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Implementation of STEAM-based bioentrepreneurship learning to improve creativity and entrepreneurship in fourth grade elementary school students

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Abstract: *This study aims to analyze the implementation of the Pancasila Student Profile Strengthening Project (P5) with the theme of coconut-based bioentrepreneurship at SDN Proppo 1 Pamekasan, increasing students' creativity and entrepreneurship through the STEAM approach in the Merdeka Curriculum. This qualitative descriptive study involved the stages of introduction, contextualization, real action, reflection, and follow-up in August–December 2024. Students were taught to make environmentally friendly soap from coconut. The results showed that the implementation of P5 succeeded in increasing students' creativity and entrepreneurial skills. The main supporting factors were local materials and facilitators, while obstacles were limited time and students' initial understanding of entrepreneurship. Reflection showed a positive impact on literacy and STEAM-based learning, as well as practical experience in entrepreneurship, with follow-up for the development of similar activities in the future.*

Keywords*: Bioentrepreneurship; Creativity; Entrepreneurship; Literacy; STEAM*

Introduction

Science and technology (IPTEK) currently plays an important role in supporting various human activities, such as the use of mobile phones, computers, and the internet. Without the support of IPTEK, human social interaction has the potential to experience obstacles. Through the ability to think creatively, humans are able to develop IPTEK sustainably over time. The various conveniences presented, such as in the fields of transportation, telecommunications, and education, show the importance of the role of IPTEK. In the world of education, advances in IPTEK have made a major contribution to improving the quality of learning. The changes that have occurred include the teaching methods used by teachers, the way students learn, and updates to learning materials. As an illustration, teachers are now utilizing technology-based media, methods, and learning strategies to adapt to the diverse characteristics of students.

The presence of educational transformation initiated by the Minister of Education, Culture, Research and Technology (Mendibudristek) Nadiem Anwar Makarim is able to answer the challenges of the times. With the presence of educational transformation, it is able to create more creative learning. Because all creativity is one of the abilities that all students need to have. However, apart from parents, teachers can also play an active role in increasing student creativity.

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Creativity can be defined as a thinking process that involves developing various ideas to overcome certain problems or challenges (Semiawan, 1990). This process encourages students to find new relationships, formulate solutions, and develop innovative methods or approaches in solving problems (1). Therefore, efforts to develop and train student creativity are an important part of the school curriculum to support the achievement of 21st century skills. Based on research conducted by the US-based Partnership for 21st Century Skills, there are four main skills known as "The 4Cs," namely communication, collaboration, critical thinking, and creativity (Haryanti & Sumarwa, 2018) (2). Furthermore, Guilford (1950) emphasized that creativity results from divergent thinking the ability to generate multiple, unique, and relevant ideas in response to a problem (Dewi, Antoro, & Meilisa, 2025). This ability can be cultivated through learning experiences that promote exploration and problem-solving. In line with this, entrepreneurship, as defined by Schumpeter (1934), reflects an individual's capacity to innovate and take risks in seizing opportunities (Hansopaheluwakan, et al., 2025). Thus, integrating creativity and entrepreneurship in education is crucial to foster learners who are adaptive, independent, and well-prepared to face future challenges.

The development of children's creativity in accordance with 21st century skills can be supported through the application of learning models that are in line with changes and developments in the era of globalization. One relevant approach is the integration of Science, Technology, Engineering, Art, and Mathematics (STEAM). The STEAM learning model is the result of the development of the STEM (Science, Technology, Engineering, and Mathematics) approach. According to Morrison (2008) in Putri (2019), STEM is an interdisciplinary approach, so that students not only study one field of science, but also gain a broad understanding in various disciplines. Furthermore, Yakman (2008) stated that STEAM is a holistic approach that integrates various disciplines in a unified way to foster critical thinking, problem-solving, collaboration, and innovation. Along with its development, STEM was modified into STEAM by adding elements of art (Arts) (3). This art aspect includes the ability to think creatively, imagine, innovate in utilizing technology, produce works, and appreciate art in understanding science (Wijaya et al., 2015) (4).

Based on Law Number 20 of 2003 Article 3 concerning the National Education System, the goal of national education is to develop the abilities of students while forming the character and civilization of a dignified nation to enlighten the life of the nation. This education aims to foster the potential of students to become individuals who are faithful, pious, have noble morals, are healthy, intelligent, skilled, creative, independent, and able to become democratic and responsible citizens (5).

In the STEAM approach, the relationship between science and religion is complementary and integrated. These two aspects become an inseparable unity, while arts that emphasize creativity remain directed at religious values to be in harmony with religious principles. The STEAM concept is rooted in the STEM approach as developed by Hsu (2014), which integrates aspects of technology, engineering, art, and mathematics as a whole (6).

These four elements—technology, engineering, art, and mathematics—are within the framework of science as its main foundation. The STEAM approach has a contextual nature

like the STEM approach, namely starting by identifying issues in the surrounding environment to formulate solutions. In addition to focusing on the engineering design process, this approach also remains connected to the scientific process as a basic step in its development.

The application of the STEAM approach in this study was carried out with the theme P5 entrepreneurship with bioentrepreneurship friendly and healthy soap learning. Bioentrepreneurship is an approach that combines science concepts with entrepreneurship. The science concept in question is the saponification reaction. Saponification is a hydrolysis reaction of fatty acids/oils by the presence of a strong base (NaOH or KOH) or known as an alkali solution (lye) to produce soap in the form of sodium salts from fatty acids/oils.

Soap is a cleaning agent formed through a chemical reaction between sodium or potassium base and fatty acids derived from vegetable oil or animal fat. Soap produced using NaOH is known as hard soap, while that produced with KOH is called soft soap. Krik et al. (1954) stated that soap is a substance used for washing and emulsifying, consisting of two main components, namely fatty acids with a carbon chain of C12-C18 and sodium or potassium. There are three types of bar soap, namely cold made soap, opaque soap, and transparent soap. Cold made soap has good foaming ability, even in water containing salt or hard water. Opaque soap is a type of bath soap that is in the form of a bar and is not transparent, while transparent soap has a clear and attractive appearance, and produces soft foam on the skin.

Entrepreneurship in bioentrepreneurship is used to foster an entrepreneurial mentality in students. Bioentrepreneurship applies biological knowledge to develop innovative and sustainable products or services (Sasongko & Hermawan, 2018). It combines scientific insight with business skills while promoting environmental awareness. In the educational context, bioentrepreneurship supports the development of students' creativity, innovation, and entrepreneurial mindset through problem-based projects involving local biological resources (Gans & Stern, 2003). Students who have an entrepreneurial mentality need to be accustomed to implementing entrepreneurship in schools which can be achieved through teaching and learning activities, implementing entrepreneurial characteristics in schools and practicing entrepreneurship. KBM begins with learning about science, CP changes in the form of objects. Students are given reading sources related to the material on changes in the form of objects. If students have understood the material on changes in the form of objects, it is continued with the practice of making friendly and healthy soap which is an application of the theory of changes in the form of objects. The practice of making friendly and healthy soap is taught using the STEAM approach. Students identify problems related to coconut plants in the Sumenep area that have not been optimally utilized for making soap. Students seek information, read and study from reading sources provided by the teacher. Then it ends with the practice of making soap by applying the STEAM approach integrating Science, Technology, Engineering, Art and Mathematics.

Previous research has extensively discussed STEM integration (Fauzi et al., 2020; Ningsih et al., 2021), but has not yet deeply linked it to bioentrepreneurship development in elementary schools. This research is novel: integrating artistic elements (design thinking and

visual innovation) into an eco-friendly soap project that focuses not only on the product but also on the students' entrepreneurial process. Learning activities on changes in the form of objects, identifying information from reading, soap making practices and packaging and marketing of these products will be implemented in P5 bioentrepreneurship at SDN Proppo I with the theme of entrepreneurship. Through a series of activities, it is expected that students will increase their insight, creativity, literacy skills, and entrepreneurial spirit.

The purpose of this study is to describe the implementation of STEAM-based bioentrepreneurship learning in grade IV of SDN Proppo 1 Pamekasan, analyze the increase in student creativity in an environmentally friendly soap project integrated with the STEAM approach, examine the development of students' entrepreneurial spirit through production, design, and marketing activities in the context of bioentrepreneurship learning, and provide alternative project-based learning that is relevant to the theme of changes in the form of objects and strengthening the profile of Pancasila students.

Method

This research is a qualitative research with a phenomenological approach. Etymologically, phenomenology comes from the words "phenomena" and "logos." Phenomenon is rooted in the Greek verb "phainesthai," which means to appear, and is synonymous with the words fantasy, fanton, and phosphorus which means light or light. In Indonesian, phenomenon is interpreted as "light" or something that appears. Thus, phenomenology is literally understood as the study of symptoms or something that appears.

This research was conducted at SDN Proppo 1 Pamekasan, with 30 fourth grade students as research subjects. The research data sources consisted of primary and secondary data. Primary data were obtained through interviews with informants, namely teachers and students, related to learning about changes in the state of matter, making Friendly and Healthy Soap on the material of changes in the state of matter, and the implementation of P5 bioentrepreneurship at SDN Proppo 1. Meanwhile, secondary data included documents such as curriculum, list of student names, school profile, and photos of teaching and learning activities and P5 bioentrepreneurship activities at the school.

The data collection process was carried out through observation, interviews, and documentation studies. The data analysis approach refers to the Miles and Huberman (2007) model, which includes three main stages: data reduction, data presentation, and drawing conclusions. Data reduction is the process of filtering and simplifying raw data obtained from the field. This stage begins at the beginning of data collection, involving activities such as summarizing, coding, tracking themes, and making memo notes. The goal is to filter relevant information and ensure data accuracy.

To ensure the validity of the findings, this study uses triangulation techniques. According to Sugiyono, data triangulation is a data collection technique that combines various sources, methods, and time. In this study, the triangulation used includes source triangulation, which compares data from various informants, and technique triangulation, which combines observation, interviews, and documentation. The data analysis process also

involves presenting data in the form of narratives or diagrams that facilitate understanding, as well as drawing conclusions based on patterns and themes found during the study.

Results and Discussion

Description of the results of this study with the title Implementation Learning Bioentrepreneurship in Grade IV Elementary School as follows:

Implementation of Bioentrepreneurship Learning in Grade IV Elementary Schools Increases Creativity and Entrepreneurship in Elementary Schools with the Steam Approach (Science-Technology-Engineering-Arts-Mathematics). This study examines the implementation of the Pancasila Student Profile Strengthening Project (P5) at SDN Proppo 1 Pamekasan with the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach to improve creativity and entrepreneurship in Elementary School students. The researcher conducted interviews with the Principal, P5 Coordinator, and grade IV teachers to gain insight into the implementation of P5 in the 2024/2025 academic year. The results of the interviews showed that good communication between the principal, P5 coordinator, teachers, and students was a key factor in the successful implementation of the Merdeka curriculum, which integrates project-based learning.

Communication between parties in the school, including with parents, has proven effective in supporting understanding and participation in the new curriculum. Grade I and IV teachers were trained through seminars and workshops to deepen their understanding of the implementation of the Merdeka curriculum, which includes P5. This also helps in choosing project themes that are appropriate for student character development.

Human resources, especially the role of teachers, also have a major influence on the success of P5 implementation. Teachers at SDN Proppo 1 Pamekasan play an active role in designing and implementing fun and meaningful learning, by paying attention to aspects of creativity and entrepreneurship. P5 learning is designed so that students can learn through real experiences in their surroundings, which also contributes to the formation of character desired by the Pancasila Student Profile.

Thus, this study shows that the implementation of P5 at SDN Proppo 1 Pamekasan went well, supported by effective communication, training for teachers, and active involvement of parents and students. Through the implementation of the Merdeka curriculum and P5, the school succeeded in creating a learning atmosphere that supports the development of student creativity and entrepreneurship, as well as strengthening characters in accordance with Pancasila values. In general, the implementation of the Pancasila Student Profile Strengthening Project (P5) at SDN Proppo 1 Pamekasan can be said to have gone very well, involving various important factors that support the success of the implementation of this project. This school has prepared adequate facilities and infrastructure, and has excellent human resources. The teachers at this school work together effectively to support the achievement of the learning objectives that have been set in the P5 project implemented in Co-curricular learning.

In addition, the disposition or attitude of the policy implementers is also very supportive, as seen from the commitment and positive attitude of the teachers in making P5 a success. The teachers and project coordinators have a high awareness to adapt to existing needs and challenges, and are ready to conduct evaluations and improvements when needed.

Another important factor is the implementation of the STEAM (Science, Technology, Engineering, Art, and Mathematics) learning method, which is used in P5 learning. This approach not only introduces science concepts to students, but also trains them to think critically, creatively, and collaborate and communicate in facing real-world challenges. The implementation of STEAM provides a fun learning experience and can help students build skills that are useful for their future.

The implementation of STEAM-based learning was carried out through the stages of the P5 project: introduction, contextualization, real action, reflection, and follow-up. Students were introduced to the issue of coconut waste in their local environment, studied the saponification reaction, conducted soap-making experiments, designed artistic packaging, and calculated production costs and selling prices. The STEAM approach was reflected in various aspects: Science (understanding the chemical reaction of soap-making), Technology (using tools and production materials), Engineering (systematic soap-making process), Arts (creative packaging design), and Mathematics (calculating measurements, costs, and profits).

Students demonstrated a high ability to imagine, modify soap recipes, choose colors and scents, and create unique packaging designs. They were also active in expressing ideas, working collaboratively, and exploring local materials.

Students showed confidence when presenting their products, were interested in conducting simple transactions, and demonstrated curiosity in calculating costs and profits. Some students even attempted to sell their products to teachers or parents.

In addition, the bureaucratic aspect is also a key factor in the smooth implementation of P5 at SDN Proppo 1 Pamekasan. This school has established clear procedures, including the Operational Curriculum in the Education Unit (KOSP), which is the main guideline in implementing P5 Co-curricular learning. This KOSP ensures that every step in the implementation of the project has been carefully planned and can be evaluated systematically to ensure high quality learning.

Overall, SDN Proppo 1 Pamekasan has managed the important factors in the implementation of the Pancasila Student Profile Strengthening Project very well, creating a conducive learning environment and supporting the development of student character in accordance with Pancasila values.

Supporting and Inhibiting Factors in the Implementation of Bioentrepreneurship Learning in Grade IV Elementary Schools. The Pancasila Student Profile Strengthening Project (P5) is one of the programs implemented in the Merdeka Curriculum, with the aim of developing the character, skills, and attitudes of students through various learning activities based on Pancasila values. At SDN Proppo 1 Pamekasan, the implementation of P5

runs with support from various parties, including the principal, teachers, and parents. Each party has an important role in making this program a success.

The principal of SDN Proppo 1 Pamekasan stated that, as an educator and principal, he always supports government policies in improving the post-pandemic learning system, including the implementation of the Merdeka Curriculum. In this effort, the school has prepared human resources and infrastructure to support the success of the program. This support was also shown by the P5 Coordinator, who emphasized the importance of cooperation between schools and parents in supporting the development of students. This good cooperation plays a very important role in creating a conducive environment for better learning.

However, despite the many supporting factors that contribute to the success of the P5 program, there are also challenges and obstacles in its implementation. One of the obstacles faced is the limited access to information and resources that can be used by teachers in developing interesting learning projects. In addition, managing the diverse learning styles of students requires further adjustments so that each student can obtain an optimal learning experience. However, with the commitment and cooperation between teachers, parents, and schools, these obstacles can be overcome gradually.

The implementation of P5 at SDN Proppo 1 Pamekasan also involves practical activities, such as making soap in the context of bioentrepreneurship. This activity provides opportunities for students to develop practical skills that can improve their understanding of science and entrepreneurship. However, the implementation of this activity requires special attention, especially in terms of safety and accuracy in following soap-making procedures. With good guidance from teachers, these obstacles can be minimized, and students can gain useful experiences.

Overall, the implementation of the Pancasila Student Profile Strengthening Project (P5) at SDN Proppo 1 Pamekasan shows that despite challenges in its implementation, this program can run well thanks to the support of various parties and a commitment to continue to innovate in the face of obstacles.

Results of the Implementation of Bioentrepreneurship Learning in Grade IV Elementary School and Its Impact on the Development of Student Creativity and Entrepreneurship. Research on the implementation of the Pancasila Student Profile Strengthening Project (P5) at SDN Proppo 1 Pamekasan shows that this project has been integrated into co-curricular learning at the school. This learning is organized through teaching modules that are arranged according to the theme determined each year, which aims to provide guidelines for teachers and all school residents in achieving the objectives of the Pancasila Student Profile Strengthening Project. This teaching module includes various learning achievements that support the implementation of P5 as a whole.

In addition, various co-curricular activities have been carried out well, supported by all parties at the school. Some examples of activities carried out include field visits, such as during the Thematic Tahfizh Qur'an activity which visited the Honey Picking Garden in Lawang to learn the implementation of Surah An-Nahl. There is also the MY Dream activity, which invites various professions to provide motivation and inspiration to students. These

activities not only develop students' academic abilities, but also religious, social, language, and cultural aspects, covering national to international scope. This proves that SDN Proppo 1 Pamekasan has succeeded in organizing a fun and useful project in strengthening the Pancasila Student Profile, in accordance with the objectives of the Merdeka Curriculum.

Discussion on the Analysis of the Implementation of Bioentrepreneurship Learning in Grade IV of Elementary School, supporting and inhibiting factors faced by SDN Proppo 1 Pamekasan. The results of the study are arranged as follows:

Implementation of Bioentrepreneurship Learning in Grade IV Elementary Schools Increases Creativity and Entrepreneurship in Elementary Schools with the Steam Approach (Science-Technology-Engineering-Arts-Mathematics. The implementation of the Pancasila Student Profile Strengthening Project (P5) in the Independent Curriculum at SDN Proppo 1 Pamekasan refers to the theory developed by George C. Edward III, which includes four factors that need to be analyzed, namely communication, resources, disposition (attitude), and bureaucratic structure. The first factor that must be considered is communication, which functions to clearly explain the objectives of the implementation of the Independent Curriculum as a replacement for the 2013 Curriculum for students in grades I and IV. In addition, communication is also needed to support the smooth implementation of co-curricular activities in the Pancasila Student Profile Strengthening Project (P5). An effective communication process must be established between the principal, P5 coordinator, grade I and IV teachers, students, and parents or guardians of students, so that there are no differences in understanding or opinion regarding the implementation of P5 at SDN Proppo 1 Pamekasan. This is in accordance with the opinion that states that good communication is the main prerequisite in policy implementation. With clear and effective communication, the parties involved can implement policies more appropriately and according to objectives (Anwar & Ayudya, 2015).

The second influencing factor is resources. In the context of this study, SDN Proppo 1 Pamekasan has prepared human resources optimally, as reflected in the ability of teachers to manage learning in accordance with the Merdeka Curriculum. In addition, this school has also held seminars and workshops for educators and education personnel regarding the implementation of the Merdeka Curriculum, which includes Co-curricular learning packaged in the Pancasila Student Profile Strengthening Project (P5). SDN Proppo 1 Pamekasan also has various facilities that support the implementation of P5. This is in line with the statement of Putri and Akmal (2019) which states that human resources, including the quality and quantity of educators and education personnel, must meet the established criteria. In addition, the existence of adequate facilities and infrastructure is very important to support the implementation of agreed policies.

The third influencing factor is disposition or attitude. This study focuses on the implementation of the Pancasila Student Profile Strengthening Project (P5). Overall, the implementation of P5 at SDN Proppo 1 Pamekasan has gone very well. This school presents P5 co-curricular learning in an interesting way to improve students' understanding and skills in carrying out the project. One of the efforts is to set a special schedule, which is once a week with a duration of 40 minutes, for students in grades I and IV to take part in P5

learning. In addition, in order to make the implementation of P5 more innovative, SDN Proppo 1 Pamekasan integrated this program with the STEAM approach through a soap making project. This approach is in line with the view that disposition is the readiness or attitude of policy implementers in carrying out tasks optimally. Institutions that receive policies must be ready to face all consequences, and the attitude of the implementer is a key factor in the success of implementing a policy (Surono & Ifendi, 2021).

The fourth factor that plays a role is the Bureaucratic Structure, which in this study refers to the mechanism and organizational structure of policy implementers. SDN Proppo 1 Pamekasan has a Standard Operating Procedure (SOP) related to planning, implementation, and evaluation as stated in the Education Unit Operational Curriculum (KOSP). This document includes plans, objectives, and the implementation flow of the Pancasila Student Profile Strengthening Project (P5). This is in line with the view of Edward III as quoted by Redana and Suprapta (2023), that the smooth implementation of a project or policy can be achieved if the implementing agency has a simple SOP that is easy to understand by all related parties.

Based on the four factors that have been described, it can be concluded that SDN Proppo 1 Pamekasan has successfully implemented the Pancasila Student Profile Strengthening Project (P5) within the Merdeka Curriculum framework optimally. This school demonstrates the ability to maintain stable communication among all school residents, support the development of human resources and facilities and infrastructure, adopt a positive attitude towards the policies implemented, and implement a bureaucratic structure according to its function.

Supporting and Inhibiting Factors in the Implementation of Bioentrepreneurship Learning in Grade IV of Elementary Schools in the Independent Curriculum at SDN Proppo 1 Pamekasan. Supporting factors in the implementation of the Pancasila Student Profile Strengthening Project (P5) in the Independent Curriculum at SDN Proppo 1 Pamekasan lie in the quality of human resources who work together. Educators and education personnel at this school have very good quality and quantity, so that they become an added value for the success of the implementation of the Independent Curriculum. In addition, support also comes from adequate facilities and infrastructure, as well as the existence of superior programs designed by the school. This makes it easier to implement P5-based learning so that it can run optimally and effectively.

According to Maharani et al. (2023), the successful implementation of P5 requires several supporting factors, including the active involvement of teachers and schools in curriculum planning that is adapted to local potential. In addition, improving teacher competence in developing Independent Curriculum-based learning is also an important aspect.

However, there are several obstacles faced in the implementation of P5 at SDN Proppo 1 Pamekasan, especially from internal factors. One of the main obstacles is the limited references that educators have to develop learning projects. This obstacle, however, can be overcome through cooperation and innovation carried out by educators at the school.

Results of the Implementation of Bioentrepreneurship Learning in Grade IV of Elementary School in the Independent Curriculum at SDN Proppo 1 Pamekasan. The P5 teaching module designed in accordance with the Merdeka Curriculum contains a flow of learning objectives that cover six main aspects of the Pancasila Student Profile. The first aspect, faith, devotion to God Almighty, and noble character, is implemented at SDN Proppo 1 Pamekasan through religious activities such as fasting on Mondays and Thursdays, Dhuha prayers, Dhuhur prayers, Ashar prayers in congregation, reviewing short surahs, and other religious activities. The second aspect, global diversity, is realized by integrating knowledge about local and national wisdom that is relevant to the surrounding environment. The third aspect, mutual cooperation, is implemented through the waste donation program, which supports the objectives of the Pancasila Student Profile Strengthening Project, especially for grade I students.

Furthermore, the creative aspect is reflected in the implementation of the peak of the Pancasila Student Profile activities in each class. Meanwhile, in the critical reasoning aspect, students are equipped with the ability to think logically and systematically to solve various problems. Finally, the independent aspect is developed through strengthening students' abilities in managing behavior, which includes freedom, initiative, self-confidence, self-control, assertiveness, and high responsibility. As stated by Marisa (2021), the implementation of the Pancasila Student Profile makes a major contribution to the formation of good character in students, especially at the elementary school level.

Conclusion

The analysis of the implementation of bioentrepreneurship learning in grade IV of elementary school can be explained using George C. Edward III's model, which consists of four main factors. Based on the data analysis, communication among school stakeholders has been highly effective in supporting the implementation of bioentrepreneurship learning. The school possesses well-qualified human resources, including both educators and education personnel, along with adequate learning facilities. The attitude or disposition of school members toward this learning policy has been positive, with implementation aligning well with expectations. This is further supported by an organized bureaucratic structure and operational guidelines that are tailored to the needs of grade IV students. Key supporting factors include strong collaboration among school members in facilitating practice-based learning and entrepreneurship, as well as external support from local communities and stakeholders in promoting locally based learning. Nevertheless, challenges remain, particularly the limited availability of references and teaching materials on bioentrepreneurship, which requires teachers to be more creative and innovative in designing relevant and meaningful learning activities. Over time, however, teachers have demonstrated strong adaptability in addressing these challenges. Overall, the results show that the school has successfully developed a teaching module aligned with the objectives of bioentrepreneurship-based learning, effectively integrating entrepreneurial values and the use of local resources into the learning process, thereby fostering students' skills in science-based entrepreneurship that are highly relevant to their future needs.

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