Didactic Effectiveness of Teaching General Sciences with an Entrepreneurial Orientation

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ABSTRACT

The goal is to identify the main directions for improving business education in Uzbekistan. The methodology includes a questionnaire, pedagogical experiment, and statistical analysis to assess the effectiveness of entrepreneurial education in general scientific disciplines, such as mathematics, biology, and geography, in the context of their application in entrepreneurial activity. The study uses quantitative and qualitative methods, in particular, questionnaires, statistical analysis of the obtained data, and comparison of the results of control (CG) and experimental (EG) groups in educational institutions of Uzbekistan. As part of the pedagogical experiment, an entrepreneurial approach to teaching general scientific disciplines is introduced, which included project activities, interactive tasks, and guest lectures of entrepreneurs. The study involves students and students who were divided into CG and EG. The results of the experiment show substantial changes in the level of awareness of the participants of the EG regarding entrepreneurship. They demonstrate higher initiative in creating business ideas and learn the material better compared to the CG. Special attention is paid to the statistical analysis of data reflecting the level of involvement of young people in business activities in Uzbekistan. The data presents enhanced interest among young people in entrepreneurship and an increase in initiatives on the part of educational institutions to prepare students and students to run their own business. The results obtained prove the effectiveness of entrepreneurial education in general scientific disciplines since after the introduction of interactive teaching methods, the level of interest of students in applying knowledge in mathematics, biology, and geography in entrepreneurship increased from 65% to 80%.

Keywords: Entrepreneurial Competence, Innovative Methods, Training Technologies, Practical Orientation, Skill Development

1. Introduction

The didactic effectiveness of teaching general scientific disciplines with an entrepreneurial focus is a crucial component in preparing students for professional activities in the labour market, referring to how well educational practices succeed in conveying knowledge and developing skills. This approach not only imparts essential knowledge but also equips students with practical entrepreneurial skills necessary for thriving in a dynamic economic environment. It is vital to explore how innovative teaching methods and the integration of entrepreneurial orientation into general scientific disciplines can foster the development of key competencies in students. This includes investigating the optimization of educational technologies, developing methodological approaches for the practical application of theoretical knowledge, and understanding the role of interdisciplinary connections in shaping students' entrepreneurial thinking. Further research is needed to assess the effectiveness of various pedagogical models in training specialists with entrepreneurial skills and to analyze the impact of these approaches on the professional activities of graduates. Central to this educational paradigm is the concept of entrepreneurial competence, which encompasses the combination of knowledge, skills, and behaviors that empower individuals to identify opportunities, manage resources effectively, and create value. Ultimately, these competencies lead to the successful establishment and growth of businesses, highlighting the importance of integrating entrepreneurial education into general scientific disciplines to prepare students for the challenges and opportunities of the modern labor market.

The effectiveness of integrating entrepreneurial elements into general scientific disciplines is grounded in the idea that knowledge is most effectively assimilated when students actively apply it to real tasks. Learning through experience, reflection, and collaboration transforms abstract scientific concepts into practical understanding relevant to real economic processes (Shen, 2024). When schools encourage students to make their own decisions, come up with creative solutions to problems, and take responsibility for the results, they not only help them learn more, but they also help them become more independent, adaptable, and confident in their abilities. This combination of intellectual and behavioral development explains why methods such as project-based learning, simulations, and case studies enhance motivation, critical thinking, and confidence in one’s entrepreneurial abilities. In this way, the integration of entrepreneurial approaches creates a dynamic learning process where theory evolves into practice, and learning outcomes extend beyond academic knowledge to the formation of applied competencies essential for success in the labor market.

One primary objective is to assess the level of awareness of entrepreneurial competencies among students and teachers. By establishing a baseline for future improvements, this study aims to increase awareness levels by at least 30% over the current baseline within one academic year, as measured by pre- and post-intervention surveys. This objective is crucial for understanding the starting point and effectively measuring progress in entrepreneurial education. Enhancing teacher training programs is another crucial objective. By focusing on professional development in entrepreneurial education and the use of innovative teaching methods, the goal is to train at least 70% of the teaching staff in entrepreneurial pedagogy within two years. This objective aims to observe a 35% improvement in teacher effectiveness ratings from student feedback, ensuring that educators are well-equipped to deliver high-quality entrepreneurial education. Finally, the study seeks to adapt educational programs to current economic conditions and global trends. By incorporating elements of financial literacy, digital competency, and sustainable business practices, the objective is to integrate these elements into 80% of the relevant courses within three years. This adaptation aims to achieve a measurable

30% improvement in student competency assessments in these areas, ensuring that students are well-prepared to meet the demands of the modern business world.

2. Literature Review

Numerous researchers explored this subject, presenting a range of perspectives. For example, B. Alimov et al. (2022) examined the development of professional competence of future teachers of technological sciences, emphasizing the importance of integrating entrepreneurial elements into the educational process. They stressed the need to apply innovative teaching methods to increase the competitiveness of graduates. The authors drew attention to the importance of using practice-oriented approaches that contributed to the development of skills to adapt to the labor market. In particular, U.T. Fayzullaev (2021) analyzed pedagogical technologies that increased the readiness of young people to run small businesses. The author emphasized the need to introduce active teaching methods that allowed students to gain practical skills in the field of entrepreneurship. It was determined that interactive methods that simulated real business processes and contributed to the formation of strategic thinking are effective.

The development of entrepreneurial education programmes for students of hotel, restaurant, and tourism business in post-Soviet countries, in particular, in Uzbekistan, was examined by L. John et al. (2023). The study underlined the importance of adapting educational programmes to new economic conditions, in particular, in the context of globalization and tourism development. They pointed out the need to develop practical skills and entrepreneurial thinking among students to prepare them for real-world business challenges. In addition, M.M. Mirzakarimova (2022) underscored the need to develop entrepreneurial skills among students in English lessons. The researcher noted that learning English provides an opportunity for students not only to improve their language skills but also to gain the knowledge necessary for doing business at the international level. The study has shown that the introduction of entrepreneurial aspects in language disciplines allows students to develop strategic thinking and prepare for real business situations. M.M. Madaminjonovna (2023) focused on the use of innovative methods and tools to develop students' entrepreneurial skills through language integrated learning (CLIL)technologies. It was noted that the integration of technologies into the educational process can substantially increase the effectiveness of teaching and ensure a higher level of assimilation of the material. S. Yegeubayeva et al. (2024) evaluated the effects of copper oxide nanoparticles on toxicity in the organs of domestic rabbits, which is not directly related to entrepreneurial education, but includes important aspects of scientific research in the field of new technologies and their impact on various industries, particularly on environmental issues.

The effectiveness of using Information and communication technologies (ICTs) in teaching general engineering disciplines at universities in Uzbekistan was examined by B.D. Ulugov et al. (2020). The authors noted that the integration of ICTs into the educational process can significantly improve the quality of education, especially in technical and engineering disciplines. The researchers claimed that the use of digital resources contributes to the development of students' independence and improves their ability to think analytically. The importance of training teachers to use ICTs to improve the effectiveness of the educational process was emphasized. The study showed that integrating ICT into learning allows students to master complex technical disciplines more effectively, as well as prepare them to work in a high-tech environment. U.A. Urinov and G.M. Norpolatova (2023) considered the content and

essence of the concept of the case method as an educational technology that allows examining real business situations in depth. They noted that this method is an effective tool for developing students' analytical and critical skills, as it allows them to analyze complex situations and make informed decisions. The use of the case method in training helps students master their knowledge theoretically and gain practical skills necessary for successful business operations. Most prior works focus on isolated courses or small pilot programmes, lacking large-scale empirical evaluation of how entrepreneurial approaches influence both knowledge acquisition and applied competence in general scientific disciplines. Moreover, few studies provide regional evidence from Central Asia, where economic transitions demand adaptive pedagogical models responsive to local labor market conditions. The current study addresses these gaps by testing a structured, year-long intervention across multiple institutions in Uzbekistan. It evaluates not only the didactic outcomes of introducing entrepreneurial methods into science-related subjects but also the degree to which such integration fosters motivation, readiness for self-employment, and collaboration between schools, universities, and the business community. Through this synthesis, the research contributes systematic evidence on the scalability and contextual effectiveness of entrepreneurial pedagogy in a transitional educational environment.

3. Materials and Methods

The study was based on a comprehensive approach to the study of the didactic effectiveness of teaching general scientific disciplines with an entrepreneurial focus. A combination of quantitative and qualitative analysis methods was used to obtain objective results, including questionnaires, statistical analysis, and a pedagogical experiment.

The survey was conducted to determine the attitude of teachers, students, pupils, and entrepreneurs to teaching general scientific disciplines with an entrepreneurial focus. The study involved 75 teachers of general scientific disciplines, 500 students in grades 9-11 and first-year students, as well as 40 entrepreneurs who interact with educational institutions. The survey was conducted in the period from September to December 2024 in three educational institutions of Uzbekistan, namely the secondary school No. 15 in Tashkent, gymnasium No. 3 in Samarkand, and Tashkent State University of Economics (Table 1).

Table 1. Demographic profile of study participants

Category	N	Age range (years)	Gender (M/F %)	Location (Urban/Semi-urban %)	Prior exposure to entrepreneurship (%)
Pupils (Grades 9-11)	250	14-17	48/52	60/40	10
First-year university students	250	18-19	47/53	65/35	15
Teachers of general scientific disciplines	75	25-60	42/58	70/30	25
Entrepreneurs cooperating with institutions	40	28-55	55/45	80/20	100

The sample of respondents was formed purposefully, considering the specifics of the study. Teachers of general scientific disciplines, high school students, first-year students, and entrepreneurs who interacted with educational institutions were involved in the study. To

provide a clearer picture of the sample and support segmentation analysis, a demographic breakdown of the participants is essential. Additionally, the sample included individuals with varying levels of previous entrepreneurial experience, from none to significant exposure, which allowed for a rich analysis of how different backgrounds influence perceptions and outcomes related to entrepreneurial education. (Figure 1).

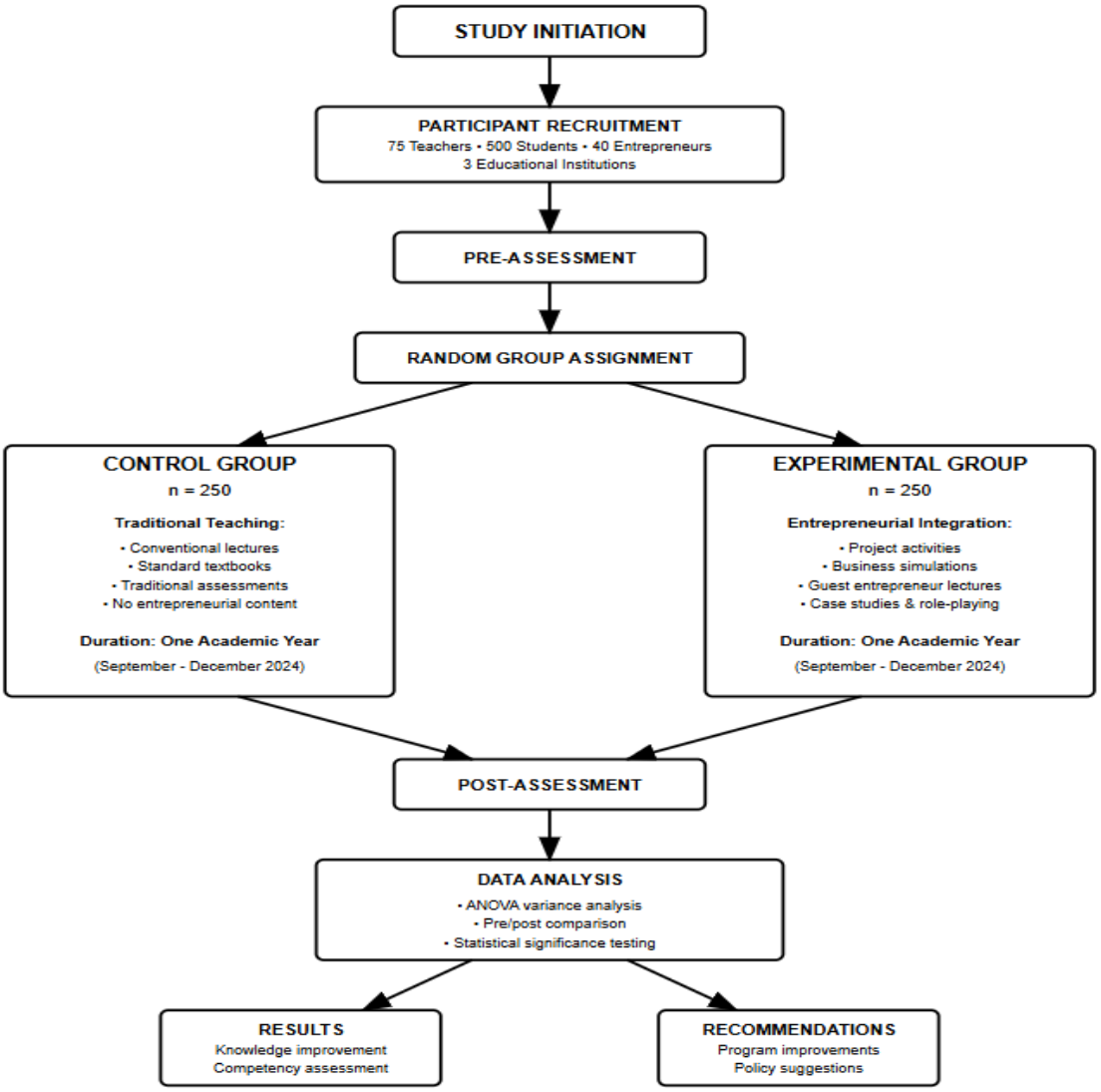

Figure 1. The research process from participant recruitment to data analysis

To minimize potential sampling bias and strengthen the internal validity of comparisons, several control measures were implemented. Participants were matched across the control (CG) and experimental (EG) groups on key baseline characteristics, including age, gender, academic performance, and prior exposure to entrepreneurship. Baseline surveys confirmed that there were no statistically significant differences between the two groups ($p > 0.05$) on these variables before the intervention. Moreover, both groups were drawn from the same institutions to ensure equivalent access to educational resources, teachers, and curricular conditions.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. A study was

approved by National Ethics Commission of the Andijan State Institute of Foreign Languages August 8, 2020, No 1028-A. The authors informed the participants (their parents) about the anonymous and voluntary participation, and the participants (their parents) provided their consent. The Google Forms platform was used for data collection. During the study, the provisions of the Code of Ethics of the American Sociological Association were observed (Asanet.org, 1997). The questionnaire contained questions for pupils and students, teachers, and entrepreneurs.

To assess the reliability of the survey instruments used, a pilot test was conducted, and Cronbach's alpha coefficients were calculated for each scale. All scales demonstrated satisfactory results, with coefficients above 0.7, indicating good internal consistency of the instrument. These results confirm that the surveys possess the necessary reliability for further use in the study. Additionally, validity checks were conducted on the instruments, including their adaptation and translation for the research context within the educational environment of Uzbekistan.

The pedagogical experiment was conducted on the basis of three educational institutions of Uzbekistan, namely secondary school No. 15 in Tashkent, Gymnasium No. 3 in Samarkand, and Tashkent State University of Economics. The study included pupils in grades 9-11, first-year students, and teachers of general scientific disciplines. The study participants were divided into control group (CG) (250 people) and experimental group (EG) (250 people). The CG was trained according to the traditional programme without integrating entrepreneurial elements into general scientific disciplines. The EG introduced an entrepreneurial approach to teaching, which included three main methods, namely project activities, interactive tasks, and guest lectures by entrepreneurs. As part of the project activities, students developed mini-business projects, created business plans, evaluated the profitability of start-ups, and analyzed financial indicators. Interactive tasks included the use of case studies, business simulations, and role-playing games. For example, economic games were held at school No. 15 and other educational institutions, where students imitated the work of companies, made decisions about investment and marketing. Guest lectures by entrepreneurs included master classes on financial literacy, project management, and market trend analysis. The study employed a purposive sampling method, which, while useful for targeting specific groups that are particularly informative about the research questions, does come with limitations. Purposive sampling can limit the generalizability of the findings, as the participants are not randomly selected and may not fully represent the broader population. This method was chosen to ensure that the sample included individuals with direct relevance to the research questions, such as teachers with experience in entrepreneurial education and students exposed to such curricula. However, readers should consider that the insights gained, while deeply informative, may not be fully applicable to other contexts without further validation.

Single-level tests are adequate in this study because the primary focus is on individual-level outcomes (e.g., student knowledge, motivation, and entrepreneurial competencies), and the data do not exhibit significant clustering effects that would require accounting for group-level variance. The sample is relatively homogeneous, and the study aims to assess the direct impact of the intervention on individuals, making single-level tests appropriate for the analysis. Additionally, they provide a straightforward and interpreted approach to exploring the primary research question.

Before starting the experiment, a survey of participants was conducted to assess their initial awareness of entrepreneurship, the level of motivation, and interest in starting their own

business. After completing the experiment, which lasted one academic year, participants were re-interviewed and tested to assess the level of knowledge acquisition and development of entrepreneurial competencies.

In addition to the quantitative methods employed in this study, a qualitative approach was utilized to gain a deeper understanding of the participants' perceptions, experiences, and attitudes toward the integration of entrepreneurial education into general scientific disciplines. Semi-structured interviews and open-ended questions within the surveys were used to collect qualitative data from both students and teachers. The interviews were designed to explore participants' views on the relevance, challenges, and impact of entrepreneurial education in fostering entrepreneurial competencies. The qualitative data were then analyzed using thematic analysis, which allowed for the identification of recurring themes and patterns related to the integration of entrepreneurial approaches in teaching. Specifically, the analysis focused on themes such as the perceived effectiveness of entrepreneurial methods, the barriers to implementation in the educational process, and the participants' motivation and readiness to engage in entrepreneurial activities. This qualitative component complemented the quantitative findings, providing richer insights into the contextual factors influencing the success of entrepreneurial education and contributing to the formulation of more comprehensive recommendations for improving educational practices.

To assess the effectiveness of integrating entrepreneurial education, a statistical analysis, including ANOVA variance analysis, was conducted. The analysis evaluated the number of pupils and students in the Samarkand region who receive entrepreneurial education, the proportion of young people who have implemented their business ideas, and the level of youth employment in small and medium-sized businesses. Special attention was given to gathering data on key sectors of the region's economy, such as agriculture, textile industry, and other significant industries that provide opportunities for business activities. These sectors play a crucial role in the local economy and offer substantial prospects for entrepreneurial ventures, enabling young people to apply the knowledge they have acquired in practical business contexts. The data on youth employment and entrepreneurial activity were analyzed within the context of regional economic trends, revealing both gaps and opportunities for further enhancing entrepreneurial education. Based on the findings, recommendations were formulated to improve the effectiveness of business education, including the introduction of innovative teaching methods, strengthening the connection between educational institutions and the real economy, and developing programs tailored to the specific needs of the labor market in Uzbekistan.

4. Results and Discussion

Level of awareness of pupils, students, and teachers about entrepreneurial competencies

Didactic effectiveness of teaching general scientific disciplines with an entrepreneurial focus is the main aspect of the educational process. This approach helps students gain theoretical knowledge and develop the practical skills necessary for successful business operations. The entrepreneurial direction in general scientific disciplines provides an opportunity to understand how knowledge in subjects such as mathematics, physics, or biology can be applied to solve real-world problems in the business environment. Due to the integration of the entrepreneurial component in the curriculum, students develop entrepreneurial thinking, the ability to innovate and respond to changes in economic conditions (Table 2).

Table 2 Integrating entrepreneurial education in scientific disciplines: Linking theory to practice

Theoretical Components	Practical Components	Intended Outcomes
Mathematics	Business simulations	Critical thinking
Physics	Project activities	Problem-solving skills
Biology	Guest lectures	Innovation and creativity
Chemistry	Internships	Job creation
Entrepreneurial theories		Economic diversification
Pedagogical approaches		Successful entrepreneurial ventures

F. Dochy and A. Wybo (2021) focused on the didactics of L&D learning and development in the context of on-the-job learning. The authors emphasize the importance of adaptive and innovative approaches to education in the professional environment, especially in the context of rapid changes. They explore a variety of methods that support effective training and professional development of workers in a changing work environment and analyze how on-the-job learning theories can be applied to create training programmes that meet the requirements of the labor market. This paper is of great importance for improving pedagogical practices in vocational education, including in the context of entrepreneurial education. S. Fischer et al. (2021) consider the use of flexible learning formats in entrepreneurship education in their study. The authors analyze various approaches to teaching that provide flexibility in the educational process and contribute to the development of critical thinking and entrepreneurial skills in students. The study also concentrates on the advantages of using flexible learning formats over traditional methods, emphasizing the importance of adapting curricula to market needs and changes.

Teaching general scientific fields with an entrepreneurial orientation develops students' entrepreneurial thinking, creativity, and economic adaptability. Integration of the entrepreneurial component into broad scientific disciplines links learnt knowledge to practical business tasks, preparing future professionals for the job market. Math, physics, chemistry, biology, geography, history, etc. are usually considered unrelated to entrepreneurship. In practice, especially with globalization and rapid technological advancement, these sciences have considerable business application potential. For instance, mathematics can assess market patterns, optimize production, and anticipate financial consequences. Chemistry and biology can create breakthrough health and ecology goods. Economic and political geography can help analyze marketplaces and establish commercial strategies in different countries (Oklander et al., 2020). Integrating entrepreneurship education with general science teaches students to apply scientific concepts and theories to entrepreneurial concerns. This enhances understanding and highlights their relevance in the actual world, where economic and social processes, scientific advances, and technologies interact. Students learn basic information, critical thinking, decision-making in tough situations, and teamwork skills that are crucial for future entrepreneurs using this approach.

One of the main aspects of integrating the entrepreneurial component into general scientific disciplines is the use of teaching methods that are focused on the practical activities of students (Titova et al., 2023; Yurtseven et al., 2025). This can include project activities, role-playing games, business simulations, and attracting real entrepreneurs and specialists to the educational process through guest lectures, seminars, and master classes. These methods allow students not

only to gain theoretical knowledge but also to use it to solve real problems that arise in business activities. Project activity is one of the most effective teaching methods that enables students to work on real business tasks, develop skills in planning, management, marketing, finance, and other aspects of entrepreneurial activity. It helps students apply their knowledge in a real business environment while also developing the ability to work in a team, resolve conflicts, find creative solutions, and assess risks (Umnov et al., 2024).

A study by M. Pech et al. (2021) examined students' preferences for teaching methods in entrepreneurship education. The authors analyzed which teaching methods are most effective from the standpoint of students and how their preferences affect the process of learning and mastering entrepreneurial skills. The results show that students prefer practical methods such as case studies, business simulations, and project-based learning that allow them to better understand real-world business processes. This research is of great importance for improving entrepreneurship teaching methods, as accounting for students' preferences allows them to create more effective and motivating curricula. The case study method contributes to the development of analytical thinking, which is consistent with the conclusions of G. Kim et al. (2020). They underscored the importance of case studies in entrepreneurial education, which allows students to examine real-world business situations and make practical decisions that have a real impact on business processes. A special role was played by subject didactics, which, according to the conclusions of H.J. Vollmer (2024), N.Y. Pikulina et al. (2023), and E.O. Pérez-Sánchez et al. (2023), promotes the formation of powerful educational knowledge through an interdisciplinary approach. G.M.B. Velásquez et al. (2022) also reviewed planning educational strategies based on learning styles in their study. They focus on using individual learning styles to improve teaching practices, in particular, through case studies and other methods that consider different ways of students' perception of information.

Business simulations and role-playing games are another method that allows pupils and students to practically apply knowledge from various scientific disciplines to solve business problems. These techniques allow modelling real-world situations in which students can make decisions, analyze the consequences of their actions, and develop strategic planning skills. Guest lectures by entrepreneurs and specialists are an effective way to attract practical experience to the educational process. Entrepreneurs can share their knowledge and experience, talk about real problems and challenges they face, and answer students' questions about the specifics of doing business. Such lectures not only enrich the learning process but also help better understand how theoretical knowledge can be applied in the real world.

The use of business simulations in the educational process has shown its effectiveness, which confirms the conclusions of S. Brylev and N. Levina (2022). The authors investigated the role of business simulations in learning and their impact on students' professional orientation in the context of Science, Technology, Engineering, and Mathematics education (STEM). They showed how simulation models help students better understand real-world business processes, increase motivation to learn, and promote practical entrepreneurship skills. The study is important for examining interactive teaching methods that are actively used in entrepreneurial education. Similarly, A. Gawel et al. (2022) stressed that the use of virtual simulations allows students to better understand business processes and the environmental sustainability of entrepreneurship. Namely, they considered the integration of virtual games into the educational process in business education and noted that such simulations help students develop strategic thinking and decision-making skills in the context of sustainable development. Their research also points to the importance of integrating the latest technologies into training to train next-generation entrepreneurs.

Interactive teaching methods, such as reasoned discussion and simulation tasks, contributed to the development of entrepreneurial competencies, which is in line with a study by G.M. Canoz et al. (2022). These authors investigated the impact of reasoned simulations on the development of entrepreneurial skills among high school students. They established that interactive approaches, in particular, argumentation methods, substantially increase the level of academic achievement and form skills of effective entrepreneurial thinking. Attention to the effectiveness of interactive applications in the educational process makes this approach relevant for educational institutions.

Entrepreneurial education should also teach financial literacy, economics, accounting, taxation, and investment. This information helps prospective entrepreneurs manage their business and comprehend the economic principles that affect it. The integration of entrepreneurial features into broad scientific fields creates new generations of entrepreneurs with academic knowledge and practical business abilities, which could boost economic growth (Nurekenova et al., 2022; Zhou et al., 2024). This solves social and economic issues and fosters economic growth through ideas, technology, and start-ups. Importantly, teaching entrepreneurs in general scientific subjects develops transdisciplinary abilities. Maths and physics assist students build critical thinking skills for business risk assessment. Biology and chemistry can help generate medical and ecological breakthroughs. Geography and economics help navigate market conditions and establish regional business development plans (Bashtannyk et al., 2020; Oklander et al., 2022). In general, the entrepreneurial direction in teaching general scientific disciplines is the main step towards the formation of new generations of entrepreneurs who are ready for the challenges of a globalized world. The implementation of this approach can substantially improve the quality of education and contributes to the development of the country's economy. However, for its successful implementation, it is necessary to create appropriate conditions, including training teachers, updating curricula, and active cooperation with entrepreneurs and the business community. It is also important to use transformational learning in entrepreneurial education, as stated by M.L. Blankesteijn et al. (2024). The authors explored how learning experiences in the face of change and innovation can change students' approach to entrepreneurship. Transformational training promotes critical thinking and flexibility, which are important traits for future entrepreneurs.

The formation of entrepreneurial competencies from an early age is consistent with the conclusions of J. Seikkula-Leino et al. (2023). They investigated how entrepreneurial education can be implemented in preschool education and its impact on the development of early entrepreneurial skills in children. The results of this study point to the importance of developing entrepreneurial thinking from an early age. Web-based courses played a major role, which correlates with the findings of L. Pet'ko et al. (2021). They also examined the effectiveness of online courses in entrepreneurial education and showed how web-based learning models can provide access to the knowledge and resources needed to develop students' entrepreneurial skills. N. Rasulova et al. (2023) analyzed the structural elements of teachers' didactic skills in the educational process, particularly theoretical and methodological approaches. The authors investigated how different teaching methods and principles can affect the quality of education and professional skills of teachers. They stressed the importance of developing teachers' ability to adapt their methods to the needs of students, in particular, in the field of entrepreneurial education. This study is important for developing curricula that promote not only academic but also practical skills in students, especially in an entrepreneurial environment.

A survey was conducted to better understand and evaluate the attitude of teachers, pupils, students, and entrepreneurs to teaching general scientific disciplines with an entrepreneurial focus, which is presented in Table 3-5.

Table 3. Results of a survey on attitudes to teaching general scientific disciplines with an entrepreneurial focus for students

Questions for students	**Responses**
1. Are you interested in applying your knowledge of mathematics, biology, or geography to business activities?	Yes – 65%; No – 15%; Partially – 20%
2. Have you participated in training projects related to business or entrepreneurship?	Yes – 45%; No – 55%
3. How would you assess the level of integration of entrepreneurial knowledge into your general scientific disciplines?	1 – 10%; 2 – 15%; 3 – 25%; 4 – 30%; 5 – 20%
4. What teaching methods do you find most effective for developing entrepreneurial thinking?	Business games – 25%; Project activity – 30%; Lectures – 20%; Meetings with entrepreneurs – 15%; Other – 10%
5. Are you considering starting your own business after training?	Yes – 50%; No – 30%; Maybe – 20%
6. Do you get enough information about financial literacy and business management at school/university?	Yes – 35%; No – 40%; Partially – 25%
7. Does your educational institution support student/student initiatives in the field of entrepreneurship?	Yes – 60%; No – 30%; I don’t know – 10%
8. Are you interested in learning about real cases of successful entrepreneurs as part of the educational process?	Yes – 75%; No – 25%
9. Do you think that entrepreneurial skills will help you in the future, even if you don’t plan to start a business?	Yes – 80%; No – 10%; Not sure – 10%
10. What topics in the field of entrepreneurship are you most interested in?	Marketing – 40%; Business financing – 25%; Personnel management – 20; Business strategies – 15%

Table 4. Results of a survey on attitudes to teaching general scientific disciplines with an entrepreneurial focus for teachers

Questions for teachers	Responses
1. Do you have any experience in teaching general scientific disciplines with an entrepreneurial focus?	Yes – 25%; No – 75%
2. To what extent are you ready to implement entrepreneurial methods in teaching your subject?	1 – 5%; 2 – 10%; 3 – 30%; 4 – 35%; 5 – 20%
3. Have you completed advanced training in business education?	Yes – 30%; No – 70%
4. What difficulties do you think may arise when integrating entrepreneurial elements into general scientific disciplines?	The most common answers: Lack of relevant training materials; insufficient experience of teachers
5. Does your institution have practices of cooperation with entrepreneurs to train students?	Yes – 40%; No – 60%
6. What resources or methods do you think are most effective for teaching entrepreneurial knowledge?	Project training – 50%; Business games – 20%; Lectures of entrepreneurs – 15%; Cases – 10%; Other – 5%
7. Does the administration of your institution support the introduction of entrepreneurial training in general scientific disciplines?	Yes – 50%; No – 30%; Partially – 20%
8. What additional knowledge or skills do you need to effectively implement the entrepreneurial component in teaching?	Business project management – 40%; Financial literacy – 35%; Active learning methods – 25%
9. Do you think entrepreneurial thinking is important for students, even if they don't plan on doing business?	Yes – 90%; No – 10%
10. What changes in the curriculum can make entrepreneurial education more effective?	The most common answers: More practical cases; Implementing business simulations

Table 5. Results of a survey on attitudes to teaching general scientific disciplines with an entrepreneurial focus for entrepreneurs

Questions for entrepreneurs	Responses
1. Do you cooperate with educational institutions to develop entrepreneurial competencies among young people?	Yes – 55%; No – 45%
2. What skills do you consider most important for young professionals?	Critical thinking – 30%; Financial literacy – 40%; Initiative – 20%; Communication – 10%
3. Are you ready to participate in training programmes as a guest lecturer or mentor?	Yes – 60%; No – 30%; Depends on the conditions – 10%
4. How do you assess the level of preparation of graduates for work in the business sector? (Answers on a scale of 1 to 5)	1 – 20%; 2 – 25%; 3 – 30%; 4 – 15%; 5 – 10%

5. Do you think education has a greater impact on business success than practical experience?	Depends on the situation – 70%; Yes – 20%; No – 10%
6. What are the main difficulties that you think young entrepreneurs have when starting a business?	Insufficient education – 35%; Lack of funding – 45%; Lack of practical experience – 20%
7. Do you think that the education system in Uzbekistan sufficiently prepares young people for a real business environment?	Partially – 55%; Yes – 30%; No – 15%
8. Would you be interested in participating in mentoring programmes to support young entrepreneurs?	Yes – 75%; No – 25%
9. Do you find it useful to teach students real business cases?	Yes – 85%; No – 15%
10. What topics do you think should be covered more in entrepreneurial education?	Startup financing – 40%; Marketing – 30%; Risk management – 15%; Strategic planning – 15%

The results of the survey showed a different attitude to teaching general scientific disciplines with an entrepreneurial orientation among students, teachers, and entrepreneurs. Students showed a substantial interest in applying knowledge in subjects such as mathematics, biology, and geography to business activities, specifically, 65% of respondents said that it is interesting for them. However, 45% of entrepreneurs did not participate in business-related training projects, which indicates a lack of active cooperation with educational institutions to develop the entrepreneurial competencies of young people. As for teachers, 75% have no experience in teaching general scientific disciplines with an entrepreneurial focus, which may limit the effectiveness of integrating entrepreneurial knowledge into general scientific courses. In particular, only 30% of teachers are ready to introduce entrepreneurial methods in teaching their subject.

Entrepreneurs, in turn, believe that young professionals need financial literacy skills (40%) and critical thinking (30%), while 55% of entrepreneurs cooperate with educational institutions to develop entrepreneurial competencies among young people. However, there are difficulties associated with the lack of relevant training materials and the insufficient experience of teachers. In view of these results, it can be concluded that although interest in entrepreneurial education is growing among students, there is a need to improve teacher training, update educational materials, and improve cooperation between entrepreneurs and educational institutions to effectively implement entrepreneurial knowledge in the educational process. This indicates the need to expand relevant educational programmes, improve the skills of teachers, and activate cooperation between educational institutions and entrepreneurs. Therefore, a pedagogical experiment was conducted aimed at evaluating the effectiveness of implementing an entrepreneurial approach in teaching general scientific disciplines.

Table 6 presents the results of the inferential statistical analysis comparing the pre- and post-intervention data for the experimental and control groups. It includes the means, standard deviations (SD), test statistics, p-values, and effect sizes for key entrepreneurial competencies, such as knowledge, confidence, attitude, understanding of economic processes, and the usefulness of business projects. The results indicate significant improvements in the

experimental group across all measured variables following the integration of entrepreneurial education into general scientific disciplines.

Table 6. Statistical analysis of pre- and post-intervention comparisons in experimental and control groups

Variable	Control Group (Before Intervention)	Experimental Group (Before Intervention)	Control Group (After Intervention)	Experimental Group (After Intervention)	Test Statistic	p-value	Effect Size (Cohen's d / η^2)
Knowledge of Entrepreneurship	Mean = 3.2 (SD = 0.7)	Mean = 3.5 (SD = 0.8)	Mean = 3.4 (SD = 0.6)	Mean = 4.5 (SD = 0.6)	t(249) = 15.92	p < 0.001	Cohen's d = 0.8 (Large)
Confidence in Starting a Business	Mean = 3.0 (SD = 0.6)	Mean = 3.3 (SD = 0.7)	Mean = 3.2 (SD = 0.6)	Mean = 4.2 (SD = 0.5)	t(249) = 10.57	p < 0.001	Cohen's d = 0.6 (Medium)
Attitude toward Entrepreneurship	Positive = 25%	Positive = 30%	Positive = 35%	Positive = 80%	McNemar's χ^2 (1) = 120.5	p < 0.001	η^2 = 0.6 (Large)
Understanding of Economic Processes	Yes = 25%, Partially = 70%, No = 10%	Yes = 25%, Partially = 65%, No = 10%	Yes = 25%, Partially = 70%, No = 5%	Yes = 85%, Partially = 10%, No = 5%	t(249) = 13.45	p < 0.001	Cohen's d = 1.1 (Large)
Usefulness of Business Projects	Yes = 15%, Partially = 80%, No = 5%	Yes = 15%, Partially = 75%, No = 10%	Yes = 15%, Partially = 80%, No = 5%	Yes = 90%, Partially = 5%, No = 5%	t(249) = 18.02	p < 0.001	Cohen's d = 1.2 (Large)

Entrepreneurial education, when integrated into general scientific disciplines, serves as a catalyst for innovation and economic development (Tiurina et al., 2023; Kozhoshev et al., 2022). In today's rapidly evolving global economy, the fusion of scientific knowledge with entrepreneurial skills equips students with the ability to transform theoretical insights into practical, marketable solutions. This interdisciplinary approach not only enhances students' understanding of scientific principles but also fosters an innovative mindset, crucial for addressing complex real-world challenges.

The integration of entrepreneurial education into scientific curricula encourages students to think critically and creatively, enabling them to identify opportunities and develop novel products and services (Kawiana et al., 2023; Yakupova, 2024). For instance, a strong foundation in scientific disciplines such as biology and chemistry, combined with entrepreneurial training, can lead to breakthroughs in biotechnology and pharmaceuticals. Similarly, knowledge in physics and engineering, when coupled with business acumen, can drive advancements in technology and sustainable energy solutions. These innovations contribute significantly to economic growth by creating new industries, generating employment opportunities, and enhancing competitiveness in the global market.

To ensure the reliability of the survey instruments used in this study, Cronbach's alpha was calculated for each scale. The results showed satisfactory reliability, with Cronbach's alpha coefficients exceeding 0.7 for all scales, indicating good internal consistency. These reliability values confirm the robustness of the instruments, supporting the validity of the findings based

on the survey data. The consistency of the scales further strengthens the reliability of the conclusions drawn from the analysis of the entrepreneurial competencies among the participants.

Moreover, entrepreneurial education promotes a culture of problem-solving and adaptability. Students learn to navigate uncertainties and risks, which are inherent in both scientific research and business ventures. By engaging in project-based learning, business simulations, and real-world case studies, students gain hands-on experience in managing projects, leading teams, and making strategic decisions. These experiences are invaluable in preparing a workforce that can thrive in dynamic economic environments and contribute to the resilience and diversification of the economy.

Incorporating entrepreneurial elements into education also strengthens the collaboration between academic institutions and the business community. Partnerships with local and international businesses provide students with practical insights and exposure to current industry practices. Such collaborations facilitate the transfer of knowledge and technology between academia and industry, further driving innovation and economic development.

The impact of the integration of entrepreneurial elements in general scientific disciplines on the quality of the educational process

Within the framework of the study, interactive methods were used, in particular, project activities, business simulations, and guest lectures of entrepreneurs, which allowed assessing their impact on the level of knowledge, motivation and practical skills of students and pupils. The results of the experiment are presented in Table 7.

Table 7. Results of the control and experimental group survey before and after the introduction of the entrepreneurial approach in training

Question	**Control group (before implementation)**	**Control group (after implementation)**	**Experimental group (before implementation)**	**Experimental group (after implementation)**
1. Has your knowledge of entrepreneurship improved?	Yes – 30%; Partially – 50%; No – 20%	Yes – 35%; Partially – 50%; No – 15%	Yes – 35%; Partially – 50%; No – 15%	Yes – 85%; Partially – 10%; No – 5%
2. Do you feel confident in your ability to start your own business?	Yes – 40%; Partially – 50% No – 10%	Yes – 45%; Partially – 50%; No – 5%	Yes – 45%; Partially – 45%; No – 10%	Yes – 75%; Partially – 15%; No – 10%
3. Has your attitude to entrepreneurship changed?	Positive – 25%; Neutral – 60%; Negative – 15%	Positive – 30%; Neutral – 60%; Negative – 10%	Positive – 30%; Neutral – 55%; Negative – 15%	Positive – 80%; Neutral – 15%; Negative – 5%
4. Have interactive learning methods helped you better understand economic processes?	Yes – 20%; Partially – 70% No – 10%	Yes – 25%; Partially – 70%; No – 5%	Yes – 25%; Partially – 65%; No – 10%	Yes – 85%; Partially – 10%; No – 5%
5. Was it useful	Yes – 10%;	Yes – 15%;	Yes – 15%;	Yes – 90%;

for you to develop business projects?	Partially – 80%; No – 10%	Partially – 80%; No – 5%	Partially – 75%; No – 10%	Partially – 5%; No – 5%
6. Would you like to gain more practical knowledge about entrepreneurship in the future?	Yes – 35%; Partially – 60%; No – 5%	Yes – 40%; Partially – 55%; No – 5%	Yes – 40%; Partially – 50%; No – 10%	Yes – 85%; Partially – 10%; No – 5%
7. What training methods did you like best?	Lectures – 20%; Practical tasks – 30%; Interactive – 50%	Lectures – 20%; Practical tasks – 30%; Interactive – 50%	Lectures – 25%; Practical tasks – 40%; Interactive – 35%	Lectures – 35%; Practical tasks – 40%; Interactive – 25%
8. Do you plan to apply your knowledge in your professional activities in the future?	Yes – 45%; Partially – 50%; No – 5%	Yes – 50%; Partially – 45%; No – 5%	Yes – 50%; Partially – 45%; No – 5%	Yes – 70%; Partially – 20%; No – 10%
9. Would you like to have more entrepreneurial subjects at your school or university?	Yes – 50%; Partially – 40%; No – 10%	Yes – 55%; Partially – 40%; No – 5%	Yes – 55%; Partially – 35%; No – 10%	Yes – 90%; Partially – 5%; No – 5%

Analysis of the survey results showed a substantial increase in the level of knowledge, motivation and confidence of students of the EG after the introduction of an entrepreneurial approach to training. If before implementation only 35% of students in the EG believed that their knowledge of entrepreneurship was sufficient, then after – this indicator increased to 85%. Confidence in one's ability to start a business has also significantly increased – from 45% to 75%. The positive attitude to entrepreneurship increased from 30% to 80%, which indicates an increase in the level of students' interest in entrepreneurship.

Interactive methods of teaching and developing business projects have proven to be extremely effective. If at the beginning only 25% of students in the EG noted that interactive methods helped them better understand economic processes, then after the introduction of methods, this figure increased to 85%. Similarly, 90% of students in the EG recognized the usefulness of business projects, compared to 15% before implementation. In addition, 85% of students expressed a desire to gain more practical knowledge on entrepreneurship, which indicates the effectiveness of the implemented methods. In general, the results of the study confirm that an entrepreneurial approach to teaching contributes to the formation of students' necessary competencies and increases their interest in entrepreneurial activity.

The study of the didactic effectiveness of teaching general scientific disciplines with an entrepreneurial direction showed that the combination of traditional educational methods with entrepreneurial approaches contributes to the formation of practical skills of students, increasing motivation, and developing critical thinking. Digital technologies have substantially improved the didactic effectiveness of the educational process, which is confirmed by a paper of O. Kuzmenko et al. (2023). They investigated the introduction of STEM-oriented

environments in teaching physics and engineering disciplines and showed how such approaches can improve understanding of complex concepts. Their works emphasize the importance of information technologies in the educational process and the development of competencies that are necessary for effective learning in the context of globalization and digitalization of education. Similar conclusions were achieved by M. Shelukhin et al. (2021), who also investigated the impact of cloud-based learning environments on entrepreneurial education. Their results show that the integration of cloud technologies into the learning process allows for a flexible, personalized environment for students, which increases learning efficiency and access to learning materials, as well as supports the development of entrepreneurial skills through technology. The competence-based approach used in the study demonstrated its effectiveness, confirming the findings of C.W. Liao et al. (2023), who examined the impact of competence-based strategies on high school students' learning. This approach is extremely important for training professionals capable of innovation and adaptation in a changing labor market. G. Martínez-Borreguero et al. (2022) and M. Núñez-Canal et al. (2023) underscored the importance of interactive and practical methods in education, which helps not only improve academic performance but also strengthen pedagogical self-confidence.

These data allow building a sound strategy for the development of entrepreneurial education in a particular region, where there is a higher concentration of young people, economic opportunities for business, and a developed educational infrastructure. The difference between the authors' approaches in the studies under consideration lies in the emphasis on various aspects of entrepreneurial education and its development. In particular, A. Iqbal and A.B. Kazmi (2024) concentrate on the effectiveness of applying didactic teaching methods to improve students' academic performance, without directly considering economic conditions or the development of entrepreneurial education in specific regions. They attach importance to pedagogical techniques that can be useful for improving overall educational performance, which can affect the preparation of young people for entrepreneurship, but without focusing on the specifics of economic opportunities. For example, M.L. Blankesteijn et al. (2024) explore entrepreneurial education from a transformational learning perspective, focusing on sustainable technological innovation. The approach of the study is more focused on how science and technology can drive entrepreneurial activity and how these areas can contribute to building sustainable businesses. This approach is beneficial for strategies in regions with developed technological infrastructure and high potential for innovation.

In addition, Ł. Brzezicki and R. Rusielik (2020) offer an analysis of the performance of Polish technical universities using mathematical models, in particular, directional distance functions. Their approach is focused on measuring the effectiveness of training activities in higher education institutions, which allows developing strategies for improving the quality of training and integrating entrepreneurial initiatives into the training programme, accounting for regional economic opportunities. Researchers R. Soler Costa et al. (2020) assessed the impact of mobile technologies on future educators' learning, enabling a more innovative approach to entrepreneurial education. Their approach focuses on the use of modern technologies to create programmes that can adapt to the needs of regions with a developed educational infrastructure, allowing them to more effectively teach young people entrepreneurial skills. Thus, the methods of these authors differ in focus: from general pedagogical methods and technological innovations to the analysis of the effectiveness of educational activities in technical universities, which allows creating different strategies for the development of entrepreneurial education, depending on the specifics of the region and available resources.

Recommendations for educational institutions to improve business education programmes

All data was used to make recommendations to improve business education in Uzbekistan. Curricula should be updated to incorporate entrepreneurial themes into general science. This will improve economic comprehension and business use of scientific information. Interdisciplinary courses that mix natural sciences, mathematics, and social sciences with entrepreneurship basics will help students and schoolchildren realize the practical applications of their knowledge. Improving teaching methods helps improve entrepreneurial abilities. Focus on interactive learning approaches such case studies, business simulations, role-playing games, and projects. Practice-oriented techniques motivate students to learn and apply theory. Business games that simulate real market circumstances, allow participants to make decisions, and assess their results will mould entrepreneurial thinking. Involving business representatives in education helps train future entrepreneurs. Collaboration between educational institutions and entrepreneurs will foster practical knowledge, market awareness, and professional advancement. Having successful entrepreneurs give lectures, master classes, and mentoring programs will give students useful guidance. Such events will also help build useful friends and commercial connections.

Institutional support for entrepreneurial education by the state and educational institution administrations is a necessary condition for its effectiveness. Government programmes aimed at stimulating entrepreneurial learning should be developed, including financing educational initiatives, supporting school business clubs, and organizing start-up competitions among pupils and students. The introduction of grant programmes and financing of innovative educational projects will help increase the interest of young people in the field of entrepreneurship. Developing financial literacy should be one of the fundamental aspects of entrepreneurial education. Students should gain knowledge of the basics of financial planning, budgeting, investing, and risk management. Teaching these topics in an accessible form will help future entrepreneurs avoid common mistakes in financial management and effectively manage their own business projects.

Interactive platforms and simulations of financial processes improve material assimilation (Luzan et al., 2022; Kapoor et al., 2025). High-quality entrepreneurship education requires teacher professional development. Teacher trainings, seminars, and educational programs will assist them learn new teaching approaches and international best practices. Teachers should adjust their teaching methods to market and entrepreneurship changes. Cooperation with international professionals and studying abroad will expand knowledge and be applied to local education. Entrepreneurial skills will be better learnt with digital training. Online courses, webinars, and interactive platforms will give students high-quality education regardless of location. Aspiring entrepreneurs who wish to learn and practice can benefit from distance learning. Integrating digital solutions into traditional learning will adapt it to modern students (Sadirbekova et al., 2024; Kutanova & Beksultanov, 2022). Supporting student initiatives and youth entrepreneurship fosters creativity and entrepreneurship.

Educational institutions can build business incubators where students can start businesses, receive coaching, and test their ideas in real life. Contests, hackathons, and project competitions will assist find and launch young entrepreneurs. Creating an entrepreneurial culture is crucial to entrepreneurial education. Educational institutions should promote successful young entrepreneurs, host topical events, and encourage student participation in the business community to foster a good attitude towards entrepreneurship. Popularizing entrepreneurial success stories will inspire young people to establish their own businesses and overcome

preconceptions about their complexity. A business-education relationship will establish an effective entrepreneurial education environment. Joint internships, dual education, and commercial partnerships will develop competitive professionals for the workplace. Students will obtain real-world work experience, apply their knowledge, and improve professional skills through such contact. These ideas will improve entrepreneurial education in Uzbekistan, prepare young people for independent work, and grow the business environment.

Educational institutions are encouraged to actively implement interactive teaching methods, such as business simulations, start-up development, and case studies, to improve entrepreneurial education programmes. For example, students can work on real business projects in collaboration with local entrepreneurs, which will allow them to apply their knowledge in practice. Universities can create business incubators where young people can test their ideas, receive mentoring support, and attract investors. In addition, successful entrepreneurs should be involved in the educational process to conduct guest lectures and master classes. In particular, in the Samarkand region, the model works effectively when representatives of small businesses advise students on financial planning and marketing strategies. The number of practical classes on developing business plans, financial modelling, and risk assessment should be increased. Educational institutions should strengthen cooperation with business structures, involving companies in the organization of internships, namely, students can take short-term programmes in local enterprises, which will increase their readiness to do business after completing their studies.

Thus, creating favorable conditions for entrepreneurship training is an important factor in forming a generation of specialists who can effectively adapt to changing economic conditions. The development of entrepreneurial skills among students not only contributes to their professional training but also increases their ability to implement their business ideas, which is of strategic importance for economic growth (Fedotova et al., 2021; Giyasova et al., 2025). In-depth use of interactive methods, practical exercises, and advanced training of teachers can drastically improve the quality of teaching and training of future entrepreneurs, ensuring their successful career and active participation in the development of the economy (Table 8).

Table 8. Mapping of research objectives to methods and conclusions

Research Objective	**Corresponding Methodology**	**Key Conclusion**
Assess awareness of entrepreneurial competencies among students and teachers	Quantitative survey of 75 teachers, 500 students, and 40 entrepreneurs using structured questionnaires (Google Forms)	Students show high interest in entrepreneurship (65%), but 75% of teachers lack experience with entrepreneurial content; training needs are substantial
Analyse the impact of integrating entrepreneurial methods into general scientific disciplines	Pedagogical experiment (control and experimental groups across three institutions); pre- and post-intervention testing	Entrepreneurial methods (project work, simulations, guest lectures) significantly improved knowledge (35-85%), confidence, and motivation
Develop methodological and policy recommendations for improving business education	ANOVA statistical analysis; assessment of employment trends, student business activity, and regional economic opportunities (Samarkand region)	Evidence supports targeted policy actions: curriculum reform, teacher training, entrepreneurship-business partnerships, and expanded digital learning

Although the findings indicate a positive impact of integrating entrepreneurial components into general scientific disciplines, the generalizability of the results is limited by the study's geographical scope. The research was confined to three educational institutions in Uzbekistan, primarily in Tashkent and Samarkand, which may not fully capture regional disparities in infrastructure, teacher preparedness, or economic conditions. Furthermore, the study did not account for socio-economic variables such as family income, urban versus rural background, or previous exposure to entrepreneurship, which could significantly influence both motivation and learning outcomes. Another limitation lies in the short-term nature of the pedagogical experiment. While the one-year intervention revealed substantial improvements in knowledge, motivation, and attitudes, it remains unclear whether these gains are sustained over time or translate into concrete entrepreneurial activity post-graduation. Additionally, the reliance on self-reported data introduces the risk of social desirability bias, particularly in post-intervention responses, which may overestimate the actual level of competency acquisition.

The recommendations for improving entrepreneurial education should be closely tied to the empirical data gathered during the research. The results clearly indicate a strong interest among students in entrepreneurial knowledge, as well as a need for more practical learning formats. Therefore, curriculum development efforts should focus on designing interdisciplinary modules that link scientific knowledge to real-world entrepreneurial tasks, such as market analysis or product innovation. Teacher training emerges as a critical factor, with a significant proportion of respondents noting a lack of pedagogical preparation in delivering entrepreneurial content. It is thus necessary to implement structured, state-supported professional development programmes that equip teachers with the skills and methods required to teach entrepreneurship within scientific contexts. Given the limited collaboration between schools and the business community, efforts should also be made to institutionalize partnerships between educational institutions and local enterprises, allowing students to engage with practitioners through guest lectures, mentoring, and project consultations. The study's results underscore the effectiveness of interactive methods – especially project-based learning, case studies, and business simulations – which should be systematically incorporated into teaching practices. Moreover, financial literacy emerged as a priority for both students and entrepreneurs, highlighting the need to include budgeting, investment, and risk management within the broader framework of entrepreneurial training. The strategic use of digital technologies, such as online simulations and hybrid learning platforms, can further enhance the accessibility and impact of entrepreneurship education, especially in under-resourced settings.

Future research should address the gaps identified in this study by incorporating additional variables and broadening the methodological scope. A key direction would be to integrate socio-economic and demographic indicators into future designs, enabling a more nuanced analysis of how different student backgrounds affect the development of entrepreneurial competencies. Longitudinal research is also needed to track how early exposure to entrepreneurial education influences career choices, business formation, and long-term employment. Comparative studies across various regions or countries could reveal how contextual factors such as policy environments, cultural attitudes, and institutional capacities shape the effectiveness of entrepreneurship education. Additionally, attention should be paid to the institutional context – examining how school governance, funding mechanisms, and leadership styles influence the implementation of entrepreneurial curricula. Gender-specific analyses would also provide valuable insights, especially in light of potential disparities in access to entrepreneurship training and differences in how male and female students engage with entrepreneurial content. By addressing these dimensions, future studies can provide a

more comprehensive and policy-relevant understanding of how to develop effective, inclusive, and scalable entrepreneurial education models.

One limitation of the study is the absence of statistical controls for baseline differences, socio-economic status, teacher experience, and prior exposure to entrepreneurship, which were not accounted for in the analysis. These factors may contribute to the observed differences in outcomes between the experimental and control groups, with socio-economic background and previous entrepreneurial exposure possibly influencing students' readiness to engage with entrepreneurial education, while teacher experience may affect the effectiveness of the intervention. Additionally, the study did not employ multilevel models to account for clustering effects within institutions, nor did it report intraclass correlation (ICC), which would have helped assess the proportion of variance attributable to group differences. Future studies should address these gaps by using multilevel models and incorporating socio-economic covariates to provide a more precise understanding of the factors driving the observed effects. Furthermore, while the study reports positive changes in entrepreneurial knowledge and confidence, the one-year duration of the intervention limits conclusions about long-term impacts on business formation or employment outcomes. Claims about these long-term effects are speculative without longitudinal data, and although the authors partially acknowledge this, it should be emphasized that further research is needed to assess the sustainability and real-world application of the developed competencies. The study also faces several biases, including measurement bias (self-report), sampling bias, lack of randomized assignment, short follow-up period, and missing socio-economic covariates, which should be addressed in future research.

5. Conclusions

The study examined various aspects of entrepreneurial education in Uzbekistan, in particular, the effectiveness of integrating entrepreneurial elements into the teaching of general scientific disciplines. The results obtained confirm the importance of entrepreneurial education in modern conditions for the formation of not only theoretical knowledge but also practical skills among students. One of the main results of the study was the identification of a substantial increase in the interest of pupils and students in entrepreneurial activities. During the experiment, which lasted one academic year, it was determined that the level of knowledge about entrepreneurial activity in the EG increased from 35% to 85%, while in the CG, this indicator increased only from 30% to 35%. Confidence in their ability to start a business among the participants of the EG increased from 45% to 75%, while in the CG, this indicator changed slightly, from 40% to 45%. The positive attitude towards entrepreneurship among the participants of the EG increased from 30% to 80%, and the level of understanding of economic processes increased from 25% to 85% due to interactive training methods. The development of business projects was useful for 90% of the participants in the EG, which greatly exceeded the same indicator in the CG (15%). Additionally, 90% of students and students of the EG had a desire to have more entrepreneurial disciplines in the curriculum, which indicates an increase in interest in this area.

The analysis of regional statistics confirmed that after the introduction of entrepreneurial methods in the educational process in the Samarkand region, the number of young people who are interested in starting their own business has increased. This indicates the effectiveness of adapting educational programmes to modern economic challenges. It was also established that the integration of entrepreneurial education into general scientific disciplines significantly increased the level of employment of young people in small and medium-sized businesses. In

general, the results of the study confirmed that combining theoretical knowledge with practical experience, particularly through interactive teaching methods, substantially improves students' readiness for real business conditions.

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