of project-based activities into the educational process gives students the opportunity to work in a team, exchange knowledge and experience, which also contributes to the development of self-educational competence, as it teaches them to learn from one another.

Fifthly, STEM education motivates students to learn through engagement in innovative projects and research, which opens up prospects for them to impact the development of society and the economy. This creates a sense of responsibility and a desire to improve their knowledge and skills.

Impact on the educational space and society: STEM education makes a significant contribution to the development of the educational space and society as a whole. It prepares professionals capable of solving complex problems, thinking innovatively, and adapting to rapidly changing workplace conditions. This contributes to economic growth, technological progress, and enhances a country's competitiveness on an international level. STEM education is one of the key elements of modern education, playing an important role in the development of self-education competencies. It not only provides a deep understanding of scientific principles and technological processes but also develops skills necessary for successful adaptation in an ever-changing world. That is why investments in STEM education are investments in the future of education and society.

STEM education holds significant importance in the modern educational landscape for several reasons:

1. Labor Market Relevance: the requirements of the modern labor market are changing rapidly, creating a demand for professionals with knowledge and skills in STEM fields who can adapt to new conditions and challenges.

2. Innovative Development: STEM education fosters innovative thinking and prepares individuals capable of creating new technologies and improving existing ones.

3. Social Implementation: STEM education allows for the cultivation of a conscious civic stance, as it provides tools for understanding and solving social problems through technical and scientific approaches.

4. Personal Development: STEM education promotes the development of critical thinking, creativity, teamwork abilities, and other important skills that ensure successful personal adaptation in a rapidly changing world.

Therefore, STEM education is a key element of the modern educational space, which not only prepares specialists for work in high-tech industries but also promotes the development of self-educational competence necessary for continuous professional growth and personal development.

Let us analyze the theoretical foundations of self-educational competence. Self-educational competence is the ability and readiness of an individual for independent learning throughout life, which includes motivation for learning, mastery of self-learning methods and techniques, the ability to independently plan, organize, and analyze one's educational process, as well as the ability to apply the acquired knowledge and skills in practical activities [1].

The components of self-educational competence can include:

1. Motivational component: internal motivation for learning, understanding the importance of continuous personal development and professional growth.

2. Cognitive component: knowledge about how to organize the learning process, including defining learning objectives, selecting resources for learning, effective time management, and various learning strategies.

3. Operational-activity component: possession of practical self-education skills, such as techniques for memorization, critical thinking, self-analysis, and reflection.

4. Emotional-volitional component: the ability to overcome difficulties that arise in the process of self-education, and to develop endurance and self-discipline.

5. The communicative component: the ability to communicate effectively, exchange information, work in a team, which is also an important aspect of self-education, especially in the modern information society.

6. The metacognitive component: awareness and regulation of one's own cognitive processes, such as understanding, memorization, and thinking, which allows an individual to adapt to various learning conditions and optimize their learning process.

The development of self-educational competence is key for adapting to the rapidly changing conditions of the modern labor market, as well as for personal development and self-fulfillment. Self-education plays a fundamental role in the professional development of an individual, as it is one of the main means of maintaining the relevance of knowledge and skills in a fast-changing world. Let us characterize the main aspects that highlight the importance of self-education in professional development:

– Adaptation to change: the modern job market requires flexibility and the ability to quickly adapt to new technologies, work methods, and professional standards. Self-education allows an individual to timely respond to these changes, maintaining their knowledge and skills at a contemporary level.

– Professional growth: continuous deepening and expansion of professional knowledge and skills through self-education contribute to career advancement. This may include obtaining additional qualifications, certifications, or even retraining for work in a new field.

– Maintaining competitiveness: in today's world, professionals who invest time and resources in self-education are able to maintain a high level of competitiveness in the job market, as they constantly improve their competencies.

– Development of critical thinking: independent acquisition of knowledge fosters the development of critical thinking and analytical abilities, which are important for solving complex professional tasks.

– Personal growth: self-education is also important for personal development, as it promotes self-actualization, boosts self-esteem, and helps to develop self-discipline.

– Flexibility in learning: self-education allows an individual to independently choose the pace, time, and methods of learning, making the process more efficient and comfortable.

– Accessibility of resources: thanks to the Internet and modern technologies, access to knowledge has become extremely broad and convenient, allowing anyone to engage in self-education at any convenient time and from any place. This opens doors to a plethora of online courses, webinars, educational platforms, electronic libraries, and other resources.

– Cost savings: traditional education can be expensive, while self-education often offers less costly or even free alternatives for developing professional knowledge.

– Individual approach: self-education allows focusing on specific interests and needs, choosing only those materials and courses that best match personal and professional goals.

– Supporting life balance: self-education allows for better coordination of learning with other aspects of life, such as work, family, and recreation, contributing to overall well-being.

In totality, these aspects emphasize that self-education is not only necessary for professional development, but it also enables a more fulfilling, balanced, and satisfied life. STEM education is an approach to learning that integrates science, technology, engineering, and mathematics into a single educational process. In a technical university, where the main focus is on training specialists in engineering and technology, STEM education occupies a key position. The basic principles, foundations of STEM education, and the practical application of STEM approaches in the self-education of future engineers can be characterized as follows:

1. Interdisciplinary approach: when implementing STEM education, the learning process is organized in such a way that instead of isolated study of individual subjects, students see connections between different scientific disciplines and understand their application in the real world. Self-education using STEM approaches encourages students to explore the connections between different scientific disciplines, which helps to form a deeper understanding of the material. STEM unites various disciplines, allowing students to see the links between science, technology, engineering, and mathematics. This helps them better understand how theoretical knowledge can be applied in practical situations.

2. Development of critical thinking and problem-solving: STEM education emphasizes the importance of analytical skills, the ability to ask questions, analyze information, solve problems, and make informed decisions. It promotes the development of critical thinking by giving students the opportunity to analyze problems, ask questions, evaluate evidence, and develop reasoned conclusions. In the learning process, students learn to use logical thinking and empirical evidence to solve complex tasks, analyze problems from different perspectives, use logic and mathematical models for their resolution, which is the basis of engineering activity.

3. Practical Experience: STEM education focuses on the practical application of theoretical knowledge, which helps students understand how their learning impacts the real world. This encourages them to seek creative solutions to real-world problems, which in turn develops critical thinking. Learning often includes hands-on laboratory work, projects, experiments, and actual research, which allow students to apply theoretical knowledge in practice. Practical experience is a key element of STEM education. Future engineers can use internships, laboratory work, and real engineering projects to refine their skills.

4. Collaboration and Communication: within STEM education, students often work in groups, which develops the ability to collaborate and communicate effectively. These skills are important for the development of critical thinking and creative abilities of future professionals. Group projects and teamwork are important as they help develop communication, leadership, and interaction skills, which are critically important in the modern work environment.

5. Use of Technology and Technological Literacy: the active use of modern technologies, including computer modeling, programming, robotics, artificial intelligence, etc., is an integral part of STEM education. Using modern technologies in self-education allows students to improve their skills in working with the latest equipment and software, which is critically important for engineers. Technology is a key element of STEM and can be used to support self-education. From virtual laboratories to programming and 3D modeling, technology allows students to experiment and refine their technical skills.

6. Project-Based Learning: STEM education often includes learning through problem-solving, where students face challenges that require the integration of knowledge from different disciplines. This practical application of knowledge requires critical thinking to identify the problem, develop strategies to solve it, and evaluate the results. The development and implementation of projects that solve real problems allow students to see the value of their

work and contribute to a deeper understanding of the material. Future engineers can independently implement projects that require the integration of knowledge from different STEM disciplines. This allows them to develop technical skills and gain experience in solving real engineering problems.

7. Support for Research and Innovation, Development of Research Skills: STEM education promotes creativity as it encourages innovation and design thinking. Students have the opportunity to create new products, processes, or solutions using their acquired knowledge and skills. This involves working with real problems that require an interdisciplinary approach and innovative thinking, stimulating students to conduct their own research and develop innovative projects. STEM approaches promote independent research, data analysis, and conclusions, which are important for scientific and engineering work.

Let's consider the key concepts of developing self-educational competence among teachers at higher technical education institutions. Continuous professional development of teachers is a key aspect in supporting and developing the quality of education. It includes a number of important aspects:

- Knowledge updating: scientific and technological knowledge is constantly evolving, so teachers need to update their knowledge to provide students with current information and modern approaches to learning.
- Pedagogical development: learning new teaching and assessment methodologies can improve the educational process, making it more effective and interesting for students.
- Development of professional competence: professional development helps teachers to enhance their leadership, communication, and student community management skills, which is important for creating a productive learning environment.
- Compliance with modern educational standards: systematic updating of professional knowledge and skills helps teachers meet national and international educational standards.
- Motivation and job satisfaction: teachers who continuously improve themselves often feel more satisfied with their work, which positively affects their motivation and productivity.
- Qualification enhancement: professional training can lead to additional qualifications, which can increase a teacher's chances of professional growth and career opportunities.
- Development of research skills: teachers who engage in research can apply their findings in the educational process, enriching the students' experience and contributing to the development of the subject's scientific base.
- Meeting the needs of society: teachers who understand and respond to changes in society and the labor market can better prepare students for future challenges and careers.
- Enhancing reputation: teachers who continuously improve professionally are respected by students and have a high reputation among the student community, which enhances the quality of education.

To successfully enhance the level of self-educational competence among teachers, there are methods and techniques of STEM education that are supported by leading technical universities. Self-education of teachers in the STEM field is key to supporting the values of STEM education and its implementation into the educational process. Here are some methods and techniques that can facilitate self-education for teachers in this area:

- Online courses and webinars: teachers can participate in various online courses and webinars that cover different STEM topics. This allows them to update their knowledge and skills and learn about the latest pedagogical strategies and technologies.
- Professional communities and networks: joining professional communities, such as STEM teacher associations, can provide access to resources, knowledge sharing, and experience exchange with peers.
- Conferences and seminars: participation in conferences and seminars gives teachers from different disciplines the opportunity to learn about new research and best practices in STEM education.
- Pedagogical innovations: experimenting with innovative pedagogical methods, such as project-based learning, teamwork, critical thinking, and creative tasks, can increase the level of engagement and motivation of teachers for self-education.
- Independent learning through research: teachers can develop their knowledge by conducting their own research or experiments in the STEM field, as well as analyzing the results and implementing them into the teaching process.
- Use of technologies: mastering new technologies, such as programming, robotics, and digital laboratories, can help teachers stay at the forefront of scientific and technological progress.
- Interdisciplinary approach: integrating knowledge from different STEM disciplines allows teachers to expand their horizons and use a comprehensive approach to professional development.
- STEM Teaching Centers: general approaches and tools are discussed that can be useful for educators in the STEM field, such as the use of mathematical software (e.g., MATLAB, Mathematica, Maple), online courses and educational platforms (Coursera, Khan Academy), interactive whiteboards, multimedia presentations, forums, and online communities (e.g., Stack Exchange, MathOverflow), as well as Learning Management Systems (LMS) like Moodle and Blackboard. These tools can be used within existing STEM teaching centers or to create new programs and initiatives for professional development.

Self-directed learning is one of the important aspects of the development of students at technical universities, playing a key role in their personal and professional growth. It involves the student's deliberate individual work on expanding and deepening their knowledge and skills beyond the mandatory curriculum.

In the context of technical education, where the pace of technological change is extremely high, self-education becomes not just desirable, but a necessary element to maintain the relevance of professional competencies [2].

Students who actively engage in self-education are better able to adapt to new challenges and labor market demands, making them more competitive and innovative. The self-education process is a purposeful activity of the individual aimed at acquiring new knowledge, abilities, and skills without the direct participation of a teacher. Project-based activities play a significant role in the self-education of students, as it promotes the development of a range of key skills and competencies that are important for their academic and professional growth. This process can be informal or non-formal and includes several key components:

- Motivation: internal or external motivation is necessary to initiate the process of self-education. This could be a desire to improve professional qualifications, personal development, interest in a specific topic, and so on.
- Goal setting: defining clear goals and tasks that need to be achieved through self-education. Students should determine what knowledge and skills they need to develop to achieve their professional activities.
- Planning: developing a self-education plan that includes the selection of educational materials, methods, and learning techniques, as well as the allocation of time for studying.
- Organization of the learning environment: creating conditions for effective learning, ensuring access to necessary resources and materials.
- Practical experience: project activities allow students to apply theoretical knowledge in practice, which contributes to a better understanding of the study material and its application in real-life situations.
- Development of research skills: while working on projects, students learn to formulate problems, find and analyze information, evaluate data sources, and develop research methodology.
- Critical thinking: project work stimulates students to critically analyze information, develops the ability to think independently, and make reasoned decisions.
- Teamwork skills: many projects involve collaborative work, which helps students develop communication, interaction, and teamwork skills, which are important for the modern work environment.
- Personal development: project activity contributes to the development of independence, responsibility, organization, as well as the ability to set goals and achieve them.
- Adaptation to change: in the process of working on projects, students learn to adapt to changes, solve unforeseen problems, and look for alternative ways to achieve goals.
- Professional self-determination: working on projects helps students better understand their interests and professional inclinations, and the needs of various industrial sectors.

Let's consider the prospects for the development of self-educational competence among teachers and students in the context of STEM education. The promising directions of research in the field of STEM are very diverse and constantly evolving in response to new challenges and technological advancements. Here are some of the most relevant directions:

1. Artificial Intelligence and Machine Learning: development of algorithms to improve automated data processing, pattern recognition, reinforcement learning, neural networks, and autonomous systems.
2. Biotechnology and Genetic Engineering: research in the field of CRISPR, genome editing, synthetic biology, and the development of new pharmaceuticals and therapies.
3. Renewable Energy and Sustainable Development: development of more efficient solar panels, wind turbines, energy storage methods, and energy consumption management systems.
4. Quantum Technologies: research in the field of quantum computing, quantum cryptography, and the development of quantum sensors.
5. Robotics and Automation: creation of robots for industry, medicine, space exploration, and personal use.
6. Space Research: development of new spacecraft, exploration of deep space, and plans for the colonization of other planets.
7. Nanotechnology: creation of materials and devices at the atomic and molecular levels for application in electronics, medicine, and materials science.
8. Information Security: development of new methods to protect data and systems from cyber attacks.

**Conclusions.** Thus, the self-educational competence of teachers and students is critically important for their professional development and competitiveness in the modern world. STEM education encourages students to engage in scientific research and innovation, conduct their own research, which is the foundation for the development of new technologies and methods. It supports research that can lead to significant discoveries and technological progress of society.

The development of self-educational competence through STEM education is an important element of the modern educational system, promoting the formation of a deep understanding of scientific principles and technological processes, developing critical thinking and analytical skills, problem-solving, practical application of knowledge, and teamwork, and, as a result, preparing professionals capable of solving complex problems and adapting to rapidly changing working conditions.

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#### **Суліма О. В. Фактори розвитку самоосвітньої компетентності викладачів та студентів технічного університету на основі STEM-освіти**

У статті розглядається роль STEM-освіти (Science, Technology, Engineering, and Mathematics) у розвитку самоосвітньої компетентності викладачів та студентів у технічних університетах. Акцентується на важливості самоосвіти в сучасному світі, де швидкі зміни вимагають постійного оновлення знань та навичок майбутніх фахівців для підтримки конкурентоспроможності та ефективності на сучасному ринку праці. Стаття висвітлює актуальність самоосвітньої компетентності у контексті глобалізації та інформаційного суспільства, де життєво необхідним є вміння самостійно здобувати нові знання та адаптуватися до змінюваних умов. У зв'язку з цим автор пропонує комплексний підхід до впровадження STEM-освіти, який включає інтеграцію міждисциплінарних знань, практичний досвід та використання інноваційних методів навчання. Авторка статті стверджує, що такий підхід сприяє не тільки розвитку фахових компетенцій, але й формуванню гнучкості мислення, критичного аналізу та креативності.

Для підтвердження висунутих тез у статті представлені результати емпіричних досліджень, які демонструють позитивний вплив STEM-освіти на самоосвітній процес. Автор аналізує різні стратегії та методи самоосвіти викладачів та студентів, які можуть бути інтегровані у навчальний процес технічних університетів, і рекомендує шляхи оптимізації навчальних планів з метою підвищення ефективності самоосвітньої діяльності.

Завдання статті полягають у наступному: проаналізувати значення самоосвітньої компетентності в сучасному освітньому просторі та її важливість для професійного розвитку індивідів, охарактеризувати основні компоненти самоосвітньої компетентності та їх роль в особистісному та професійному розвитку, розглянути роль STEM-освіти у розвитку самоосвітньої компетентності викладачів та студентів технічного університету.

**Ключові слова:** самоосвіта, компетентність, викладачі, студенти, технічний університет, STEM-освіта, мотивація, інноваційні проєкти.

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#### **РОЛЬ ШКІЛЬНОГО ПІДРУЧНИКА В ЗАБЕЗПЕЧЕННІ ЕМОЦІЙНОГО БЛАГОПОЛУЧЧЯ ЗДОБУВАЧІВ БАЗОВОЇ СЕРЕДНЬОЇ ОСВІТИ**

Статтю присвячено актуальній проблемі оновлення змісту шкільних підручників, визначено роль підручника в забезпеченні емоційного благополуччя, зокрема, розглянуто його вплив на емоційний інтелект здобувачів базової середньої освіти. Зазначено, що найбільшої уваги потребує саме емоційний компонент психологічного здоров'я, схарактеризовано поняття емоційного благополуччя як складової психологічного здоров'я, зроблено висновок про синонімічність понять емоційного здоров'я та благополуччя. У статті наголошується на тому, що підручники мають бути не просто засобом передачі інформації, а й сприяти гармонізації емоційного стану учнів. Отже, постають питання актуальності оновлення змісту підручників та необхідності розширення критеріїв експертизи наукових видань з урахуванням впливу сучасних реалій на емоційну сферу здобувачів освіти. Особливу увагу приділено психолого-педагогічним вимогам до підручника, що сприятимуть ефективності навчання та особистісному розвитку учнів. Запропоновано наступні вимоги: наявність завдань для гармонізації емоційної сфери, відсутність психотравматичних текстів, доступність основного тексту, наявність додаткового тексту, що впливає на емоційну сферу учнів, відсутність стереотипів, висока якість ілюстрацій, оптимальне співвідношення матеріалів, які активізують правопівкульне мислення та лівопівкульне мислення. Проаналізовано шляхи вдосконалення підручників, оцінено відповідність чинних підручників з української мови та історії України вищезазначеним вимогам. Зроблено висновок про вплив цих вимог на учнів, їх загальний розвиток та про необхідність удосконалення підручників на основі впровадження елементів, спрямованих на підтримку емоційного благополуччя, розвитку емоційного інтелекту та емоційної стійкості.

**Ключові слова:** емоційне благополуччя, емоційне здоров'я, психологічне здоров'я, емоційний інтелект, здобувачі базової середньої освіти, шкільний підручник, вимоги до підручника, урахування аспектів емоційної складової.