



Introducing CAPAB(L)E: A Learning Model to Promote Prospective Biology Teacher's Entrepreneurship Skills

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ABSTRACT

Biology is one of the fields of study that has a lot of scopes that have the potential to be directed to the entrepreneurship aspect. Currently, there is no report on a particular learning model that prepares prospective teachers to design and implement businesses related to the use of biological principles, processes, and products. This study aims to develop and validate an entrepreneur-oriented learning model of biology in higher education, later known as CAPAB(L)E. CAPAB(L)E, stands for Characterizing, Analyzing, Prototyping, Assessing, Building up, and Exposing, a bioentrepreneurship learning model to promote biology education students' entrepreneurial skills was successfully designed through this research. This design-based research (DBR) used the ADDIE model, which consisted of five stages, namely: analysis, design, development, implementation, and evaluation. The logical validation sheet consisted of six objective items with four Likert scales and an open question regarding recommendations for improving the developed learning model filled by two validators or experts (a lecturer in biology learning design and a lecturer in entrepreneurship). In addition, to obtain an overview of students' perceptions of the CAPAB(L)E learning model, a questionnaire was used containing six items of Likert Scale 4-level statements and an open question about skills that were most trained during learning. Research data were analyzed descriptively. The results of the logical validation of the hypothetical model of CAPAB(L)E bioentrepreneurship learning model indicate that the learning model is valid and can be implemented, with a score of 81,25%. The students' perceptions are generally positive on the structure and content of the material. Students suggest using teamwork strategies in planning and implementing student businesses. Based on this research results, it is necessary to carry out further research to determine the effectiveness of CAPAB(L)E bioentrepreneurship learning on students' skills, knowledge, and attitudes toward entrepreneurship.

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Keywords: CAPAB(L)E learning model; bioentrepreneurship; biology prospective teacher; 21st-century skills

INTRODUCTION

Indonesia launches several visions in the economic sector to welcome 100 years of independence, including Indonesia as a world-class creative and digital economy center, 3-4% Open Unemployment Rate, zero unskilled workers, and

USD 28,934 GDP per capita in 2045 (Ministry of National Land Agency/Bappenas, 2017). To achieve this, Indonesia needs superior human resources, especially in the field of entrepreneurship. Entrepreneurship is a person's ability to determine and evaluate business opportunities by managing existing resources (Ghina, 2014; Amalia & von Korfflesch, 2021). Entrepreneurship is categorized as one of the eight skills needed by

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society to survive in the 21st century (Council, 2006). Entrepreneurship skills are very complex skills because they include and emphasize the importance of innovation, creativity, risk-taking, and teamwork, not only focusing on commercial entrepreneurship (European Commission, 2018).

The 2019 Global Entrepreneurship and Development Institute (GEDI) report released on its official website (<https://thegedi.org/>), shows that Indonesia's Global Entrepreneurship Index (GEI) increases from 21.0 to 26.0 which results in a ranking increase of 94 to 75 and shifts from quartile four to three. GEI is a parameter to measure the health of the entrepreneurial ecosystem in a country, which includes attitudes, resources, and infrastructure (Szerb et al., 2019). This indicates that entrepreneurial activity in Indonesia has experienced significant developments in the domestic and international context. However, this achievement is still below other ASEAN countries. However, the problem is the lack of independence and the spirit of entrepreneurship for most college graduates. Most of them are more dominant as job seekers than job creators. The learning system in higher education, which is generally still focused on the accuracy of graduation and the speed of getting a job, is still a priority. This results in low readiness to create job opportunities (entrepreneurship) for graduates (Afriadi & Yuni, 2018).

Providing entrepreneurial skills for students is a demand for every educational institution. Entrepreneurial skills that can be taught consist of three dimensions, namely entrepreneurial attitudes, entrepreneurial skills, and entrepreneurial knowledge (Welter et al., 2017; Silveyra et al., 2021). Entrepreneurship skills can be packaged in an entrepreneurship education program. Entrepreneurship education is defined as an educational program that is more focused on building an effort to become an entrepreneur, in contrast to enterprise education which is more focused on self-development, mindset, skills, and abilities of an individual (Fayolle et al., 2006; Ahmed et al., 2020). Entrepreneurship education programs (EEPs) can influence an individual's intention to start a new business in an emerging economy. Learning in EEPs plays an important role in developing the knowledge and skills needed to create new ventures (Ahmed et al., 2020; Bauman & Lucy, 2021). Entrepreneurship education has a positive impact on students' ability to generate business ideas and increase their confidence in starting a business. In addition, entrepreneurship education influences attitudes and intentions to become entrepreneurs in the future (Martin et al., 2013).

At the university level, entrepreneurship is taught as a special program or a program that is integrated with courses, both for the undergraduate and postgraduate levels (Back, 2008; Meyers & Hurley, 2008; Oosterbeek et al., 2010; Kjelstrom, 2012; Buller & Finkle, 2013; Maresch et al., 2016; Alan, 2019; Cui et al., 2021; Okolie et al., 2021). One of the specific entrepreneurship programs that are closely related to biology is bioentrepreneurship. The field of biology is very suitable to be applied in the field of entrepreneurship because the scope of biology is very broad, covering all aspects of organisms that can be utilized to improve meeting the needs of human life, both products and bioprocesses. Sinha et al. (2021) explain that bioentrepreneurship is a scientific discipline consisting of a combination of life sciences and entrepreneurship. Bioentrepreneurship also can be defined as the use of living things that can be processed into business products and can be marketed to produce a productive economy (Sisnodo et al., 2015). Bioentrepreneurship learning is generally integrated with biotechnology subjects (Crispeels et al., 2008; Natadiwijaya et al., 2018) and the development of the Masters in Biotechnology Enterprise and Entrepreneurship (MBEE) program at Johns Hopkins University (Langer, 2014).

Several studies regarding the development of bioentrepreneurship learning models and their implementation in learning have been reported, including the development of integrated bioentrepreneurship programs in biotechnology courses (Crispeels et al., 2008; Natadiwijaya et al., 2018); and the development of the Masters in Biotechnology Enterprise and Entrepreneurship (MBEE) program at Johns Hopkins University (Langer, 2014). Kloftsen (2000) mentions three basic activities that must be found in universities to stimulate entrepreneurship. First, activities that create and maintain an entrepreneurial culture throughout the university. Second, there must be a special course in entrepreneurship so that every student can learn more about entrepreneurship as a subject itself. Third, there should be a special training program for individuals who want to start their own business.

Based on the results of a literature review of the results of research and development of entrepreneurship programs, it is known that the lecture programs developed tend to be integrative with certain subjects, such as microbiology or biotechnology. However, the bioentrepreneurship lecture program specifically for students with a teacher education background, especially the biology education study program as a special program implemented in long/regular semesters, has not

been reported. In addition, in the biology education curriculum, courses that develop students' entrepreneurship skills have a less portion. In fact, this skill is one of the most important skills for dealing with the era of disruption, as described above. Therefore, more intensive and structured interventions are needed so that students can have direct experience in entrepreneurial practice with the knowledge and skills they have based on a background in the field of biology education. Through this research, a bioentrepreneurship learning model is proposed which is applied in tertiary institutions under the name CAPAB(L)E,

which is an acronym for the stages, namely Characterizing, Analyzing, Prototyping, Assessing, Building up, and Exposing.

METHODS

This development research (Design-Based Research, DBR) used the ADDIE model, standing for Analyze, Design, Develop, Implement, and Evaluate (Branch, 2009). The stages of research and the resulting output can be seen in Figure 1.

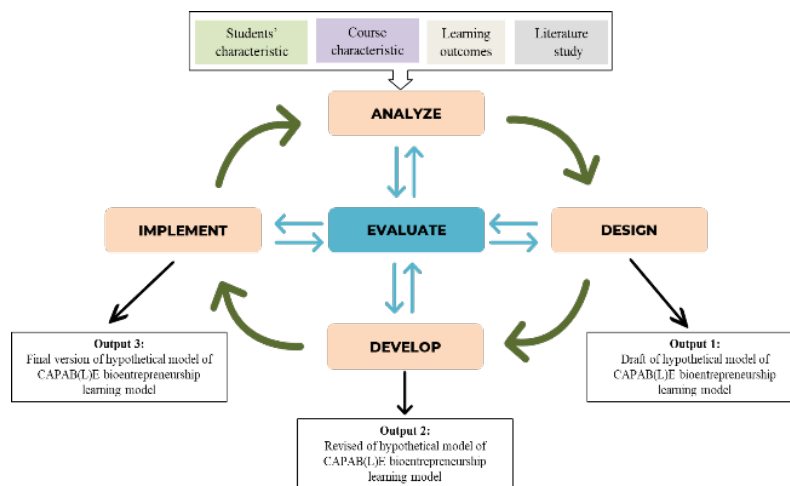


Figure 1. Research Stages and Outputs Based on the ADDIE Model

In the analysis stage, analysis activities on the characteristics of students, courses, process achievements based on literature studies and evaluation of the implementation of the bioentrepreneur learning model in the previous curriculum were carried out to obtain a framework used to develop a hypothetical model of bioentrepreneurship learning model. Based on the results of the analysis of the implementation of these courses in the previous year, several aspects were found that were considered to have several weaknesses, including four aspects. First, the pattern and orientation of lectures did not have a direction, for example, students were asked to design a business, but there was no example of a guide for analyzing business ideas, so students did not pay attention to the gaps that existed in products/services that were already on the market with those that would be developed. Second, practitioners were involved in learning models at the level of motivation and insight into the business processes of a business in the fields of biology or education, without being involved in the process of forming knowledge or inculcating important business ideas and concepts as the basis for building a strong business idea foundation. Third, during lectures, students were asked to prepare business proposals, make product prototypes and marketing, but the feedback and guidance

was not optimal, so as a result, not all students/groups succeeded in submitting business proposals to entrepreneurial competitions at local and national levels. Fourth, an assessment was carried out on the proposal and the achievement of business targets carried out by students using an assessment instrument whose reliability had not been tested. Based on these four aspects, it was necessary to redesign the bioentrepreneurship learning model to achieve the learning outcomes formulated by the study program.

At the design stage, a CAPAB(L)E hypothetical model of bioentrepreneurship learning framework was formulated, which is an acronym for the phases in bioentrepreneurship learning, namely Characterizing, Analyzing, Prototyping, Assessing, Building up, and Exposing. At the development stage, the draft hypothetical model for the CAPAB(L)E bioentrepreneurship learning model was reviewed/validated by two experts (a lecturer in biology learning design and a lecturer in entrepreneurship), then refined to obtain a hypothetical model for the CAPAB(L)E bioentrepreneurship learning model.

At the implementation stage, a hypothetical model of the CAPAB(L)E bioentrepreneurship learning model was implemented in the learning process. The CAPAB(L)E bioentrepre-

neurship learning model was implemented in the online lecture process (distance learning) for 16 meetings. The lecture method applied emphasized a combination of discussion, guest lectures by practitioners, and the practice of analyzing business, making business plans, developing product/service prototypes, and marketing. However, the strategy of organizing students between the three classes was different. In classes A and C, the team strategy was applied, while in class B, the individual strategy was applied. These two strategies were applied to evaluate the most appropriate strategies in the planning, implementation, and development of business.

In the characterization stage, characterization of the entrepreneurial spirit of students was carried out. Students were provided with the basics of entrepreneurship and the importance of changing the entrepreneurial mindset and creative-innovative power by lecturers and guest lecturers (from the School of Business and Management ITB and KangPuj Farm). In the analysis stage, students were trained to analyze problems in everyday life and find gaps between facts/realities in society and ideal/expected conditions. Furthermore, students formulated business ideas based on analysis using the Value Proposition Canvas (VPC). In developing their business ideas, students consulted with lecturers and practitioners to get feedback. Business ideas that had been initiated were written in a business proposal. Business proposals designed by students were planned to be included in student competitions such as the Student Entrepreneurship Program (*Program Mahasiswa Wirausaha/PMW*) held at the faculty and university levels, as well as the national level Entrepreneurship Student Creativity Program (*Program Kreativitas Mahasiswa-Kewirausahaan/ PKM-K*). In the assessment stage, students did prototype trials with potential customers to get input and feedback either directly or using an online questionnaire. In the prototyping stage, students designed a product/service prototype according to their business idea. After that, in the building up stage, students carried out their business by applying managerial and financial skills. In the exposing stage, students promoted and disseminated their business information through various social media and e-commerce platforms or marketplaces.

At each stage, an evaluation was carried out to ensure the process to achieve expected results properly. After going through the complete stages of ADDIE, the final model of the CAPAB(L)E bioentrepreneurship learning model was successfully formulated.

This study involved 86 seventh-semester students from three classes (27 students from class A, 31 students from class B, and 28 students from class C) who enrolled in bioentrepreneurship courses at the Department of Biology Education, Universitas Pendidikan Indonesia in the odd semester of the 2020/2021 academic year.

There were two data explored in this study, namely the validation results of the CAPAB(L)E learning model and students' perceptions of the CAPAB(L)E learning models. First, the data from the logical validation of the hypothetical model of bioentrepreneurship learning were obtained from the logical validation sheet filled in by two validators. This validation sheet consisted of six objective items with four Likert scales (which include: 1) background for developing learning models; 2) the theory supporting the learning model; 3) the purpose of developing a learning model; 4) hypothetical design of learning models; 5) suitability of the learning phase with learning outcomes; and 6) suitability of the assessment instrument with learning outcomes), and with an open question regarding recommendations for improving the developed learning model. Second, students' perceptions regarding the CAPAB(L)E learning model were obtained through a questionnaire consisting of six items with four Likert scales (which include: the composition of the course material, advantages of the learning program on their self-development, the relevance of guest lecture session, the adequacy of learning resources, the students' learning load, the effectiveness of lecture method to equip entrepreneurial skills) and an open question about skills that were most trained during learning.

The research data in the form of logical validation results were analyzed descriptively. Data were in the form of scores with a value of 1 to 4, then used a Likert scale converted to the validation criteria table to be converted into qualitative data. The learning model validation criteria can be seen in Table 1.

Table 1. Criteria for the Validation of the Learning Model

Score	Validity Category	Description
21-24	Very Valid	Very good to use
16-20	Valid	Can be used with minor revisions
11-15	Enough Valid	Can be used with major revisions
6-10	Invalid	Should not be used

(Adapted from Fayolle et al., 2006)

The data of students' perceptions regarding the CAPAB(L)E learning model obtained were analyzed descriptively using percentages.

RESULTS AND DISCUSSION

The result of this study shows that the CAPAB(L)E bioentrepreneurship learning model is intended for students as a special program imple-

mented in one semester. The acronym describes the learning stages that are implemented, namely: Characterizing, Analyzing, Prototyping, Assessing, Building up, and Exposing (Figure 2). Each learning stage is structured based on several rationalizations. First, learning entrepreneurship is not only relying on talent but more importantly having a strong will and motivation to start a business (Afriadi & Yuni, 2018).

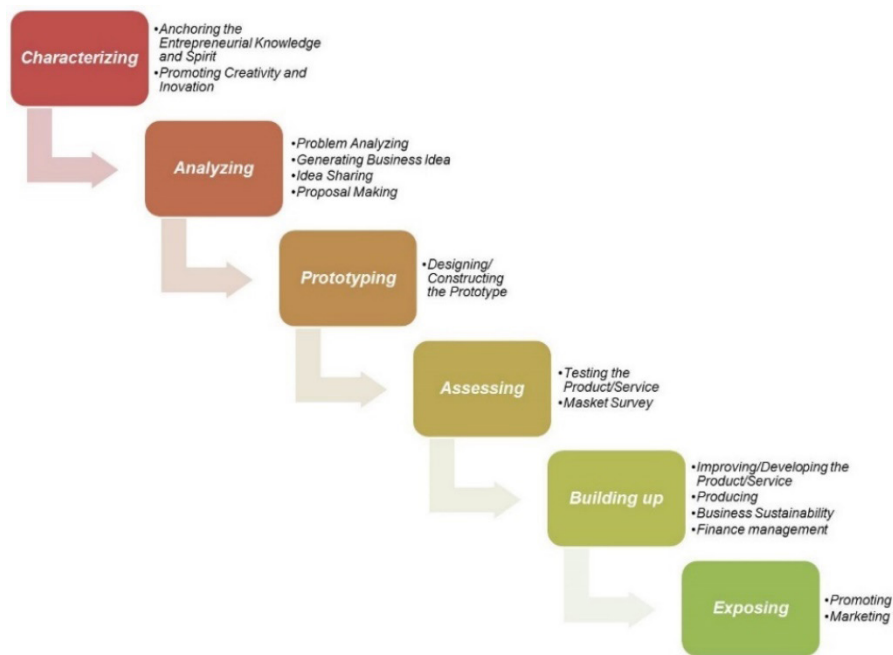


Figure 2. The Hypothetical Model Framework of the CAPAB(L)E Bioentrepreneurship Learning

A theoretical introduction related to business economics and entrepreneurship is the main thing that needs to be considered when developing a bio-entrepreneurship education program at a university (Crispeels et al., 2008). Second, students are required to be serious in activities that can produce creative and innovative work in accordance with the needs and developments of the times (Afriadi & Yuni, 2018). Business ideas designed must focus on consumer needs, not their own desires (Bhuiyan, 2011). Third, in entrepreneurship education, students must make a product based on the technical knowledge they have mastered and relevant research results (Collet & Wyatt, 2005). Fourth, product prototype trials or final designs aim to get customer input and feedback so that they can meet customer requirements. This is important to gain a competitive advantage (Cooper, 1993). Fifth, a good bioentrepreneurship education development program is a program that includes soft skills in the learning curriculum, such as communication, conflict resolution, team building, optimism, self-control, and the ability to empathize (York et al., 2009). In addition, the ability to formulate and implement leadership strategies, appropriate management

to achieve company goals and objectives, and create financial and funding strategies for organizational success in various economic situations is important things that need to be provided through entrepreneurship programs (Langer, 2014).

Based on the results of the logical validation of the characteristics of the CAPAB(L)E bioentrepreneurship learning model by two expert lecturers, the following results are obtained (Table 2). Based on Table 2, it is known that each validator gives an assessment that the CAPAB(L)E bioentrepreneurship learning model is valid and can be used with minor revisions. In addition, there are several recommendations for the draft CAPAB(L)E bioentrepreneurship learning model. First, the problem analysis is preceded by an observation of the target market before formulating the value proposition canvas (PVC), after which a competitor analysis is usually carried out so that the resulting product is competitive. Second, practitioners are also expected to share experiences in building their businesses and controlling risks. Third, in the building-up phase, a marketing strategy is added that is tailored to the target mar-

ket. Based on these suggestions, the CAPAB(L)E bioentrepreneurship learning model is developed to accommodate several improvements related to lecture patterns and orientation, practitioner involvement, lecture program outcomes, and assessment of lecture program outcomes.

Table 2. The Results of the Logical Validation of The CAPAB(L)E Bioentrepreneurship Learning Model

No.	Indicators	Validator		Average
		I	II	
1	Background for developing learning models	4	4	4
2	Theory supporting the learning model	3	3	3
3	The purpose of developing a learning model	3	3	3
4	Hypothetical design of learning models	3	4	3,5
5	Suitability of the learning phase with learning outcomes	3	3	3
6	Suitability of the assessment instrument with learning outcomes	3	3	3
	Total	19	20	19,5
	Category	Valid	Valid	Valid
	Percentage (%)	79,2	83,3	81,25

The details of the stages of the CAPAB(L)E learning model are presented in Table 3.

Table 3. Syntax of the CAPAB(L)E Bioentrepreneurship Learning Model

Learning Phases	Descriptions
Characterizing Anchoring the Entrepreneurial Knowledge and Spirit Promoting Creativity and Innovation	Students are provided with the basics of entrepreneurship and the importance of changing the entrepreneurial mindset and creative-innovative power so that the entrepreneurial spirit is awakened. Practitioners are involved in the process of forming knowledge or inculcating important business idea concepts as the basis for building a strong business idea foundation. In addition, practitioners are also expected to share experiences in building their businesses and controlling risks.
Analyzing Analyzing Problems Generating Business Ideas Sharing Ideas Making Proposals	Lectures are made in a more directed and systematic pattern, using the signs of a business model canvas (BMC). The formulation of business ideas begins with observation of the target market, value proposition canvas (VPC) analysis, and competitor analysis so that it is more rational in designing businesses that are needed by consumers, not just what producers want. Moreover, the product orientation of the business is expanded towards a sustainable business, because it is not only a matter of profit but also about society and the environment. In developing their business ideas, students consult with lecturers and practitioners to get feedback. The business idea that has been initiated is written in a business proposal.
Prototyping Designing/ Constructing the Prototype	Students design product/service prototypes based on appropriate analysis.
Assessing Testing the Product/ Service Surveying Market	Students conduct prototype trials with potential consumers to get input and feedback so that they can meet consumer requirements.
Building up Improving/Developing the Product/ Service Producing Business Sustainability Finance management	Students are provided with soft skills related to the sustainability efforts of a business, for example business development strategies, marketing strategies tailored to the target market, business ethics, organizational management, and financial management. The hope is that students can make plans for sustainable business development efforts.
Exposing Promoting Marketing	Students promote and disseminate business information by implementing marketing strategies.

Learning outcomes of the CAPAB(L)E bio-entrepreneurship learning model are: 1) analyzing problems to obtain business opportunities by utilizing biology and biology education disciplines; 2) formulating solutions in the form of business ideas based on professional data analysis; 3) designing business based on biology science and biology education; 4) promoting business in the field of biology and biology education which is designed and developed; 5) designing sustainable business development efforts; and 6) applying ethical business practices. The achievement of learning outcomes is measured by a set of evaluation instruments in the form of the Readiness Inventory of Bioentrepreneurship (RIB), performance assessment in the form of products (business plan assessments, creative-innovative products, and business reports), and peer assessment to assess the collaboration ability of business team members.

The development of the CAPAB(L)E bioentrepreneurship model adopts Blenker's framework, Buller & Finkle's, and Gibb's view of entrepreneurial learning. Blenker et al. (2013) develop an entrepreneurship education framework consisting of six elements, including (1) entrepreneurial competencies, (2) pedagogical methods, (3) organizational and cultural structures, (4) support mechanisms, (5) external stakeholders, and (6) evaluation and feedback. In addition, Blenker et al. (2013) argue that entrepreneurship education should focus not only on creating new ventures but also on developing entrepreneurial mindsets and skills that can be transferred to various contexts. Blenker et al. (2013) also suggest that entrepreneurship education should be integrated into various disciplines and students should be

allowed to apply their knowledge in real-life situations. According to Buller and Finkle (2013), an innovative and effective entrepreneurial education program for the university context emphasizes experimental and mentorship learning, as well as an interdisciplinary approach, so that it can help prepare students with the skills and mindset needed to become successful entrepreneurs. According to Gibb (2010), there is a need for a transition from traditional 'instruction' to experiential learning methodologies, utilizing action-oriented approaches, mentoring, and group work. In this approach, critical thinking and problem-solving are recognized as key skills, while the development of skills related to risk-taking, innovation, creativity, and collaboration need to be considered important. A more direct 'go to the field' approach is also needed for the development of project management and budgeting skills.

The CAPAB(L)E learning model is expected to be one of the entrepreneurship education programs (EPPs) that can develop an entrepreneurial spirit and innovation in Biology teacher candidates. EEPs can facilitate the development of perceptions of entrepreneurship and innovation, improve the ability of prospective teachers to develop creative ideas and solutions in learning mathematics and science, and prepare them to become innovative and entrepreneurial teacher candidates in the future (Akar & Üstüner, 2017; Alan, 2019; Arruti & Panos-Castro, 2020). Apart from collecting data from the validator, at the end of the implementation stage, students' perceptions of the learning model are also explored. The results are presented in Table 4.

Table 4. Students' Perceptions Regarding the CAPAB(L)E Bioentrepreneurship Learning Model

No.	Statements	Percentage (%)			
		SD	D	A	SA
1	The composition of the material provided in lectures is in accordance with the demands of the current generation's needs.	0,0	6,5	66,2	27,3
2	The material content presented in the lecture is beneficial for self-development.	0,0	3,9	63,6	32,5
3	The guest lecture given is relevant to the material that should be given.	1,3	2,6	61,0	35,1
4	Learning resources are well available.	1,3	24,7	64,9	9,1
5	The learning load of this course is in accordance with the number of credits.	19,5	37,7	33,6	9,1
6	The lecture method that is implemented (a combination of discussion, guest lecture, and business practice) is appropriate to equip entrepreneurial skills.	1,3	7,8	70,1	20,8

Information: SD=Strongly Disagree; D=Disagree; A=Agree; SA=Strongly Agree

Most of them give positive responses to the aspects of the structure and composition of the material in accordance with the demands of the current generation, the material content presented in the lecture is beneficial for self-development, and the guest lectures given are relevant to the material that should be given. Students state that learning resources are available quite well, but still need to be added and updated. Most students state that the study load of this course is too heavy. This is generally because students also take other courses and internship programs or practice teaching in schools. Students from class B (who apply individual strategies) generally say so. Some students state that the lecture method implemented, namely by implementing multi methods (discussion, guest lectures, and business practices) is appropriate. However, concerning student organizing strategies in learning, some students prefer to use teamwork strategies rather than individually.

Generally, the competencies obtained by students can be grouped into three aspects, namely skills, knowledge, and attitudes. Most of the students state that leadership, decision-making ability, basic entrepreneurial skills, and the ability to make business plans by utilizing or managing biological resources have increased after participating in the CAPAB(L)E bioentrepreneurship learning. Entrepreneurial skills include analyzing business opportunities/market needs using the Value Proposition Canvas (PVC) technique and making business plans, including business proposals and product prototypes. Knowledge of entrepreneurial concepts and principles and the spirit to work hard are also felt as a direct impact of the CAPAB(L)E bioentrepreneurship learning.

Based on the results of student disclosures, the implementation of the CAPAB(L)E learning can provide real experience in practicing business development for beginners. This is in line with the opinions of Krakauer et al. (2017), McGuigan (2016), and Walter and Block (2016) which state that experiential learning can be an effective approach to teaching entrepreneurship. Through experiential learning, students can learn about entrepreneurship in a more engaged and practical way, thereby helping them to understand the concepts and skills related to entrepreneurship. In addition, Mason & Arshed (2013) explain that experiential learning is effective in improving student entrepreneurial skills, such as creativity, innovative thinking skills, and leadership skills. Effective experiential learning also involves engaging students in hands-on experience in creating, developing, and launching their own businesses.

In the implementation of the CAPAB(L)E bioentrepreneurship learning model during the pandemic, students experience many challenges from technical, managerial, capital, and personal aspects. The challenges faced by students who come from classes that apply individual strategies in planning and carrying out their business are greater than those that apply team strategies. Students also face various obstacles in realizing their business, both by applying team and individual strategies. However, it seems that the obstacles faced by students in the class who apply individual strategies are greater because they cannot share tasks and workloads with their peers. These challenges and obstacles ultimately have an impact on the achievement of the business stage, readiness to start a business, and student entrepreneurial skills. The achievement of the business stage (analyzing, prototyping, assessing, building up, and exposing) in classes that implement team strategy is better when compared to individuals. This achievement illustrates that collaboration is a very determining factor. From this research, it is also revealed that working individually can reduce motivation to become entrepreneurial. This is following the decrease in the percentage of several factors that support students starting a business, including support from family and colleagues, readiness to compete in business, strong will, discipline, strong stamina, and emotional strength. Fejes et al. (2019) describe several challenges in implementing entrepreneurship learning, such as limited resources, lack of time, and the need for more training and professional development. Meanwhile, Valerio et al. (2014) mention some of the challenges faced in implementing entrepreneurship programs around the world, such as lack of resources and access to capital, lack of networking and accessibility for minority groups, as well as cultural differences and different economic environments in each country.

In a pandemic condition like today, for some students, especially those who work individually, it seems difficult to start a business, especially if someone is used to being in a comfort zone. Routine and busy learning sometimes turn off someone's passion for creation and hone their interest in entrepreneurship. Before participating in the CAPAB(L)E bioentrepreneurship learning, some students consider themselves quite ready to start a business (level 3). However, after participating in the lesson, students actually consider themselves somewhat ready (level 2). This is presumably because students have not experienced entrepreneurship directly. Students as novice entrepreneurs often have fear and worry about un-

certainty in the business world (Walter & Block, 2016; Wiklund et al., 2019). Kutzhanova et al. (2009) explain that personal transformation is an important part of training programs for entrepreneurs. It should also be recognized that the process of developing entrepreneurial skills takes place over a period of time and requires the active involvement of entrepreneurs.

Based on the results of the evaluation, it is necessary to make a recommendation for the implementation of the bioentrepreneurship lesson in the future. First, the choice of strategy as a team or individual is left to the student personnel, but there must be an explanation of the consequences at the beginning. Second, if using a team strategy, the number of group members must be effective so that the guidance and control process by the lecturer is more optimal. Third, in each team, there needs to be clarity on targets periodically along with the person in charge. Fourth, students need to be informed of the importance of building a business that is not only oriented toward the economy but also has noble purposes related to society and the environment. This last point is both a challenge and an opportunity in developing a sustainable entrepreneurship education program (Rashid, 2019; Edokpolor, 2020; Hermann & Bossle, 2020; Shu et al., 2020; Hsu & Pivec, 2021; Ratten & Usmanij, 2021).

CONCLUSION

The CAPAB(L)E (Characterizing, Analyzing, Prototyping, Assessing, Building up, and Exposing) bioentrepreneurship learning model has been designed through the instructional development stages, namely ADDIE. This learning model is designed to equip knowledge and develop entrepreneurship in the field of biology and biology education. The results of the logical validation of the hypothetical model of the CAPAB(L)E bioentrepreneurship learning indicate that the learning model is valid and can be implemented. Students give positive responses on the structure and content of the material.

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REFERENCES

- Afriadi, R., & Yuni, R. (2018). Pengembangan Jiwa Bioentrepreneur Mahasiswa Biologi. *Jurnal Biologus*, 1(2), 123-127.
- Ahmed, T., Chandran, V. G. R., Klobas, J. E., Liñán, F., & Kokkalis, P. (2020). Entrepreneurship education programmes: How learning, inspiration and resources affect intentions for new venture creation in a developing economy. *The International Journal of Management Education*, 18(1), 100327.
- Akar, H., & Üstüner, M. (2017). Mediation role of self-efficacy perceptions in the relationship between emotional intelligence levels and social entrepreneurship traits of pre-service teachers. *Journal of Education and Future*, (12), 95-115.
- Alan, S. (2019). Comparative Investigation of Entrepreneurship and Innovation Perceptions of Preservice Teachers. *International Journal of Education in Mathematics, Science, and Technology*, 7(4), 311-318.
- Amalia, R. T., & von Korfflesch, H. F. (2021). Entrepreneurship education in Indonesian higher education: mapping literature from the Country's perspective. *Entrepreneurship Education*, 1-43.
- Arruti, A., & Panos-Castro, J. (2020). International entrepreneurship education for pre-service teachers: a longitudinal study. *Education+Training*, 62(7/8), 825-841.
- Back, S. M. (2008). The Bioentrepreneurship MBA: Options for mid-tier business schools. *Journal of Commercial Biotechnology* (2009), 15(2), 183-193.
- Bauman, A., & Lucy, C. (2021). Enhancing entrepreneurial education: Developing competencies for success. *The International Journal of Management Education*, 19(1), 100293.
- Blenker, P., Dreisler, P., Faergemann, H. M., & Kjeldsen, J. (2013). A framework for developing entrepreneurship education in a university context. *International Journal of Entrepreneurship and Small Business*, 5(1), 45-63.
- Branch, R. M. (2009). *Instructional Design-The ADDIE Approach*. New York: Springer.
- Buller, P. F., & Finkle, T. A. (2013). The Hogan entrepreneurial leadership program: an innovative model of entrepreneurship education. *Journal of Entrepreneurship Education*, 16, 113-132.
- Bhuiyan, N. (2011). A framework for successful new product development. *Journal of Industrial Engineering and Management (JIEM)*, 4(4), 746-770.
- Collet, C., & Wyatt, D. (2005). "Bioneering" – teaching biotechnology entrepreneurship at the undergraduate level. *Education + Training*, 47(6), 408-421.

- Cooper, J. C. (1993). Logistics Strategies for Global Businesses. *International Journal of Physical Distribution & Logistics Management*, 23(4), 12-23.
- Crispeels, T., Uecke, O., Goldchstein, M., & Schefczyk, M. (2008). Best practices for developing university bioentrepreneurship education programmes. *Journal of Commercial Biotechnology*, 15(2), 136-150.
- Council, E. (2006). Recommendation of the European Parliament and the Council of 18 December 2006 on key competencies for lifelong learning. *Brussels: Official Journal of the European Union*, 30(12), 2006.
- Cui, J., Sun, J., & Bell, R. (2021). The impact of entrepreneurship education on the entrepreneurial mindset of college students in China: The mediating role of inspiration and the role of educational attributes. *The International Journal of Management Education*, 19(1), 100296.
- Edokpolor, J. E. (2020). Entrepreneurship education and sustainable development: Mediating role of entrepreneurial skills. *Asia Pacific Journal of Innovation and Entrepreneurship*, 14(3), 329-339.
- EC—European Commission. (2018). Commission staff working document accompanying the document Proposal for a Council Recommendation on Key Competences for Lifelong Learning.
- Fayolle, A., Gailly, B., & Lassas-Clerc, N. (2006). Assessing the impact of entrepreneurship education programmes: a new methodology. *Journal of European Industrial Training*, 30(9), 701-720.
- Fejes, A., Nylund, M., & Wallin, J. (2019). How do teachers interpret and transform entrepreneurship education?. *Journal of Curriculum Studies*, 51(4), 554-566.
- Ghina, A. (2014). Effectiveness of entrepreneurship education in higher education institutions. *Procedia-Social and Behavioral Sciences*, 115, 332-345.
- Gibb, A. (2005). Towards the entrepreneurial university: entrepreneurship education as a lever for change. *NCGE Policy paper series*, 15, 1-46.
- Hermann, R. R., & Bossle, M. B. (2020). Bringing an entrepreneurial focus to sustainability education: A teaching framework based on content analysis. *Journal of Cleaner Production*, 246, 119038.
- Hsu, J. L., & Pivec, M. (2021). Integration of sustainability awareness in entrepreneurship education. *Sustainability*, 13(9), 4934.
- Kementerian Perencanaan Pembangunan Nasional/Kepala Badan Perencanaan Pembangunan Nasional. (2017). *Visi Indonesia 2045*. Jakarta, Indonesia: Author.
- Kjelstrom, J. (2012). *The 21st Century Needs Entrepreneurial Scientists and Engineers*.
- Klofsten, M. (2000). Training entrepreneurship at universities: a Swedish case. *Journal of European Industrial Training*, 24(6), 337-344.
- Krakauer, P. V. D. C., Serra, F. A. R., & De Almeida, M. I. R. (2017). Using experiential learning to teach entrepreneurship: a study with Brazilian undergraduate students. *International Journal of Educational Management*, 31(7), 986-999.
- Konaklı, T. (2015). Effects of self-efficacy on social entrepreneurship in education: a correlational research. *Research in Education*, 94(1), 30-43.
- Kutzhanova, N., Lyons, T. S., & Lichtenstein, G. A. (2009). Skill-based development of entrepreneurs and the role of personal and peer group coaching in enterprise development. *Economic Development Quarterly*, 23(3), 193-210.
- Langer, L. J. (2014). Building a curriculum for bioentrepreneurs. *Nature Biotechnology*, 32(9), 863-865.
- Maresch, D., Harms, R., Kailer, N., & Wimmer-Wurm, B. (2016). The impact of entrepreneurship education on the entrepreneurial intention of students in science and engineering versus business studies university programs. *Technological forecasting and social change*, 104, 172-179.
- Martin, B. C., McNally, J. J., & Kay, M. J. (2013). Examining the formation of human capital in entrepreneurship: A meta-analysis of entrepreneurship education outcomes. *Journal of business venturing*, 28(2), 211-224.
- Mason, C., & Arshed, N. (2013). Teaching entrepreneurship to university students through experiential learning: A case study. *Industry and higher education*, 27(6), 449-463.
- McGuigan, P. J. (2016). Practicing what we preach: Entrepreneurship in entrepreneurship education. *Journal of Entrepreneurship Education*, 19(1), 38-50.
- Meyers, A. D., & Hurley, P. (2008). Bioentrepreneurship education programmes in the United States. *Journal of Commercial Biotechnology*, 14(1), 2-12.
- Natadiwijaya, I. F., Rahmat, A., Redjeki, S., & Anggraeni, S. (2018). Sikap Wirausaha Mahasiswa pada Perkuliahan Bioteknologi Bermuatan Bioentrepreneurship. *Mangifera Edu*, 3(1), 40-51.
- Okolie, U. C., Igwe, P. A., Ayoola, A. A., Nwosu, H. E., Kanu, C., & Mong, I. K. (2021). Entrepreneurial competencies of undergraduate students: The case of universities in Nigeria. *The International Journal of Management Education*, 19(1), 100452.
- Oosterbeek, H., Van Praag, M., & Ijsselstein, A. (2010). The impact of entrepreneurship education on entrepreneurship skills and motivation. *European economic review*, 54(3), 442-454.
- Rashid, L. (2019). Entrepreneurship education and sustainable development goals: A literature review and a closer look at fragile states and technology-enabled approaches. *Sustainability*, 11(19), 5343.
- Ratten, V., & Usmanij, P. (2021). Entrepreneurship education: Time for a change in research direction?. *The International Journal of Management Education*, 19(1), 100367.
- Shu, Y., Ho, S. J., & Huang, T. C. (2020). The development of a sustainability-oriented creativity, innovation, and entrepreneurship education

- framework: A perspective study. *Frontiers in Psychology, 11*, 1878.
- Silveyra, G., Herrero, Á., & Pérez, A. (2021). Model of teachable entrepreneurship competencies (M-TEC): Scale development. *The International Journal of Management Education, 19*(1), 100392.
- Sinha, D., Singh, A., & Kumar, P. (2021). Introduction to Bioentrepreneurship. In *Bioentrepreneurship and Transferring Technology Into Product Development* (pp. 1-21). IGI Global.
- Sisnodo, S., Ridlo, S., & Widyaningrum, P. (2015). Pembelajaran Bervisi Bioentrepreneurship Melalui Pembuatan Makanan Hasil Fermentasi Berbahan Dasar Kedelai Lokal. *Jurnal Biology Science & Education, 4*(2), 85-96.
- Szerb, L., Lafuente, E., Márkus, G., & Acs, Z. (2020). Global Entrepreneurship Index 2019.
- Valerio, A., Parton, B., & Robb, A. (2014). *Entrepreneurship Education and Training Programs around the World: Dimensions for Success*. The World Bank: Washington, DC, USA.
- Walter, S. G., & Block, J. H. (2016). Outcomes of entrepreneurship education: An institutional perspective. *Journal of Business Venturing, 31*(2), 216-233.
- Welter, F., Baker, T., Audretsch, D. B., & Gartner, W. B. (2017). Everyday entrepreneurship—a call for entrepreneurship research to embrace entrepreneurial diversity. *Entrepreneurship Theory and Practice, 41*(3), 311-321.
- Wiklund, J., Wright, M., & Zahra, S. A. (2019). Conquering relevance: Entrepreneurship research's grand challenge. *Entrepreneurship Theory and Practice, 43*(3), 419-436.
- York, A. S., McCarthy, K. A & Darnold, T. C. (2009). Teaming in biotechnology commercialisation: The diversity performance connection and how university programmes can make a difference. *Journal of Commercial Biotechnology, 15*(1), 3-11.