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Methodology for Developing Entrepreneurial Skills in Engineering Students

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Abstract: This article examines the methodology for developing entrepreneurial skills in engineering sciences. Special attention is given to fostering and enhancing entrepreneurial competencies among students in the fields of electronics and mechatronics. The article highlights the necessity of training innovative and competitive specialists who meet the demands of the modern labor market. A three-stage methodology for entrepreneurial skill development has been designed, encompassing preparation, practical implementation, and outcome evaluation. The methodology aims to integrate technical knowledge with entrepreneurial skills, enabling students to build successful careers in the industry. Additionally, the article provides insights into sources for generating business ideas and practical recommendations for students embarking on entrepreneurial activities.

Keywords: Entrepreneurship, engineering education, electronics, mechatronics, competencies, innovations, labor market, third-generation universities, startups, practical education.

Introduction: Fundamental transformations are taking place in the organizational structure of leading higher education systems worldwide, leading to the emergence of third-generation universities. These institutions prioritize the development of entrepreneurial competencies aligned with the demands of the modern labor market, emphasizing project-oriented and innovation-driven training of specialists [1, 2].

LITERATURE REVIEW

An analysis of the experiences of higher education institutions in developed countries reveals that, in highly competitive labor markets, it has become

essential to adopt entrepreneurship-oriented educational models for training highly qualified specialists [3, 4]. Entrepreneurship plays a crucial role in ensuring the stable development of national economies, facilitating technical and technological modernization, and enabling the adoption of new types of products. Furthermore, it serves as a primary source for supplying domestic markets with essential goods and services. Engineering students often limit their learning to understanding the structure and operation of technical devices and systems, as well as acquiring design skills. However, this approach does not guarantee them stable employment in the labor market or a consistent personal income. Addressing this issue, it is crucial to develop and enhance entrepreneurial competencies among students in technical higher education institutions [5, 6]. Highly skilled and competitive professionals in this field are among the key drivers of a nation's economic development [7]. Therefore, conducting research on effective methods for teaching future engineers to engage in entrepreneurial activities and developing corresponding methodologies are among the most pressing tasks of both the present and the future.

How Can Entrepreneurial Readiness and Competencies Be Developed Among Engineering Students in Higher Education Institutions?

Research Methodology. Nowadays, as higher education institutions (HEIs) are increasingly required to fulfill the "third mission" entrepreneurship education, research, and outreach activities are becoming standard practices in technical universities. Therefore, developing a methodology to enhance entrepreneurial skills among students, particularly in the fields of electronics and mechatronics, is of great importance in modern education and industry [8].

The importance of improving the methodology for developing entrepreneurial skills among students in the fields of electronics and mechatronics encompasses the following key factors [9, 10]:

- The innovative nature of emerging electronic technology devices in the industry.
- Stable competitiveness compared to other types of electronic technology;
- Technological startups related to the selected electronic technology;
- Demand for specialists capable of working freely with multifunctional electronic technology;
- Collaboration with businesses and small enterprises serving small and medium-power consumers;
- Encouraging scientific research and innovations in

electronic technology within education;

- The global trend of education based on real-world practice, application, and operation;
- Ensuring energy efficiency and economic growth through self-financing.

Based on the aforementioned factors, developing a technology for enhancing entrepreneurial skills among students in the fields of electronics and mechatronics is well-founded and relevant. This is because it helps graduates acquire not only technical expertise but also the entrepreneurial competencies necessary for a successful career in modern industries. From this perspective, the primary goal in designing a technology for fostering entrepreneurial skills among students is to establish a systematic and effective approach to developing the essential abilities, knowledge, and competencies required for successful entrepreneurial activity. In order to developing this technology, the following key aspects were identified as foundational principles:

- Adaptation to modern realities: the strategic demand for technology and energy requires considering economic changes and technological trends to prepare students for working in today's industry and business;
- Practical orientation: students should be able to apply the knowledge and skills they acquire in practice, such as assembling electronic equipment. This includes creating real business projects, participating in startup initiatives, and collaborating with business partners;
- Multimedia approach: utilizing various educational resources such as webinars, online courses, practical assignments, mentorship, and more allows students to acquire knowledge in a format that best suits their learning preferences;
- Integration with the educational process: the technology should be incorporated into the curriculum to complement traditional teaching methods, ensuring a comprehensive approach to developing entrepreneurial skills;
- Developing creative thinking: the enhancement of entrepreneurial competencies should encourage students to develop creative and innovative thinking, enabling them to generate new ideas and solve complex problems;
- Mentorship support: key element of the technology is the presence of experienced entrepreneurs and experts who act as mentors and advisors, helping students develop their projects and business plans;
- Evaluation and feedback: The technology should provide an assessment and feedback system,

allowing students to track their progress and improve their skills based on constructive recommendations.

The essence of the technology for developing entrepreneurial skills lies in creating a comprehensive and innovative approach that helps students become successful and creative entrepreneurs capable of adapting to the rapidly changing business world [10, 11, 12].

Analysis and Results. Based on the key factors and aspects mentioned above, a three-stage methodology for developing entrepreneurial skills among students in the fields of electronics and mechatronics has been developed (Figures 1, 2, 3). Stage 1 is dedicated to preparation and analytical assessment. Stage 2 focuses on experimental testing and practical implementation. The final stage, is dedicated to evaluation and analysis of the results.

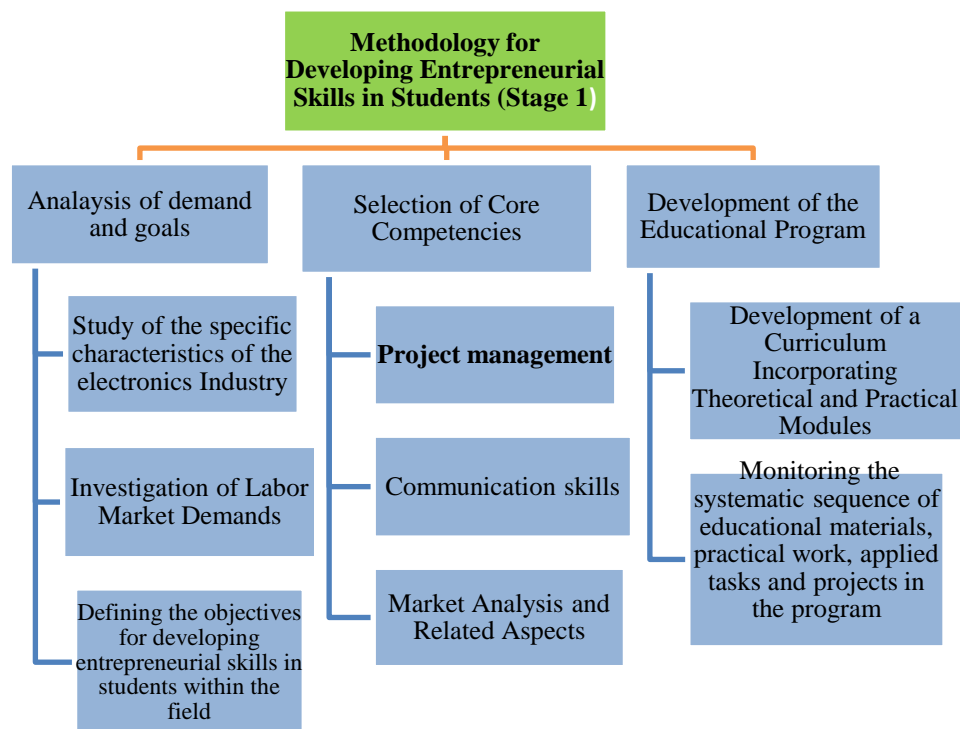


Figure 1. Methodology for Developing entrepreneurial skills in students (Stage 1)

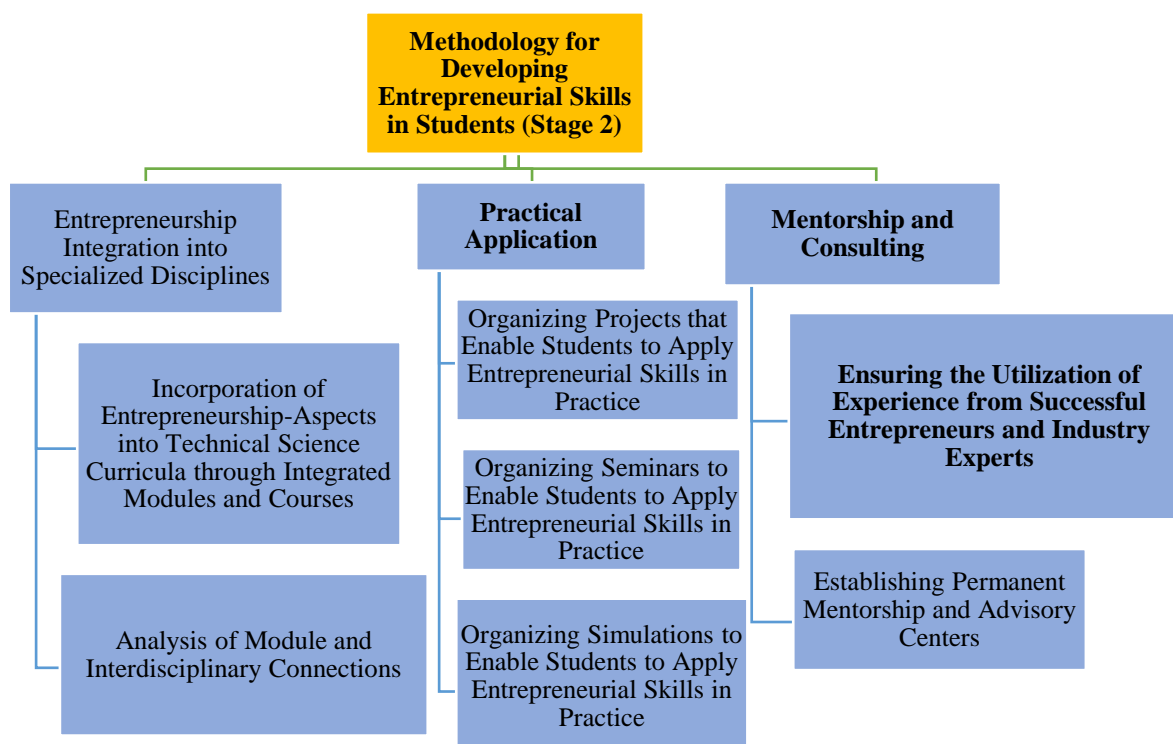


Figure 2. Methodology for Developing Entrepreneurial Skills in Students (Stage)

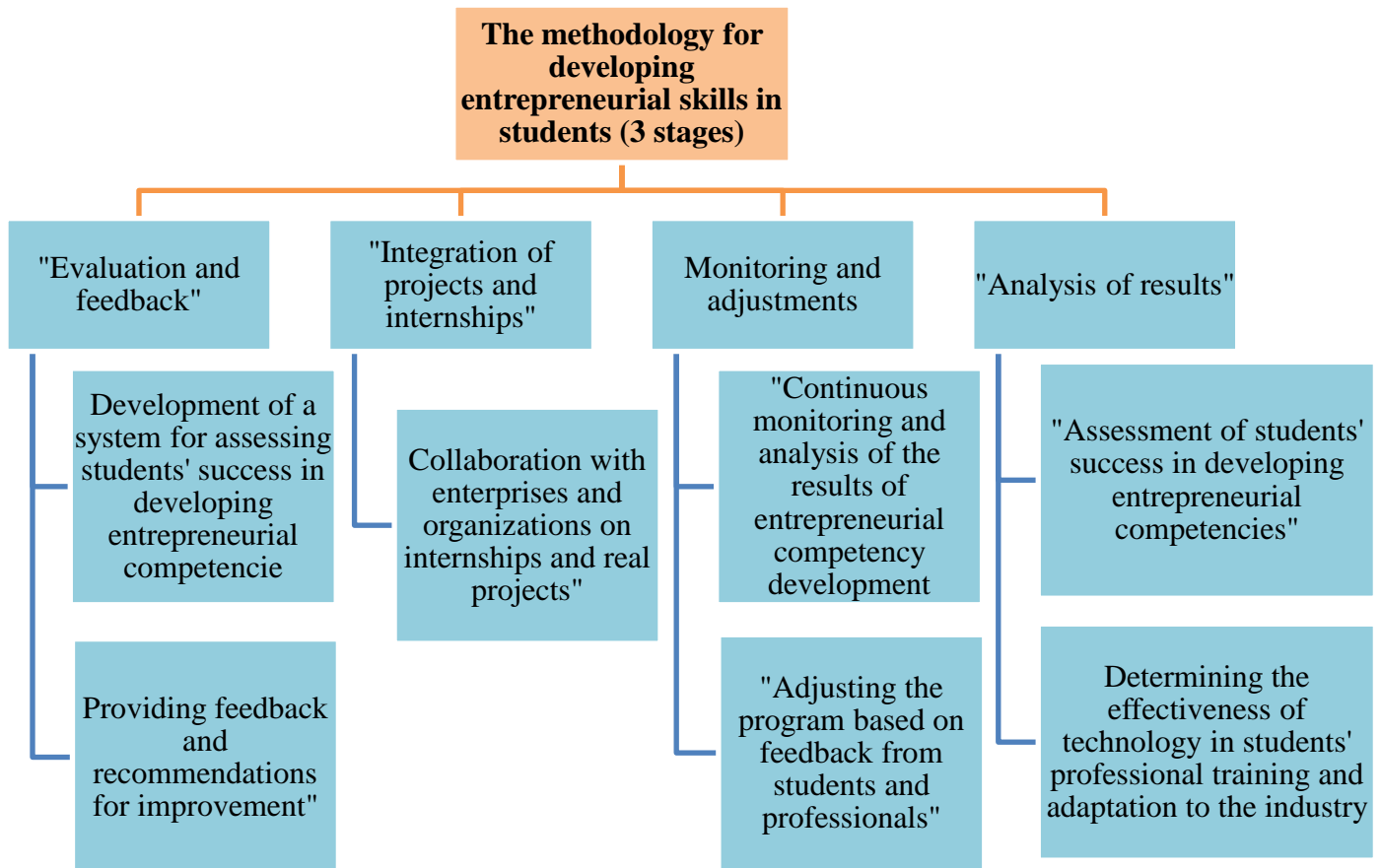


Figure 3. Methodology for Developing Entrepreneurial Skills in Students (Stage 3)

This methodology for developing entrepreneurial skills enables students in the fields of electronics and mechatronics to successfully integrate their technical expertise with entrepreneurial knowledge and skills, fostering a more successful career in the industry.

When shaping a business idea among students, several key factors should be considered:

Firstly, their personal interests should be taken into account, such as the type of activities they enjoy or the specific devices they prefer to design and manufacture.

Secondly, their acquired skills and experiences from university education should not be overlooked. For

instance, a student might be proficient in assembling electronic circuit diagrams, installing mechatronic control devices, setting up simple automatic control systems, working efficiently with sensors, or handling electrical measurement instruments.

Thirdly, external influences on their interests should also be considered. This may include inspiration from close relatives (such as an older brother, uncle, or cousin) engaged in a particular business, as well as exposure to information through the internet, television programs, or advertisements that spark curiosity and entrepreneurial motivation (Figure 4).

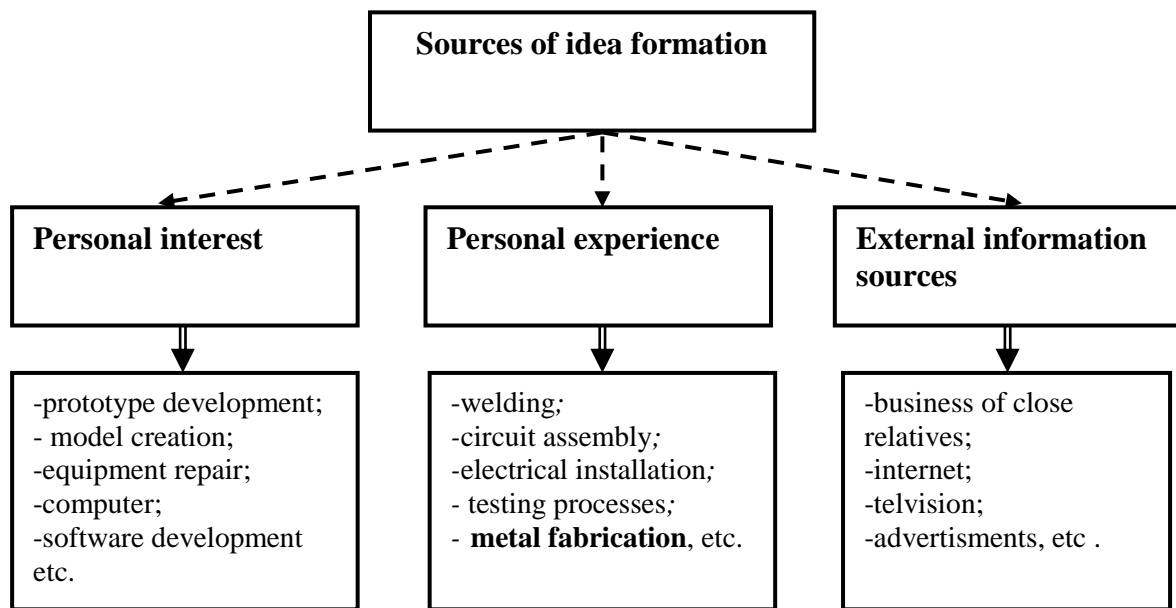


Figure 4. Sources of Idea Formation

Advice for Students Aspiring to Become Entrepreneurs:

- The business you intend to pursue should be familiar to you.
- A business that brought success to one person may not necessarily work for another.
- Entrepreneurs who establish production based on local raw materials, resources, and supplies have a higher chance of success.
- Everything that is not prohibited by law is permissible in business.
- People learn from mistakes, but it is better to learn from the mistakes of others rather than making your own.
- It is beneficial if the business you start aligns with your interests or builds upon the knowledge and skills you already possess.

Once a business idea is selected, it is essential to define a clear and concise understanding of the key aspects of the business.

At this stage, the student should be able to answer the following questions:

- What product or service do you offer? What are you particularly good at? This should align with your strengths. Do you have any experience in a specific field? How do your academic skills, training, or personal interests contribute to this business idea?
- Who are your target customers? Will your consumers range from individuals to large corporations? Will you sell your products in a small town or on a national scale? Who needs your product or service, and who is likely to become

your regular customer? Understanding your potential customers is crucial.

- How do you plan to sell your product or service? Will you sell directly to customers or through intermediaries? Will you have a dedicated location (e.g., a store, office, or workshop) for providing services or selling products?
- What specific needs of your regular customers can you fulfill? Do you clearly understand what your customers require? Is there a demand for your business? Understanding market demand is crucial for success.

Before starting an entrepreneurial activity, you must have a clear understanding of the field you plan to engage in. It is essential to recognize that a successful business not only meets customer needs but also allows you to realize your personal capabilities and aspirations.

In other words, your business should offer what people need and want—at a price they are willing and able to pay. At the same time, it must generate sufficient revenue and provide personal satisfaction for you. Therefore, it is crucial to identify and develop business ideas that are both viable for the market and fulfilling for you as an entrepreneur.

CONCLUSION

this article presents a three-stage methodology aimed at developing entrepreneurial skills among students in the fields of electronics and mechatronics. The methodology is designed to prepare competitive and innovative specialists in line with the demands of the modern labor market and includes the stages of preparation, practical implementation, and evaluation of results. This approach enables students to integrate technical knowledge with entrepreneurial skills,

allowing them to succeed in the industry. Additionally, practical advice is provided on generating business ideas and starting entrepreneurial activities. The methodology fosters creative thinking, practical skills, and competitiveness, helping students achieve independence and economic activity in the labor market. The findings of this research align with the concept of third-generation universities in engineering education and serve as a valuable foundation for future scientific and practical studies.

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