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REVIEW

Mapping the Definition and Development Strategy of Entrepreneurship Self-Efficacy in Biology Learning: A Systematic Literature Review

Mapeo de la definición y la estrategia de desarrollo de la autoeficacia empresarial en el aprendizaje de la biología: una revisión sistemática de la literatura

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ABSTRACT

Introduction: Entrepreneurial Self-Efficacy (ESE) is an individual's belief in the ability to carry out entrepreneurial tasks. ESE is important to form students who not only master knowledge but also can apply it in innovation and entrepreneurship. However, the development of ESE in the context of Biology education is still a challenge and requires an understanding of the right strategy.
Method: this study uses the Systematic Literature Review (SLR) method by examining 22 articles selected from the Scopus database based on strict inclusion criteria. The focus of the analysis is the definition of ESE in Biology learning and students' ESE development strategies.
Results: ESE in Biology learning is defined as the student's belief in applying biological knowledge in creating innovation and business opportunities. Effective ESE development strategies include project-based learning, the use of digital technologies such as e-learning and simulation, strengthening social support through mentoring, and developing creativity and leadership. The main challenges are the lack of practical experience and the lack of optimal integration of entrepreneurship in the curriculum.
Conclusions: Entrepreneurial Self-Efficacy (ESE) in Biology learning is the belief of students to apply biological science in creating innovations and business opportunities. ESE development can be done through project-based learning, the use of digital technology, as well as social support and mentoring.

Keywords: Entrepreneurial Self-Efficacy; Biology Education; Self-Efficacy; Systematic Literature Review.

RESUMEN

Introducción: la autoeficacia empresarial (ESE) es la creencia de un individuo en la capacidad de llevar a cabo tareas empresariales. La ESE es importante para formar estudiantes que no solo dominen los conocimientos, sino que también puedan aplicarlos en la innovación y el emprendimiento. Sin embargo, el desarrollo de la ESE en el contexto de la enseñanza de la biología sigue siendo un desafío y requiere una comprensión de la estrategia correcta.
Método: este estudio utiliza el método de Revisión Sistemática de la Literatura (SLR) mediante el examen de 22 artículos seleccionados de la base de datos Scopus en base a estrictos criterios de inclusión. El enfoque del análisis es la definición de ESE en el aprendizaje de la Biología y las estrategias de desarrollo de ESE de los estudiantes.

Resultados: el aprendizaje de ESE en Biología se define como la creencia del estudiante en la aplicación del conocimiento biológico en la creación de innovación y oportunidades de negocio. Las estrategias efectivas de desarrollo de ESE incluyen el aprendizaje basado en proyectos, el uso de tecnologías digitales como el aprendizaje electrónico y la simulación, el fortalecimiento del apoyo social a través de la tutoría y el desarrollo de la creatividad y el liderazgo. Los principales desafíos son la falta de experiencia práctica y la falta de una integración óptima del emprendimiento en el plan de estudios.
Conclusiones: la autoeficacia empresarial (ESE) en el aprendizaje de la biología es la creencia de los estudiantes de aplicar la ciencia biológica en la creación de innovaciones y oportunidades de negocio. El desarrollo de ESE se puede realizar a través del aprendizaje basado en proyectos, el uso de la tecnología digital, así como el apoyo social y la tutoría.

Palabras clave: Autoeficacia Empresarial; Educación en Biología; Autoeficacia; Revisión de la Literatura Istemática.

INTRODUCTION

Entrepreneurship Self-Efficacy (ESE) is an individual's belief in his or her ability to carry out entrepreneurial tasks, such as recognizing opportunities, managing risks, developing innovations, and making strategic business decisions.[1] This concept is rooted in Albert Bandura's theory of self-efficacy, which emphasizes that a person's confidence in completing a certain task affects their motivation, perseverance, and success.[2] ESE is an important factor in shaping students' mindsets and skills to be better prepared to face the challenges of the business world. The importance of ESE is also seen in various entrepreneurship training programs designed to improve students' skills and confidence. In addition, support from the environment, both in the form of education policies, entrepreneurial communities, and access to capital and technology, also plays a role in strengthening ESE.[3,4] Individuals are not only better prepared to enter the business world but also have higher resilience in the face of competition in the entrepreneurial world.

ESE in the field of biology education refers to the self-confidence of biology students in developing and implementing entrepreneurship-based innovations in the field of biology.[3] ESE not only includes the ability to manage biology-based businesses, such as applied biotechnology or eco-enterprises, but also skills in creating innovative educational products, such as digital-based learning modules, interactive media, or educational board games that incorporate augmented reality (AR) technology. Biology students can open new opportunities in creating creative solutions that connect biological science with the industrial world, while expanding the impact of biology learning in society.[5] In addition, collaboration with industry, the conservation community, and start-ups in the field of biology can increase the confidence of students and teachers in applying entrepreneurial skills. Biology education graduates not only become innovative educators but are also able to become entrepreneurs in the field of education and applied biology, which can create new job opportunities as well as contribute to environmental sustainability.[6]

The low ESE among students is currently a challenge in forming an independent and innovative young generation in the world of work.[7,8,9] Many students still feel less confident in developing business ideas, taking risks, and facing entrepreneurial challenges.[10] Factors such as lack of practical experience, lack of introduction to the industrial world, and limited curriculum in integrating entrepreneurship education contribute to the low ESE.[11] In addition, a mindset that prioritizes finding a job rather than creating business opportunities is also an obstacle to increasing student confidence in entrepreneurship.[12] The impact of this low ESE is quite significant. Students become less motivated to take risks and look for business opportunities, even though the potential for innovation and economic growth often emerges from the younger generation. As a result, college graduates tend to prefer conventional career paths as employees, and their contribution to creating new jobs becomes limited. Therefore, efforts to improve student ESE are crucial through various programs such as business incubators, mentoring with successful entrepreneurs, and a more applicable curriculum.[13]

Systematic literature review (SLR) studies that specifically discuss Entrepreneurial Self-Efficacy (ESE) in the context of biology education have not been found. The integration of entrepreneurial concepts in biology education has significant potential to equip graduates with relevant skills in the modern era. The absence of this comprehensive study shows that there is a gap in our understanding of how ESE is influenced and can be developed through biology learning, as well as its impact on biology students' interest and ability to create innovations and businesses in relevant fields.[12] This condition raises important questions about future research opportunities. SLR studies that focus on ESE in biology education can summarize partial findings that may be scattered across studies with different focuses. Thus, the results of this SLR will provide a strong foundation for

the development of effective learning strategies to improve the ESE of biology education students, as well as potential factors that affect student ESE in the field of biology education.

METHOD

Research Framework

This study is a Systematic Literature Review (SLR), which is a systematic and explicit method to identify, select, and critically assess relevant research based on the questions formulated.[14,15,16] We use the research theme on ESE in biology education at universities.

Research Question

Research questions serve to establish the scope and focus of the research. The research questions were developed as follows.

RQ1: How to define ESE in Biology learning?

RQ2: What strategies have the potential to develop student ESE in the field of biology education?

Search Article and Inclusion Criteria

Researchers use the keywords "entrepreneurial self-efficacy" AND "university students" (Figure 1). The included stage is to include studies that meet all criteria in a systematic analysis. The remaining 22 articles are relevant and qualitative, so they can be used to answer research questions.

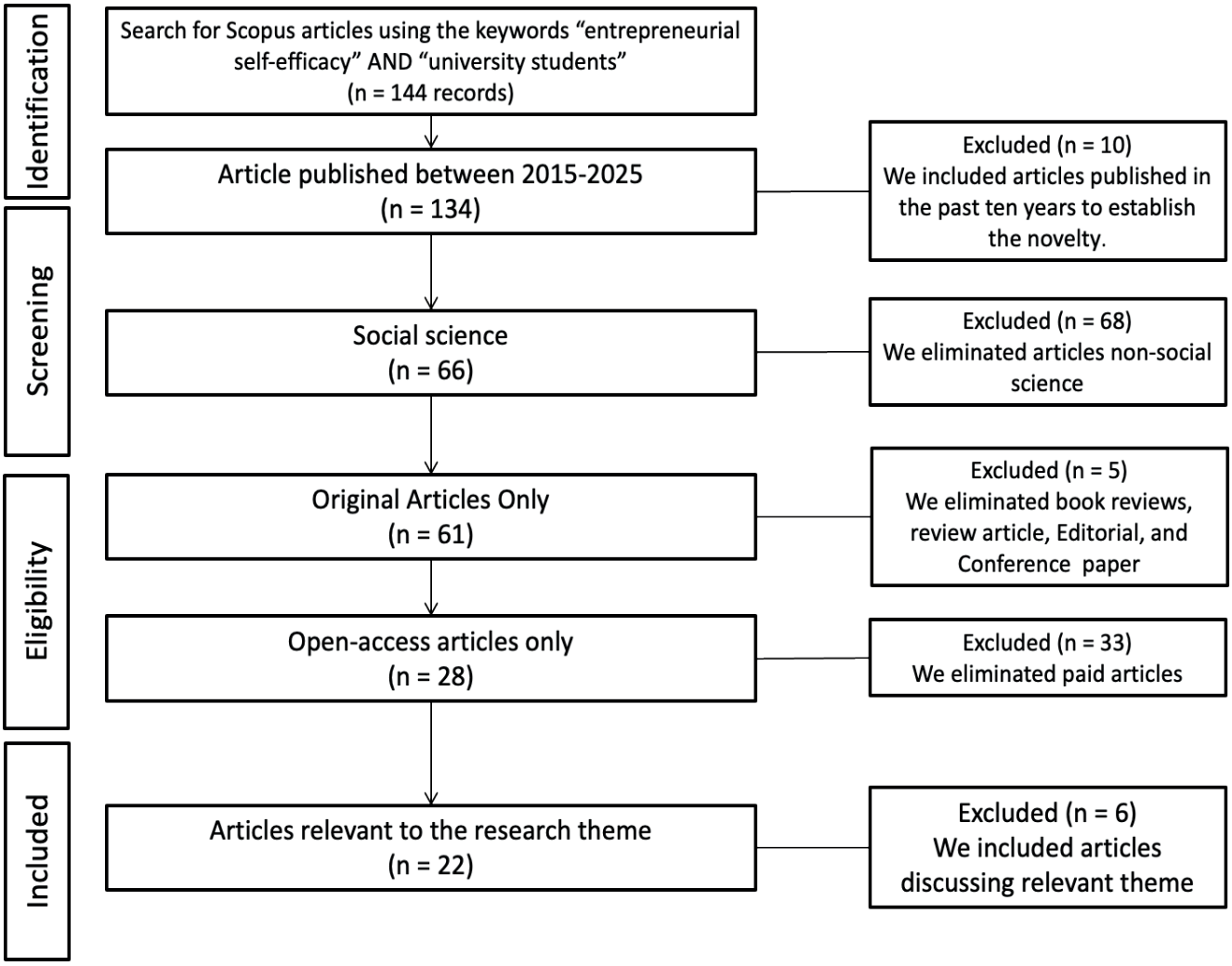

Figure 1. PRISMA Diagram

RESULT

Based on the results of the review of 22 articles, three keywords were found to define the concept of ESE as described in figure 2.

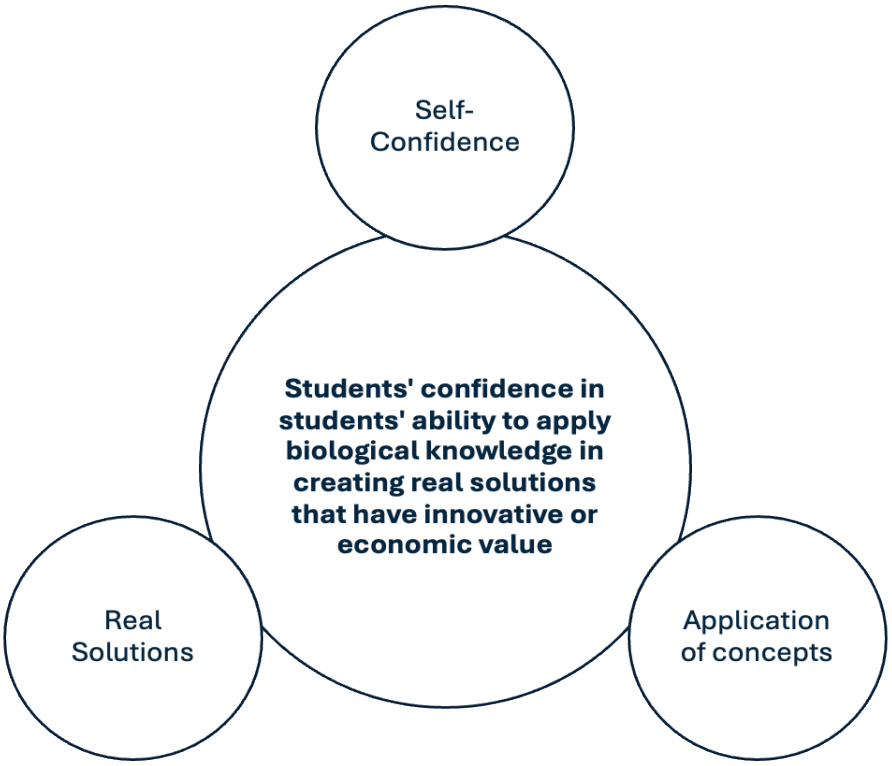

Figure 2. Definition of ESE in Biology Learning

Based on the synthesis of 22 articles that have been studied, it was found that various strategies have proven to be effective in developing ESE in students and can be adapted in the context of Biology learning. The most dominant strategy is the project-based learning approach that allows students to develop real science-based solutions (figure 3).

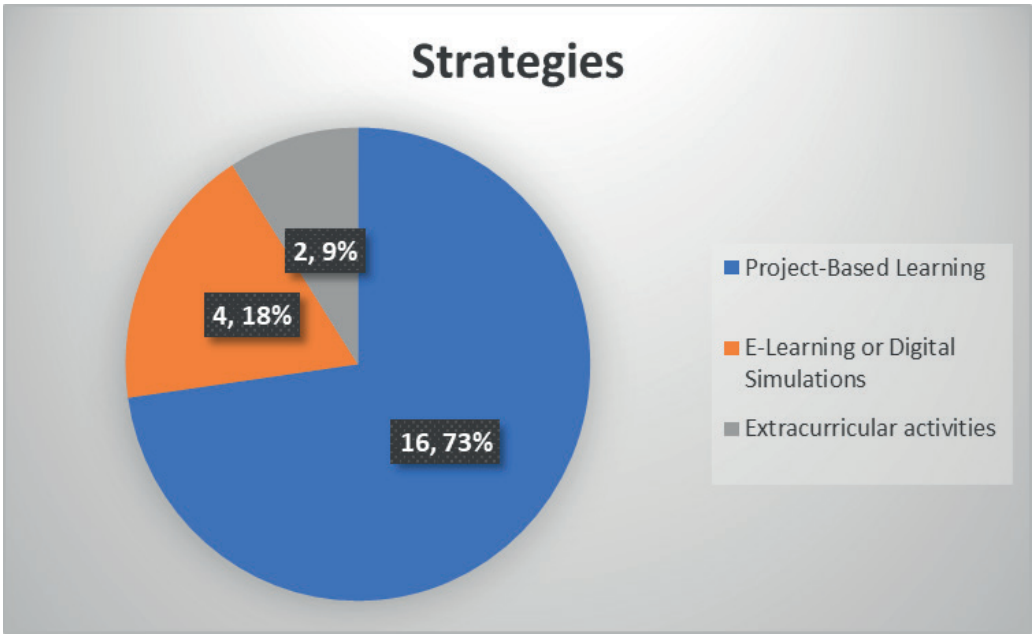

Figure 3. Strategies for ESE

DISCUSSION

Definition of ESE in Biology Learning

This definition rests on a common understanding of ESE as individuals' confidence in their entrepreneurial capabilities.[18] ESE in the context of biology learning can be interpreted as students' confidence in students' ability to apply biological knowledge in creating real solutions that have innovative or economic value. This belief includes the student's capacity to identify biological science-based opportunities, such as organic waste

management, herbal product development, or innovation in sustainable agriculture. ESE is formed through belief in one's ability to solve problems and generate new ideas.[19] Therefore, ESE not only reflects the courage to be entrepreneurial in biology learning but also reflects students' readiness to bridge science with the real world through creativity, leadership, and real action based on scientific knowledge.

Entrepreneurial Self-Efficacy (ESE) consists of several key dimensions that are highly relevant to be developed in Biology learning, especially through a project-based approach and contextual problem-solving. There are four main dimensions in ESE, namely innovation efficacy, opportunity identification, relationship coordination, and risk-taking efficacy. Innovation efficacy in biology learning is seen when students design biotechnology-based solutions, such as organic fertilizers or herbal products. Opportunity identification occurs when students recognize local needs, such as the potential for medicinal plants to be utilized as a business opportunity. While risk-taking efficacy is related to the courage of students to try new approaches in experiments or the presentation of their scientific ideas. Relationship coordination plays an important role when students work in teams to complete environmental projects or product development. In addition, another study adds that entrepreneurial self-efficacy was comparatively higher for individuals with higher levels of perseverance/learning consistency (innovativeness), those who enjoy problem-solving tasks, and those who are creative.[20] Therefore, Biology learning that integrates creativity, cooperation, and exploration of the real world is a strategic means to develop these four dimensions holistically

Strategies to Develop Student ESE

Project-based learning strategies are the most dominant strategy to improve student ESE. Students should engage in meaningful entrepreneurial projects that relate to real-world problems to develop ESE.[21] In addition, the use of e-learning and digital simulations has also been proven to encourage the formation of ESE, especially when supported by lecturer competence and the availability of adequate facilities. Strengthening ESE is also obtained through social support from family, friends, and institutions, which enhances the relationship between self-confidence and entrepreneurial intentions. Social support positively moderated the effect of entrepreneurial self-efficacy on entrepreneurial intentions.[22] Other skills, such as creativity and leadership, also play a big role, with findings suggesting that creative self-efficacy contributed most to the expected change in entrepreneurial self-efficacy.[9] Another strategy that is no less important is exposure to entrepreneurial alumni, as well as student involvement in extracurricular activities such as innovation competitions that provide space for the exploration of scientific ideas into business opportunities.

Biology learning has strategic potential as a medium for the development of ESE because of its scientific character that is close to daily life, the environment, and biotechnology innovations. Strategies to strengthen ESE in this context require a transdisciplinary approach that emphasizes not only the mastery of biological content, but also on its practical and social application. For example, the application of project-based learning allows students to develop solutions to local environmental issues such as water pollution or organic waste treatment, as well as to train critical thinking and leadership skills. Digital-based strategies such as laboratory simulations, virtual entrepreneurial platforms, or interactive e-learning have also proven effective in building student confidence, if they are supported by lecturers' pedagogic competence and an adequate learning environment. Strengthening creative self-efficacy and leadership self-efficacy is very important. These two aspects are proven to be the foundation for forming a good ESE, especially for students who lack an entrepreneurial background. Creative self-efficacy contributed most to the expected change in entrepreneurial self-efficacy.[23] Biology learning strategies should explicitly encourage students to create, lead, and communicate innovative science-based ideas.[24] In addition, the presence of exemplary figures such as alumni or entrepreneurial actors in the biological field can form an entrepreneurial identity in students. Finally, the establishment of supportive social networks and learning communities should not be overlooked, as social support has a very important effect in strengthening the relationship between ESE and entrepreneurial intentions. Thus, strengthening ESE in Biology education is not only about delivering material, but includes holistic strategies that shape students' confidence, experience, and practical skills to become creative and useful scientists.

CONCLUSIONS

Entrepreneurial Self-Efficacy in Biology learning is students' confidence in applying biological knowledge to create innovations and carry out entrepreneurial activities with economic and social value. The definition of ESE includes the ability to recognize bio-based business opportunities, manage risk, and innovate in products and services relevant to life sciences. The development of ESE for Biology students can be carried out through various effective strategies, especially project-based learning that integrates real-world contexts, the use of digital technologies such as e-learning and simulation, and the strengthening of social support through mentoring and entrepreneurial communities. In addition, the development of soft skills such as creativity and leadership also plays a very important role as a foundation for strengthening ESE. Despite challenges such as low practical experience and a lack of integration of entrepreneurship into the curriculum, opportunities

to improve ESE are wide open through collaboration with industry, contextual curriculum development, and entrepreneurship incubation and training programs.

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CONFLICT OF INTEREST

There is no conflict of interest.

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