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Integrating Science Education and Financial Economics to Enhance Knowledge-Based Entrepreneurship

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Abstract: This study explores the integration of science and financial economics education in higher education curricula to foster knowledge-based entrepreneurship in the context of globalization and digitalization. Using a qualitative approach with literature analysis and focus group discussions (FGDs) involving academics and business practitioners, the research highlights how a multidisciplinary approach—merging scientific knowledge and financial economics—can enhance entrepreneurial skills. This integration not only deepens theoretical understanding but also equips students with essential financial skills for sustainable business practices. The study underscores the need for educational policies that promote synergy between these fields to cultivate competitive, knowledge-driven entrepreneurs in the futuree.

Keywords: Financial Economics; Higher Education Curriculum; Innovation Knowledge-Based Entrepreneurship; Science Education

Introduction

Entrepreneurship plays a crucial role in the global economy by contributing to job creation and economic growth. (Toshaliyeva Saodat Toxirovn, 2024) However, a major challenge faced by many entrepreneurs, especially in developing countries, is the inability to integrate various disciplines essential for sustainable business development. (Ioannis Kostakis, Konstantinos P. Tsagarakis, 2022). In this fast-paced era, knowledge-based entrepreneurship has become highly relevant, as it relies on technological innovation and the utilization of scientific knowledge. (Hughes, M., Hughes, P., Hodgkinson, I., Chang, Y., & Chang, C., 2021). Therefore, a broader set of skills is required—not only technical skills but also a deep understanding of economics and finance, which complement each other in business management and development.

Science education, which focuses on research and innovation, plays a significant role in the development of technology-based products or services that can enhance market competitiveness. . (Cooper, 2023) However, without strong financial management skills, the potential for such innovations is often not fully realized. (Ingale, 2020). On the other hand, a solid understanding of financial economics is essential to ensure efficient resource management, proper risk planning, and strategic business decision-making. (Ijaz & Chughtai, 2022). Despite the strong interconnection between these two fields, the integration of science education and financial economics within higher education curricula remains limited and has not been widely explored as an effective entrepreneurship learning model. (Mei & Symaco, 2020).

Financial economics education provides essential skills for managing capital, planning and mitigating risks, and formulating long-term strategies for business sustainability. (Frisancho, 2022) However, many curricula still teach these two fields separately, which may hinder the development of entrepreneurs who are

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not only innovative but also capable of managing and growing their businesses with a strong financial analysis approach. (Fachururaji, 2023). Therefore, this study is crucial in exploring and developing an integration model between science education and financial economics to create entrepreneurs with multidisciplinary skills who are prepared to face the increasingly complex challenges of the global economy.

This research systematically integrates science education and financial economics into entrepreneurship curricula. Through a multidisciplinary approach, it aims to cultivate a generation of entrepreneurs who not only possess technical and innovative skills but also a deep understanding of economic and managerial aspects that support the success and sustainability of knowledge-based enterprises. By developing a curriculum model that combines these two disciplines, this study is expected to contribute to the renewal of entrepreneurship education systems, making them more relevant and adaptive to market dynamics and rapid technological advancements.

In the era of globalization and digitalization (Koos, 2022), knowledge-based entrepreneurship has become a key factor in creating sustainable economic competitiveness (Yang et al., 2023) However, several challenges hinder the development of entrepreneurs capable of integrating scientific knowledge with financial economic skills (Toudas & Kanellos, 2022) . Although many studies have looked at integrating general curricula with entrepreneurship models, very few explore how science practicums can embed economic concepts and financial literacy. Science labs—like quantitative chemistry experiments or climate-change simulations—provide a perfect setting for cost–benefit analyses, risk assessment, and market-dynamics modeling, yet no framework ties lab methods to real-world economic decision-making (Mei & Symaco, 2020; Toudas & Kanellos, 2022). Addressing this gap could transform the science curriculum into an interdisciplinary platform that prepares students as both scientists and entrepreneurs for the global market.

Based on the background described, the research problem formulation is as (1) What are the current characteristics and needs of science and financial economics education in supporting the development of knowledge-based entrepreneurship? (2) What are the challenges and barriers to integrating science and financial economics education within the educational environment? (3) How can an effective learning model be designed to integrate science and financial economics education to enhance knowledge-based entrepreneurial skills?

This problem formulation serves as the foundation for addressing the need for an educational approach that fosters innovative and competent entrepreneurs in managing knowledge-based businesses.

Method

This study employs a mixed-methods approach (Nesher Shoshan *2021*), combining quantitative and qualitative methods to gain a comprehensive understanding of how to integrate science and financial economics education to enhance knowledge-based entrepreneurship. The research methodology is outlined as follows:

Research Design

This study is conducted in two main stages:

a. Exploration Stage**:** Identifying the needs and challenges in integrating science and financial economics education through literature reviews, in-depth interviews, and focus group discussions (FGDs) (Susanto et al., 2024)
b. Implementation and Evaluation Stage**:** Designing and testing the integration model within an educational environment, followed by an evaluation of its effectiveness.

Research Subjects

a. Participants: (1) Science and financial economics teachers from high school to higher education levels; (2) Students and university students involved in entrepreneurship programs.
b. Practitioners and experts in the fields of entrepreneurship, education, and financial economics.

Research Location

The study is conducted in several schools and universities that offer science and entrepreneurship programs.

Data Collection

a. Qualitative:

In-depth Interviews: Conducted with teachers, students, and experts to understand the needs, perceptions, and challenges of educational integration .(Paños-Castro-et-Al-2024.).

Focus Group Discussion (FGD): Engaging teachers and experts to formulate a relevant integration model (Susanto et al., 2024).

b. Quantitative:

Survey: Using questionnaires to assess students' perceptions of the importance of integrating science and financial economics.

Pre-test and Post-test: Administered to students participating in the integrated learning model to

measure improvements in knowledge-based entrepreneurial skills. The pre-test/post-test instrument comprised 40 items in total: 30 multiple-choice questions (each with four options) measuring core science and financial-economics concepts, and 10 five-point Likert-scale statements assessing students' confidence in applying those concepts to entrepreneurial tasks. Content validity was ensured by an expert panel of five science and economics lecturers, yielding an item-level Content Validity Index (CVI) of ≥ 0.80; construct validity was confirmed via confirmatory factor analysis in AMOS (factor loadings ≥ 0.50; CFI > 0.90; RMSEA < 0.08). Internal consistency reliability was assessed using Cronbach's α (science subscale = 0.87; finance subscale = 0.85; overall = 0.89), and test–retest reliability (ICC = 0.82) was evaluated on a pilot sample (n = 30).

Data Analysis

Qualitative Data: Interview and FGD data are analyzed using thematic analysis techniques to identify key themes relevant to integration needs.

Quantitative Data: Pre-test and post-test results are analyzed using statistical methods. Data were analyzed using IBM SPSS Statistics v26 (for data cleaning, descriptive statistics, paired-samples t-tests, ANOVA, and reliability analysis), IBM SPSS for robustness checks of the structural models. The analysis procedures included screening for missing data, assessing normality and outliers; computing descriptive statistics; conducting item–total correlation analyses; testing internal consistency via Cronbach's α; performing paired-samples t-tests to compare pre-test and post-test scores; and running CFA and SEM to evaluate the hypothesized relationships among variables.

Result and Discussion

"*Current Characteristics and Needs of Science and Financial Economics Education in Supporting the Development of Knowledge-Based Entrepreneurship*"

Science education tends to focus on theoretical understanding and laboratory experiments (Ullah et al., 2022), with little emphasis on practical applications in the business or entrepreneurial world. Conversely, financial economics primarily discusses financial management, such as capital planning and risk management, but lacks connection to science-based innovation.(Acharya et al., 2023) This separation creates a gap that hinders students' ability to link scientific knowledge with relevant economic skills (Tiberius & Weyland, 2023)(Mahmudin, 2023).

To bridge this gap, education requires an integrated curriculum where science and financial economics are taught together in an entrepreneurial context. (Miço, 2023) Learning materials should be designed to be more practical, incorporating technology-based business simulations and relevant case studies. Additionally, teachers from both fields should receive specialized training to effectively teach interdisciplinary content. (Wahyuni & Aspan, 2023) Collaboration between science and economics educators is also necessary to develop complementary learning programs (Roos & Reccius, n.d.). By addressing these needs, education can equip students with multidisciplinary skills required to create knowledge-based innovations and professionally manage businesses in a competitive global environment (Mesutoglu et al., 2024, Hookway, 2023, Li, 2023)

Research findings indicate that science and financial economics education currently exhibit separate characteristics with distinct focuses. Science education primarily emphasizes conceptual understanding and laboratory practice (Febri et al., 2023), yet it does not sufficiently stress practical applications in business or entrepreneurship. (Raharjo et al., 2023) Meanwhile, financial economics education is oriented towards resource management, (Shadiyev Alisher Xudoynazarovich Asian, 2024) financial planning, and investment theory, but lacks integration with scientific knowledge to create economically valuable innovative products.

The primary identified need is for a more integrated curriculum that practically combines scientific concepts with financial economics skills. Learning materials should be designed to be more relevant to real-world applications, for example, by incorporating technology-based business simulations or case studies on innovative products. Moreover, educators from both disciplines require training to effectively deliver interdisciplinary content.

The results of interviews with science teachers revealed that although science has great potential for innovation, current learning is still limited to laboratory experiments without providing an understanding of how scientific knowledge can be applied to create economically valuable solutions. On the other hand, financial economics teachers acknowledged that students learn theories of capital management and investment, but they are not trained to integrate this knowledge with science-based innovation, such as business feasibility analysis for technology-based products.

Below is a table presenting the research findings from the interviews and FGDs conducted to address the research question regarding the characteristics and needs of science and financial economics education in supporting the development of knowledge-based entrepreneurship.

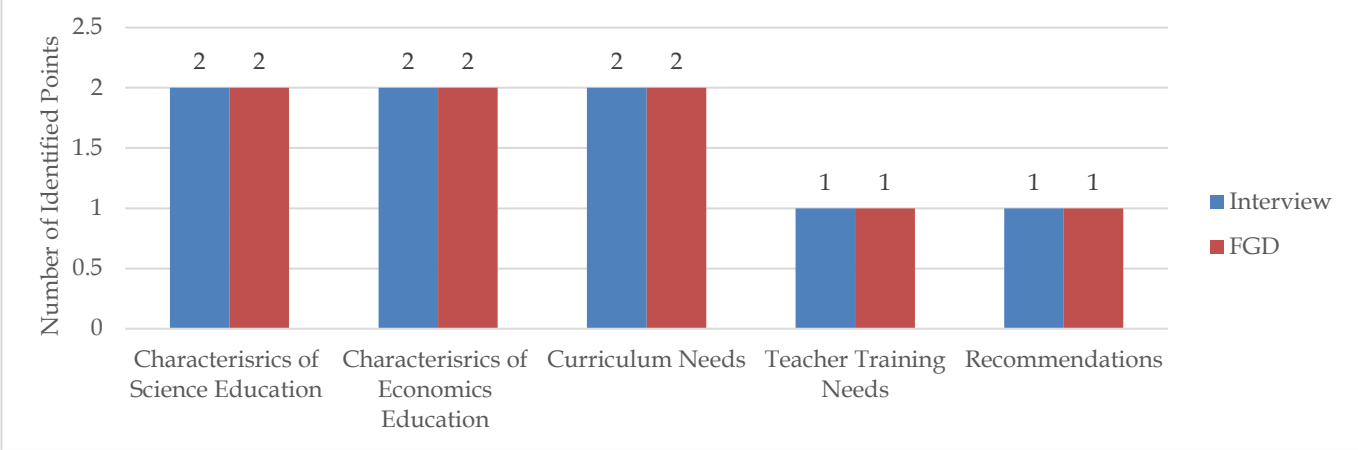

Figure 1. Comparison Interview vs. FGD Findings by Aspect

Above is a bar chart comparing the number of identified findings from direct interviews versus focus group discussions (FGDs) for each research aspect. The x-axis represents each aspect, and the y-axis indicates the number of points identified through both data-collection methods. This chart facilitates visualizing the proportion and parity of findings from interviews and FGDs across all aspects.

This study emphasizes that the integration of science education and financial economics is crucial for supporting the development of knowledge-based entrepreneurship. This can be achieved through project-based learning, interdisciplinary collaboration between science and economics teachers, and educational policies that support an integrative curriculum. These measures are expected to equip students with multidisciplinary skills relevant to addressing the increasingly complex challenges of the global economy.

Several key issues relate to the characteristics and needs of science and financial economics education in supporting the development of knowledge-based entrepreneurship (Zamhariri et al., 2023). First, current science and financial economics education tends to focus on theoretical aspects while paying less attention to practical applications in the context of entrepreneurship (Okoye et al., 2023). Science education primarily emphasizes fundamental concepts and laboratory experiments, whereas financial economics education focuses more on financial management theories without integrating scientific knowledge to create technology-based innovations (Wihelmina Afua Addy et al., 2024). This separation makes it difficult for students to connect their learned knowledge with the skills needed to manage knowledge-based businesses.

Second, there is an urgent need to design a more integrated curriculum that combines science and financial economics within an entrepreneurial context (Okoye et al., 2023). A project-based learning (PBL) curriculum is highly needed, where students can apply scientific knowledge to develop technology-based products or solutions with economic value (Block et al., n.d.). Business simulations and real-world case studies will help students understand how these concepts interconnect and are applicable in real-world scenarios.

Moreover, teachers' readiness to teach interdisciplinary material is also a critical issue. Science and financial economics teachers have expressed a lack of confidence and skills in delivering an integrated curriculum. Therefore, specialized training is necessary to equip teachers with the knowledge and ability to teach interdisciplinary subjects that combine science with financial economics. Collaboration between science teachers, economics teachers, and business practitioners is also essential in designing more relevant and effective learning programs that prepare students to face global economic challenges.

Overall, this analysis reaffirms that the integration of science and financial economics, combined with project-based learning and interdisciplinary collaboration, will significantly support the development of knowledge-based entrepreneurship. This approach will foster innovative and competent entrepreneurs capable of managing knowledge-based businesses effectively.

Challenges and Barriers in Integrating Science and Financial Economics Education in the Educational Environment

Integrating Science and Financial Economics Education in the Educational Environment Faces Various Complex Challenges and Barriers. (Arman & Aditya, 2023)One of the main challenges is the limitation of curricula, which are often still separated between science and financial economics, requiring a more structured interdisciplinary approach. (Lurger et al., 2023) Additionally, the readiness of educators is also a constraint, as not all teachers possess in-depth knowledge in both fields, particularly in remote areas. (Yangambi, 2023)

Adequate infrastructure and facilities are also crucial factors in this integration process. (Saidi et al., 2017) Many schools or educational institutions lack sufficient resources to provide teaching materials, laboratories, or supporting technologies that can practically link scientific concepts with financial economics. (Austin, 2023; Rezky & Handy, 2022)

Furthermore, resistance from students and the community toward changes in learning patterns can also be a barrier. .(Sakagianni et al., 2023)(Jaenullah, Ferdian Utama, 2022) Some students struggle to understand the connection between science and financial economics, while parents or other stakeholders in the education sector remain accustomed to conventional teaching models. .(Obiuto et al., 2024)

Therefore, a comprehensive strategy is required, ranging from enhancing teacher capacity (Timotheou et al., 2023),, updating curricula (Schalkwyk, 2024), to utilizing technology in learning (Wekerle et al., 2020), to ensure that the integration of science and financial economics education can be effectively implemented and provide optimal benefits for students.

The following are the research findings presented in both quantitative and qualitative formats regarding the challenges and barriers in integrating science and financial economics education within the educational environment. This study was conducted through a survey of 100 respondents, including science teachers, financial economics teachers, and university students from various educational institutions. Respondents were asked to assess several aspects of the challenges and barriers to integrating these two fields in learning. The survey results are as follows (Table 2).

Table 2. The challenges and obstacles in integrating science education with financial economics.

Aspects Being Assessed	Percentage (%)
Lack of an Integrated Curriculum	82
Teachers' Inability to Teach Interdisciplinary Material	74
Limited Time to Teach Integrated Material	68
Lack of Training for Teachers in Integrative Subjects	70
Lack of Resources and Infrastructure	55
Difficulties in Collaboration Between Science and Economics Teachers	63
Lack of Support from School Management	58

From this survey's results, it is evident that the greatest challenge faced is the lack of an integrated curriculum linking science education with financial economics (82%), followed by teachers' inability to teach interdisciplinary material (74%). Another significant challenge is the limited time available to teach material that integrates both fields (68%), as well as the lack of training for teachers to teach integrative subjects (70%).

1. The lack of an integrated curriculum

Many teachers have expressed that the current curriculum does not support teaching material that connects science with financial economics. Science education often focuses on theory and laboratory experiments, while financial economics is more focused on financial management theories without considering the relevant scientific aspects. This separate curriculum makes it difficult to teach and for students to understand the relationship between science and economics in the context of entrepreneurship.

This was expressed by Drs. Salehuddin, a teacher at SMA Negeri 1 Jeneponto, who said:

> *"The current curriculum is still very much separated between science and financial economics. Science education, for example, is more focused on basic theories and laboratory experiments, without providing a clear connection to how these concepts can be applied in the world of economics or business. Students often only study theories of physics or chemistry, but are not given an understanding of how this scientific knowledge can be transformed into economically valuable innovations. On the other hand, financial economics focuses more on theories of financial management, such as investments, risk, or capital management, but rarely discusses technologies or scientific innovations that could become part of business management. Since these two fields are taught separately, students have difficulty seeing the connection between scientific knowledge and economics, which is actually highly relevant in the context of knowledge-based entrepreneurship." (Interview, December 23, 2024)*

Further, from an interview with Ramlawati S.Pd., M.Pd, a science teacher at SMA Negeri 1 Jeneponto, she stated:

> *"Because of this separation, students often cannot see how the knowledge they learn in science can be used to solve economic problems or build a business. They tend to view science as something separate from the economic world, whereas in reality, science-based innovations can be extremely valuable for developing products and services that require financial analysis for sustainability." (Interview, December 23, 2024)*

Syamsuddin SE, a Financial Economics Teacher at SMA Negeri 1 Jeneponto, said:

> *"I feel that the material we teach focuses more on classical economic theories, such as financial management, investments, and capital planning. Unfortunately, many of us are not given the opportunity to link these concepts with more technical or technology-based scientific applications. Science is often viewed as a separate subject, yet many aspects of*

science, such as research and product development, are crucial in financial decision-making or business planning." (Interview, December 23, 2024)

He further mentioned:

"The current curriculum doesn't adequately support teaching that connects financial economics with science-based innovation or technology. Students should learn how these economic concepts can be applied in a broader context, such as in the development of products or technology-based startups. Without that, they can't fully understand how economics and finance play a role in entrepreneurship that leverages scientific knowledge." (Interview, December 23, 2024)

Both science and financial economics teachers acknowledge that the current curriculum is insufficient in linking the two disciplines. Science teachers emphasize that science should be applied in the context of entrepreneurship, while financial economics teachers express the need for a more integrated approach to teaching economic concepts related to knowledge-based innovation. This highlights the need for a curriculum change to provide students with a more holistic understanding of the relationship between science and economics in the world of entrepreneurship.

2. *Time and Resource Limitations*

Teachers have also expressed concerns about the limited time available to teach more complex and integrated material. The existing content often requires more time to explain, while the available time is limited. Additionally, the lack of resources and educational infrastructure, such as access to technology or supporting laboratories, becomes another barrier to teaching the integration between these two fields.

Here are the results from interviews with teachers:

Alimuddin SPd, a teacher at SMA Negeri 1 Jeneponto, said:

"Honestly, the time allocated to teach science is already very limited, especially for subjects with many theories and practices, such as physics or biology. When I have to add material that connects science with financial economics, it feels almost impossible to cover everything within the available time. Moreover, integration material like this requires a different approach and more detailed explanations, which means it needs a considerable amount of extra time." (Interview, December 23, 2024)

Similarly, Andi Basmi S.Pd.MM. mentioned:

"Resources and infrastructure also pose a major problem. We don't always have the necessary technology or well-equipped laboratories to support project-based or simulation-based learning. For example, when I want to demonstrate how a specific science technology can be turned into a product with economic value, I often struggle because the laboratory equipment doesn't support that. So, while there's an intention to integrate both fields, technical barriers often get in the way." (Interview, December 23, 2024)

"Time is indeed a major constraint. Right now, we are already struggling to cover the existing financial economics curriculum, such as financial planning, investments, or risk management. If we have to add material on how science can be integrated into business management or innovation, it would definitely take more time. This is not possible without sacrificing other important material." (Interview, December 23, 2024)

Regarding the available facilities or resources to support integrated teaching:

Rusdi Afendi SE, MM, a Financial Economics Teacher, said:

"Resources are indeed very limited. At our school, for example, we don't have access to relevant technology or laboratories that allow students to understand the application of science in the business world. Without such resources, it's difficult for us to provide a more integrated and practical learning experience. In the end, students only receive theory without seeing how it can be applied." (Interview, December 23, 2024)

From the interviews, it can be concluded that the main challenge in integrating science and financial economics is the lack of time to teach complex and integrated material. Teachers feel that the current curriculum is already too packed, making it difficult to add new content without compromising the quality of learning. Additionally, the lack of resources and infrastructure, such as laboratories and supporting technology, poses a significant barrier. This highlights the need for curriculum revision, additional time allocation, and improvement of educational infrastructure to support the integration between science and financial economics.

3. Challenges in Teacher Training

Many teachers have expressed that they have not received adequate training to teach interdisciplinary material. They feel unprepared and lack the necessary skills to connect science and economics in a single subject. More focused training on integrating disciplines would greatly assist in improving teachers' ability to teach these subjects.

4. Lack of Support from School Management

Some participants in the FGD (Focus Group Discussion) also mentioned that support from school management is still lacking in implementing an integrated curriculum. Some schools have not fully supported changes in the education system that involve the integration of interdisciplinary curricula due to concerns about effectiveness and resource readiness.

The challenges and obstacles in integrating science education and financial economics mainly focus on the lack of an integrated curriculum, limited time and resources, and insufficient teacher training in teaching interdisciplinary material. In addition, the lack of collaboration between teachers and support from school management also poses significant barriers that need to be addressed in the development and implementation of education that connects these two fields to support knowledge-based entrepreneurship.

Design of an Effective Learning Model to Integrate Science Education and Financial Economics to Enhance Knowledge-Based Entrepreneurship Skills. A quantitative study was conducted through a survey of 120 respondents, including science teachers, financial economics teachers, students, and education experts. Respondents were asked to evaluate various aspects of the proposed learning model design to integrate science education and financial economics. Below are the results.

Table 3. Aspects of the Proposed Learning Model Design to Integrate Science Education and Financial Economics

Aspects Being Assessed	Percentage (%)
Project-Based Learning Approach	85
Collaboration Between Science and Financial Economics Teachers	78
Use of Digital Technology in Learning	73
Integration of Real-World Case Studies Focused on Entrepreneurship	88
Provision of Supporting Facilities such as Laboratories	69
Specialized Teacher Training for Integrated Learning	82
Development of a Flexible Integrated Curriculum	87

The data shows that integrating real-world case studies (88%) and developing a flexible integrated curriculum (87%) are considered the most important elements in the learning model design. In addition, the project-based approach (85%) and specialized teacher training (82%) are also prioritized in developing an effective learning model.

This study uses ANOVA testing to analyze the effectiveness of different learning model approaches in integrating science education and financial economics to enhance knowledge-based entrepreneurship skills. The learning model approaches tested include: (1) Project-Based Approach (PBP); (2) Integration of Real-World Case Studies (ISK); (3) Use of Digital Technology (PTD); (4) Conventional Method (MK) **(**as the control group).

Dependent Variable

Knowledge-based entrepreneurship skills of students measured using test scores after the learning implementation. Let me know if you need further assistance in refining or interpreting the results from the analysis.

Based on this table, the hypothesis testing can proceed:

- H_0 (Null Hypothesis): If the p-value is greater than 0.05, fail to reject the null hypothesis (there's no significant difference in knowledge-based entrepreneurship skills across the different learning models).
- H_1 (Alternative Hypothesis): If the p-value is less than 0.05, reject the null hypothesis (there's a significant difference in knowledge-based entrepreneurship skills across the different learning models).

Table 4. Output of the ANOVA Analysis Results**.**

Learning Model	Number of Students (N)	Average Score	Standar Deviasi (SD)
Project-Based Approach	30	85.3	4.5
Integration of Real-World Case Studies	30	87.5	5.1
Use of Digital Technology	30	82.7	6.3
Conventional Method"	30	75.4	4.8

Result of ANOVA test:
F-value: 15.67
p-value: < 0.001
Interpretation of Results:

1. Normality and Homogeneity of Variance Test: The data meets the assumptions of normality and homogeneity of variance ($p > 0.05$), thus ANOVA can be used.
2. ANOVA Test Results: The F-value of 15.67 with a p-value < 0.001 indicates that there is a significant difference in the knowledge-based entrepreneurship skills of students between the different learning model groups.
3. Post-hoc Test (Bonferroni):
   a. The Project-Based Approach group has a significantly higher average score compared to the Conventional Method group ($p < 0.01$).
   b. The Real-World Case Study Integration group has a significantly higher average score compared to the Conventional Method group ($p < 0.01$).
   c. There is no significant difference between the Project-Based Approach and Real-World Case Study Integration groups ($p > 0.05$).
   d. The Use of Digital Technology is more effective

compared to the Conventional Method ($p < 0.05$) but less effective compared to the other two approaches.

Conclusion:

The Project-Based Approach and Real-World Case Study Integration are the most effective learning models for enhancing knowledge-based entrepreneurship skills. This can be explained by the practical, contextual advantages and real-world relevance that these two models offer.

The Use of Digital Technology, although it contributes positively, is less effective than the other two approaches due to possible limitations in student access to devices or a lack of training in utilizing technology to its full potential. The Conventional Method shows the lowest average score, indicating that traditional approaches are not sufficiently effective in integrating science and economics to support knowledge-based entrepreneurship.

Hypothesis Conclusion:

Based on the data analysis, H_0 (Null Hypothesis) is rejected, and H_1 (Alternative Hypothesis) is accepted, meaning there is a significant difference in the effectiveness of the learning models. To support the development of knowledge-based entrepreneurship, the education curriculum should place more emphasis on the Project-Based Approach and Real-World Case Study Integration as primary learning models. The development of technology facilities and teacher training is necessary for the optimal use of digital technology. These findings can serve as a foundation for the development of more effective learning designs in the future.

The findings of this study pave the way for transforming science practicums into innovative business simulations, in which students not only conduct scientific experiments—such as quantitative chemical reactions—but also model raw-material costs, assess investment risks, and analyze profit projections within a "mini-company" laboratory, thereby developing scientific skills and financial literacy simultaneously. By leveraging digital simulations, experimental variables (e.g., concentration, temperature) and market variables (e.g., price, demand) can be combined to teach data-driven decision-making and marketing strategies. To realize this vision, the science curriculum is reformed into interdisciplinary modules: each practicum unit includes budget-planning worksheets and market scenario exercises, assessments encompass both lab reports and simple financial statements, and science teachers are prepared through co-teaching workshops with economics teachers to design and facilitate science-based business simulations.

Conclusion

Science and financial economics education are still separate, hindering integration for knowledge-based entrepreneurship. An integrated curriculum, teacher training, project-based learning, collaboration among teachers, and infrastructure support are needed. The main challenges include the lack of curriculum integration (82%), limited time (68%), and insufficient teacher training (70%). Integration through a project-based approach and flexible policies will strengthen students' multidisciplinary skills in facing global economic challenges.

Science educators are encouraged to incorporate economic concepts into laboratory activities, enabling students to connect scientific experiments with real-world financial considerations. For instance, during fermentation experiments, students can calculate production costs, assess market potential, and devise marketing strategies for the resulting products. Implementing project-based learning (PBL) that combines scientific inquiry with economic analysis can enhance students' critical thinking and problem-solving skills. Collaborating with economics or entrepreneurship teachers to design interdisciplinary projects will further enrich students' learning experiences and provide a comprehensive understanding of how scientific knowledge applies within economic contexts.

Policymakers should advocate for the development of integrated curricula that merge science and economics education, particularly at the secondary school level. Such curricula will equip students with interdisciplinary skills essential for the modern workforce. Providing professional development programs for teachers to effectively deliver integrated content is crucial. Additionally, allocating resources to support the creation of interdisciplinary teaching materials and the establishment of facilities that facilitate combined scientific and economic learning experiences will be instrumental in successfully implementing this educational approach

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Author Contributions

Conceptualization, MD.; methodology, MD, NOR, SRN.; validation, SY, MD,SR, and ER; formal analysis, MD, NOR and ER.; investigation, , MD, NOR and ER, resources, , MD, NOR, ER and SR; data curation SY, JU and BS.: writing—original draft preparation, SY, JU, BS

writing—review and editing, SY, MD, and SR visualization, and MD, NOR, SR and ER. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest

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