Bioedukasi
Jurnal Biologi dan Pembelajarannya

Vol. 22 No 3, October 2024, page 356-364
e-ISSN: 2580-0094; p-ISSN:1693-3931
DOI: 10.19184/bioedu.v22i3.50861
jurnal.unej.ac.id/index.php/BIOED

The Influence of Biotechnology-Based Bio entrepreneurship Learning Model on the Enthusiasm Level and Entrepreneurial Personality of High School Students in Sukabumi Regency

Wilda Waliam Mursyida[1], Aa Juhanda[2], Endris Rukmana[3], Billyardi Ramdhan[4]
[1, 2, 4] Biology Education, Muhammadiyah University of Sukabumi, Indonesia
[3] Senior High School 1 Cireunghas, Indonesia

Article Info

Article history:
Received July 24, 2024
Revised September 30, 2024
Accepted October 1, 2024

Keywords:
Biotechnology-Based
Bioentrepreneur
Enthusiasm level
Entrepreneurial Personality

ABSTRACT

This research is motivated by the low level of student enthusiasm towards entrepreneurship due to the lack of activities that foster entrepreneurial personality. The research aims to examine the influence of biotechnology-based bio entrepreneurship on students' enthusiasm and entrepreneurial personality. A quasi-experimental design with a non-equivalent control group was used, involving class X students at SMAN 1 Cireunghas, Sukabumi district. Questionnaires were administered to collect data. Results showed that in the experimental group, 81% of students demonstrated a high level of enthusiasm with an N-Gain score of 0.81, increasing from a pretest average of 73.13 to a posttest average of 93.7. Regarding entrepreneurial personality, 79% of students exhibited high scores, with an N-Gain of 0.79, improving from a pretest average of 82.97 to a posttest average of 97.3. Hypothesis testing revealed significant differences between the experimental and control groups, with a significance level of 0.003 for enthusiasm and 0.020 for entrepreneurial personality ($p < 0.05$). Thus, biotechnology-based bio entrepreneurship positively influences both the enthusiasm and entrepreneurial personality of students.

Corresponding Author:
Billyardi Ramdhan,
Biology Education, Muhammadiyah University of Sukabumi
Jalan R.Syamsudin,S.H. No. 50, Cikole, Sukabumi, Indonesia
Email: billyardi@ummi.ac.id

1. INTRODUCTION

Technological advancements have ushered in the era of the Industrial Revolution 4.0 (Schwab, 2018), demanding the development of 21st century skills such as character, citizenship, critical thinking, creativity, collaboration, and communication, known as 6C (Putri et al., 2022; Fonseca, 2018). These skills align with the characteristics of entrepreneurship, emphasizing the importance of entrepreneurial capabilities in modern life (Yulian, 2018). However, the number of entrepreneurs in Indonesia remains low, with only 3.47% of the population being entrepreneurs (Gultom, 2021). Many students show low enthusiasm towards entrepreneurship, as they are unfamiliar with its concepts (Baktiningsih et al., 2021).

Research reveals that entrepreneurial education needs to be implemented not only in tertiary institutions but also in high schools (Arquisola et al., 2019). This aligns with the necessity of developing students' enthusiasm and entrepreneurial personality, which includes characteristics like innovation, self-efficacy, and risk-taking attitudes (Bican et al., 2020; Tentama et al., 2019). Integrating entrepreneurial values with biotechnology, known as bioentrepreneurship, offers an innovative approach (Muliadi et al., 2020). This integration helps students create applicable products and enhances their entrepreneurial mindset.

By focusing on bioentrepreneurship within biotechnology education, students can cultivate entrepreneurial skills through the development of renewable and innovative products, such as plant-based industries and organic skincare (Wardhani et al., 2020). Therefore, bioentrepreneurship learning in biotechnology can increase students' enthusiasm and entrepreneurial personality, particularly through entrepreneurship-oriented craft subjects (Alfaniah, 2022). Based on the explanation above, the researchers revealed how the Enthusiasm level and Entrepreneurial Personality of students in the biotechnology-based Bioentrepreneur-laden Crafts subject.

2. RESEARCH METHOD

This study employs a quantitative approach using a quasi-experimental design with an experimental and a control group. The design used is Non-equivalent Control Group Design, where the experimental and control classes were not randomly selected. At the beginning, both groups were administered a pretest to assess initial capabilities. The experimental class received instruction using the Project-Based Learning (PjBL) model combined with the Biotechnology-Based Bioentrepreneur method, while the control class used the conventional PjBL approach. Data were collected through questionnaires and observation sheets, distributed directly to 30 purposively sampled students from class X at SMAN 1 Cireunghas, Sukabumi, during the 2023/2024 academic year. The questionnaires, consisting of 66 items, measured students' Enthusiasm levels (5 indicators) and Entrepreneurial Personality (6 indicators). All instruments had been validated for reliability. Data collection occurred after both classes completed their respective learning treatments, followed by a posttest to assess changes in Enthusiasm and Entrepreneurial Personality.

Table 1. Indicators for measuring Enthusiasm level and Entrepreneurial Personality

Aspect	Indicator
Enthusiasm Level (Suvittawat, 2019)	Commitment to the Product or Service Passion for Competition Passion for Entrepreneurship Passion for Opportunity Passion for Development
Entrepreneurial Personality (Salmony & Kanbach, 2021)	The Big Five Need for Achievement Innovatiness Self-efficacy Locus of control Risk attitudes

The data from this research were reviewed using the criteria proposed by (Sundayana, 2016) which groups the N-Gain score into five criteria, namely:

Tabel 2. N-Gain Score Table

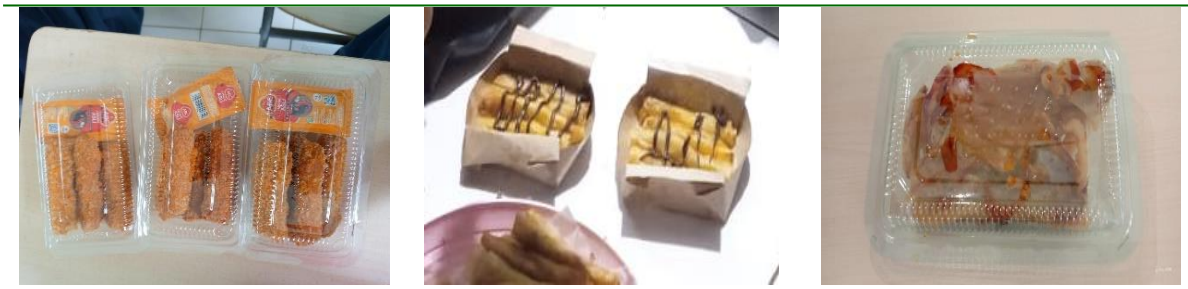
No	N-Gain Score	Criteria
1	$0{,}70 \leq g \leq 1.00$	High
2	$0{,}30 \leq g \leq 0.70$	Medium
3	$0{,}00 \leq g \leq 0.30$	Low
4	$g = 0{,}00$	No increase occurred
5	$1{,}00 \leq g \leq 0.00$	There was a decline

(Sundayana, 2016)

Variable	Class	Pretest Avg	Posttest Avg	N-Gain
Enthusiasm Level	Experimental	73.13	93.7	0.81
	Control	69.00	86.9	0.60
Entrepreneurial Personality	Experimental	82.97	97.3	0.79
	Control	78.93	91.7	0.58

3. RESULT AND DISCUSSION

This research begins with a learning process by giving a posttest to the experimental and control classes with the aim of finding out the students' initial abilities. In the experimental class, Biotechnology-Based *Bioentrepreneur* learning treatment is given using the PjBL learning model and in the control class, learning is given using the PjBL model which is often used. at school. In the experimental class, 1 class was divided into 3 groups with each group working on a project to make processed plant-based food ingredients using biotechnology principles. Below are pictures of processed food products from each group.



(a) (b) (c)

Figure 1. (a) Nugget Tempe (b) TapeRoll (c) Kimchi

After both classes were given classroom learning treatment by the teacher, they were then given a posttest to determine the influence of biotechnology-based Bio entrepreneurship on students' Enthusiasm level and Entrepreneurial Personality. The questionnaire given consisted of 30 statements consisting of 5 Enthusiasm level indicators and 30 statements consisting of 6 Entrepreneurial Personality indicators. After obtaining data on the results of the pretest and posttest in the experimental class and control class, the N-Gain test was then carried out to determine the difference between the posttest and pretest scores. Enthusiasm level and Entrepreneurial Personality of students which shows the influence of learning in the experimental class after the learning carried out by the teacher. The following is the N-Gain value data from the pretest and posttest recapitulation results that were given to the experimental class and control class.

Table 3. Data on N-Gain Enthusiasm level and Entrepreneurial Personality values in the Experiment Class and Control Class

Variable	Class	Average						N-Gain Category
		Pre-test	Standard deviation	Post-test	Standard deviation	N-Gain	Standard Deviation	
Enthusiasm Level	Experiment	73,13	7,74	93,7	8,82		0,50	High
	Control	69,00	7	86,9	8	0,81	0,22	
Entrepreneurial Personality	Experiment	82,97	8,3	97,3	9,8	0,60	1,85	Medium
	Control	78,93	7,9	91,7	8,3		0,46	High
						0,79		
						0,58		Medium

The N-Gain results in the experimental class and control class have different criteria. The average N-Gain Enthusiasm Level score for the experimental class is 0.81 (high criteria) with a standard deviation of 0.50 and the average N-Gain Enthusiasm Level score in the control class is 0.60 (medium criteria) with a standard value deviation is 0.22. These results show that the standard deviation value is smaller than the average value, which means the data is evenly distributed. The average N-Gain score for Entrepreneurial Personality in the experimental class was 0.79 (high criteria) with a standard deviation of 1.85, while the N-Gain score in the control class was 0.58 (medium criteria) with a standard deviation of 0.46. The results show that the standard deviation value in the experimental class is greater than the average, which means that the data is distributed unevenly because the difference between one data and another is greater than the average value. The results of research on Entrepreneurial Personality in the control class show that the standard deviation is smaller than the average, which means the data is evenly distributed.

In this study, the Shapiro-Wilk test was employed to assess the normality of the data, as the sample size was less than 50. The results indicated that both the experimental and control classes had significance values greater than 0.05 (sig > 0.05), confirming that the data in both classes were normally distributed. The results of the normality test using the Shapiro-Wilk test because the research sample was less than 50 showed that both classes, both the experimental class and the control class, had a significance value of more than 0.05 (sig > 0 .05) which means the data in both classes is normally distributed. Once it is known that the data is normally distributed in the two classes, a homogeneity test is then carried out. The results of the homogeneity test show that the Enthusiasm level value is 0.681 > 0.05 and the Entrepreneurial Personality value is 0.562 > 0.05, which means that the data is homogeneously distributed because the resulting significance value is greater than 0.05. After obtaining data that is normally distributed and homogeneous. Next, a hypothesis test was carried out using the independent sample z-test, obtaining a Sig (2-tailed) significance value of 0.003 on the Enthusiasm level variable

and a Sig (2-tailed) significance value of 0.020 on Entrepreneurial Personality, which shows that the posttest data in the experimental class was significantly different due to the significance is less than 0.05 (0.000 < 0.05), so it can be seen that the hypothesis H_0 is rejected and H_1 is accepted. Therefore, it can be concluded that there is an influence of biotechnology-based Bio entrepreneurship on students' Enthusiasm level and Entrepreneurial Personality.

The Enthusiasm level of students for each indicator was obtained from pretest and posttest data in the experimental class. The following are the results of the average Enthusiasm level which can be seen in Table 4 below.

Table 4. Recapitulation of the Enthusiasm Level of Experimental Class Students for Each Indicator

No	Indcator Enthusiasm level (Suvittawat, 2019)	Experimental Class Average Score					
		Pretest	Standard Deviation Pretest	Postest	Standard Deviation *Postest*	N-Gain	Standard Deviation N-Gain
1	Commitment to the product of service	66,50	7,9	92,00	4,8	0,76	0,14
2	Enthusiasm for Competition	77,50	4,4	95,33	2,1	0,79	0,1
3	Passion For Entrepreneurship	76,83	4,4	94,00	3,9	0,74	0,13
4	Enthusiasm for Opportunity	73,67	4,8	92,33	4,0	0,71	0,14
5	Enthusiasm for Development	71,17	5,4	94,83	1,7	0.94	0,1

Based on Table 4 above, it shows that the average pretest and posttest scores in the experimental class show an increase in each indicator. The average pretest and posttest scores increased so that the N-Gain score in the experimental class also increased. The highest n-gain score in the experimental class was in the 5th indicator (Enthusiasm for Development), namely 0.94 ($0.70 \leq g \leq 1.00$), a high criterion with a standard deviation of 0.1. These results show that the standard deviation value is smaller than the average value, which means the data distribution is even. The Enthusiasm for Development indicator received the highest score compared to the other indicators, because seen from the results of the observation sheet, experimental class students had more innovative product development ideas, this is in accordance with what was stated by Salmony *et al.* (2021) that the passion for development (Passion for Development) focuses on developing more innovative products such as developing business operations which is the main competitive advantage for entrepreneurs.

The lowest n-gain score in the experimental class is in the enthusiasm for opportunity indicator, namely 0.71 ($0.70 \leq g \leq 1.00$) high criteria with a standard deviation of 0.14. These results show that the standard deviation value is smaller than the average value which means the data distribution is even. The enthusiasm for opportunity indicator obtained the lowest n-gain score among other enthusiasm level indicators. This is because students in the experimental class show less ability in determining market strategies and looking for business opportunities. Passion for opportunity can shape students' self-efficacy (Mielniczuk *et al*., 2020) and train students to see business opportunities and determine market strategies (Rizal *et al*., 2022).

In the control class, the pretest and posttest results of the Enthusiasm level instrument were analyzed and presented in table 5.

Table 5. Recapitulation of Enthusiasm Level of Control Class Students for Each Indicator

No	Indikator Enthusiasm level (Suvittawat, 2019)	Control Class Average Score					
		Pretest	Standard Deviation Pretest	Postest	Standard Deviation Postest	N-Gain	Standard Deviation N-Gain
1	Commitment to the product of service	64,67	4,9	86,50	4,7	0,62	0,13
2	Enthusiasm for Competition	68,33	4,2	89,00	4,3	0,65	0,11

No	Indikator Enthusiasm level (Suvittawat, 2019)	Control Class Average Score					
		Pretest	Standard Deviation Pretest	Postest	Standard Deviation Postest	N-Gain	Standard Deviation N-Gain
3	Passion For Entrepreneurship	67,17	2,9	88,50	4,6	0,65	0,13
4	Enthusiasm for Opportunity	66,50	2,1	84,00	4,6	0,52	0,13
5	Enthusiasm for Development	68,83	3,0	86,50	3,6	0,60	0,1

Based on Table 5 above, it shows that the average pretest and posttest scores in the control class show an increase in each indicator. The average pretest and posttest scores increased so that the n-gain score in the control class also increased. The highest n-gain score in the control class is in indicators 2 and 3 (Enthusiasm for competition and Enthusiasm for Entrepreneurship) namely 0.65 ($0.30 \leq g \leq 0.70$) medium criteria with a standard deviation of 0.11 for indicator 2 and 0.13 for indicator 3. These results show that the standard deviation value is smaller than the average value, which means the data distribution is even. This indicator received the highest score compared to the other indicators, because seen from the results of the observation sheet, control class students already had creative ideas for making a product, and already had knowledge about entrepreneurship. Passion for entrepreneurship is a provision for developing students' entrepreneurial creativity, because enthusiasm for entrepreneurship is a positive reflection of someone in building their business (Yang *et al.,* 2021)..

The lowest n-gain score in the control class was the same as the experimental class, namely the Enthusiasm for Opportunity indicator, namely 0.52 ($0.30 \leq g \leq 0.70$), a high criterion with a standard deviation of 0.13. These results show that the standard deviation value is smaller than the average value, which means the data distribution is even. The Enthusiasm for Opportunity indicator obtained the lowest n-gain score among other Enthusiasm level indicators in both the experimental and control classes. This is because students lack visible ability in determining market strategies and looking for business opportunities.

In the Experimental class, the pretest and posttest results of the Entrepreneurial Personality instrument were analyzed and presented in table 7.

Table 6. Recapitulation of Entrepreneurial Personality of Experimental Class Students for each indicator

No	Indicator Entrepreneurial Personality (Salmony et.al, 2021)	Experimental Class Average Score					
		Pretest	Standard Deviation Pretest	Postest	Standard Deviation postest	N-Gain	Standard Deviation N-Gain
1	The Big Five	66,33	2,5	80,33	7,03	0,50	0,25
2	Need for Achievment	71,83	4,2	83,50	7,4	0,41	0,23
3	Innovatinnes	69,17	3,5	83,00	2	0,45	0,04
4	Self-efficacy	68,67	2,7	80,17	1,5	0,37	0,09
5	Locus of Control	66,83	3,4	78,67	3,4	0,36	0,14
6	Risk Attitudes	63,50	2,1	80,67	3,3	0,47	0,09

Based on Table 7 above, it shows that the average pretest and posttest scores in the experimental class show an increase in each indicator. The average pretest and posttest scores increased so that the N-Gain score in the experimental class also increased. The highest N-Gain score in the experimental class is in the 1st indicator (The Big Five), namely 0.50 ($0.30 \leq g \leq 0.70$) medium criteria with a standard deviation of 0.25. These results show that the standard deviation value is smaller than the average value, which means the data distribution is even. The Big Five indicator obtained the highest score compared to the other indicators, because seen from the results of the observation sheet, experimental class students had these five categories in entrepreneurship. The Big Five is a general classification system of personality traits. In accordance with its cultivation, the big five consists of five categories: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience (Salmony *et.al*., 2021). The entrepreneurial spirit can be used as a basis for introducing the big five personalities (Mathews, 2018). Apart from that, through entrepreneurial learning, the big five can be improved. The big five build students' awareness of the surrounding environment, one of which is entrepreneurship to reduce environmental problems (Rizal *et al*., 2022). The big five are considerations in training as entrepreneurial

practitioners. Students who have a high entrepreneurial spirit have the opportunity to become entrepreneurs to change the economy (Agustiani *et.al.*, 2022).

The lowest N-Gain score in the Control class is the Locus of Control indicator, namely 0.36 ($0.30 \leq g \leq 0.70$) medium criteria with a standard deviation of 0.14. These results show that the standard deviation value is smaller than the average value, which means the data distribution is even. The Locus of Control indicator obtained the lowest N-Gain score among the other Entrepreneurial Personality indicators in the Control class. This is because students are less able to regulate emotions or control in entrepreneurial activities.

The Entrepreneurial Personality results of students in the experimental and control classes were calculated and analyzed after obtaining pretest and posttest scores. The following are the results of the average score and N-gain entrepreneur personality score seen in table 7 .

Table 7. Recapitulation of Entrepreneurial Personality of Control Class Students for each indicator

No	Indicator Entrepreneurial Personality (Salmony et.al, 2021)	Control Class Average Score					
		Pretest	Standard Deviation Pretest	Postest	Standard Deviation Postest	N-Gain	Standar Deviation Gain
1	The Big Five	65,00	2,61	74,17	5,64	0,26	0,16
2	Need for Achievment	64,83	3,31	79,00	2,76	0,40	0,05
3	Innovatinnes	65,50	3,45	76,50	4,18	0,32	0,13
4	Self-efficacy	63,83	2,04	76,83	3,66	0,36	0,08
5	Locus of Control	62,33	2,94	70,33	3,27	0,21	0,11
6	Risk Attitudes	61,50	1,87	71,00	1,26	0,25	0,09

Based on Table 6 above, it shows that the average pretest and posttest scores in the Control class show an increase in each indicator. The average pretest and posttest scores increased so that the N-Gain score in the Control class also increased. The highest N-Gain score in the experimental class is in the 2nd indicator (Need for Achievment), namely 0.40 ($0.30 \leq g \leq 0.70$) medium criteria with a standard deviation of 0.05. These results show that the standard deviation value is smaller than the average value, which means the data distribution is even. The need for achievement (Need for Achievement) is a multidimensional construct that includes motivation to achieve goals in the environment (Rizal *et al.*, 2022). McClelland (1961) first hypothesized that the need for high achievement influences individuals towards an entrepreneurial orientation, because these individuals obtain higher levels of achievement satisfaction from entrepreneurial activities.

The lowest N-Gain score in the Control class is the Locus of Control indicator, namely 0.21 ($0.00 \leq g \leq 0.30$), a low criterion with a standard deviation of 0.11. These results show that the standard deviation value is smaller than the average value, which means the data distribution is even. The Locus of Control indicator obtained the lowest N-Gain score among the other Entrepreneurial Personality indicators in the Control class. This is because students are less able to regulate emotions or control in entrepreneurial activities.

The results obtained from the data processing above show that learning using the biotechnology-based Bioentrepreneur learning model in the experimental class has an influence on the Enthusiasm level and Entrepreneurial Personality of students. The Enthusiasm level and Entrepreneurial Personality abilities of students in the experimental class increased more than those in the control class, this is because students in the experimental class tended to be more active, creative and responsive. Learning with good student activity will create an effective class, in contrast to the control class, students in the control class tend to be quiet and have a high level of shyness and lack of self-confidence. Lack of self-confidence can also be caused by feelings of anxiety and unease as well as feelings of - other feelings that follow such as laziness, lack of patience, difficulty, difficulty or low self-esteem (Mansur et.al., 2022). Learning activities must apply learning models that develop students' creative thinking skills (Yasir et.al., 2019). The biotechnology-based Bioentrepreneur learning model can improve students' ability to search and find knowledge more independently, find solutions to problems that in this research students are trained to design a project for making food from plant-based food ingredients using biotechnology concept analysis provided in the LKPD and pouring it out. Bioentrepreneur learning activities encourage students to think creatively and innovatively, particularly in transforming traditional food into modern variations while adhering to traditional biotechnology concepts. This approach not only enhances creativity but also installs an entrepreneurial mindset, making it distinct from other learning methods that may not emphasize the integration of traditional

knowledge with modern applications. encourage students to start their courage in the world of entrepreneurship because they are required to be able to sell the products they have made.

4. CONCLUSION

The conclusion of the research is that there is an influence of biotechnology-based Bio entrepreneurship on Enthusiasm level and Entrepreneurial Personality in students. The Enthusiasm Level and Entrepreneurial Personality scores of students in the experimental class are higher than those in the experimental class so that biotechnology-based bio entrepreneurship can be an alternative model used by educators to accommodate learning needs and facilitate an increase in the Enthusiasm Level and Entrepreneurial Personality of students seen from good responses from students.

5. ACKNOWLEDGEMENT

The researcher would like to thank all parties involved both morally and materially in this research, especially the Ministry of Education and Culture as the scholarship sponsor while the researcher was studying, the supervisor and SMAN 1 Cireunghas, Sukabumi Regency so that this research could run well.

6. REFERENCES

Agustiani, S, Billyardi Ramdhan, S. (2022). *Analisis Minat Wirausaha Dan Kreativitas Dalam Pembelajaran Menggunakan Model Project Based Learning Berorientasi Bioentrepreneurship*. *08*, 19–29.

Alfaniah, D. (2022). Prakarya dan Kewirausahaan; Budidaya untuk SMA/MA Kelas X. *Kemendikbud: Jakarta Selatan.*

Arquisola, MJ, & Muanar, I. (2019). Peran Pengaruh Keluarga, Jenis Kelamin, dan Pendidikan Kewirausahaan Terhadap Peserta didik SMK Indonesia Menjadi Wirausaha. *International Journal of Research in Business and Social Science, 8(5), 104– 112. Https://Doi.Org/10.20525/Ijrbs.V8i5.309*.

Attaqiroh, A. D., Chaidir, A. R., & S. (2023). *Sistem Pengendalian Suhu pada Inkubator Fermentasi Tempe dengan Metode Proportional Integral Derivative (PID) Secara Digital. Emitor: Jurnal Teknik Elektro, 23(1), 14–22. https://doi.org/10.23917/emitor.v1i1.21593*.

Bae, G., Kim, J., Kim, H., Hyeon, J., Bi, D., Hyun, K., & Sook, M. (2018). *Inactivation of Norovirus Surrogates by Kimchi Fermentation in The Presence of Black Raspberry*. *Food Control, 91, 390– 396. https://doi.org/10.1016/j.foodcont.2018.04.025*.

Baktiningsih, Arafat, Y., & Wahidy, A. (2021). *Jurnal Administrasi Pendidikan. Jurnal Administrastrasi Pendidikan, 27(1), 42–52. https://www.researchgate.net/profile/SilmiAmrullah2/publication/352678331_Efektivitas_Evaluasi_Diri_Program_Studi_Studi_Kasus_Analisis_Swot_danPerencanaan_Strategis/links/6*.

Bican, PM, & Brem, A. (2020). *Model Bisnis Digital, Transformasi Digital, Kewirausahaan Digital: Apakah ada "digital" yang berkelanjutan? https://doi.org/10.3390/su12135239.*

Bridges, T., & Hracs, B. (2019). *Apa yang memotivasi generasi milenial? Bagaimana interseksionalitas membentukn kehidupan kerja para pengusaha perempuan di industri fesyen Kanada. Gender, Tempat dan Budaya, 26(4), 510–532. https://doi.org/10.1080/0966369X.2018.1552558.*

Edwin, SF, Ali, JK, & Noor, N. (2021). *Ciri-ciri Kepribadian Pengusaha dan Kinerja Bisnis: Kerangka Konseptual. 7(3), 56–64. https://doi.org/10.24191/abrij.v7i3.15128*.

Fonseca, L. . (2018). *"Industry 4 . 0 and the digital society: concepts , dimensions and envisioned benefits,", doi: 10.2478/picbe-2018-0034*

Gazzola, P., Pavione, E., Pezzetti, R., & Grechi, D. (2020). *Tren di industri fashion. Persepsi keberlanjutan dan ekonomi sirkular: Pendekatan kuantitatif gender/generasi. Keberlanjutan (Swiss), 12(7). https://doi.org/10.3390/su12072809.*

Gultom, E. (2021). *Pengaruh E-Commerce, Pengetahuan Kewirausahaan dan Lingkungan Keluarga Terhadap Minat Berwirausaha Mahapeserta didik (Studi Pada Mahapeserta didik Program S1 Manajemen Sekolah Tinggi Ilmu Ekonomi Riau Pekanbaru). Journal of Business and Economics Research*.

Hamburg, I. (2021). *Meningkatkan keterampilan dalam Pembelajaran Seumur Hidup Digital dan Kewirausahaan dalam Pendidikan Kejuruan. Penelitian Bahasa, Pendidikan dan Kebudayaan, 1(1), 8. https://doi.org/10.22158/lecr.v1n1p26*.

Hayati, N., & Arifah, L. (2021). *A biodiverse entrepreneurship-based textbookÿ: A media of students' entrepreneurship* Enthusiasm *development. JPBI (Jurnal Pendidikan Biologi Indonesia), 7(3), 248–257*.

Khasbullah, F., Manggiring, W., Krisnarini., Kurniawati, N. (2024). *Aktivitas antioksidan dan bakteri asam laktat kimchi pakcoy akibat konsentrasi garam dan lama fermentasi. Jurnal Agroindustri, https://doi.org/10.31186/j.agroind.14.1.77-86.*

Kuat, T. (2018). *Implementasi Edupreneurship Melalui Teaching Factory di SMK Akomodasi Hotel: Studi Kasus Di SmkN 6 Yogyakarta. Jurnal Studi Pendidikan Kejuruan, 1(1), 7. https://doi.org/10.12928/joves.v1i1.590.*

Mansur, N. R., Ratnasari, J. ., & Ramdhan, B. (2022). *Model STEAM Terhadap Kemampuan Kolaborasi dan Kreativitas Peserta Didik: (STEAM Model Collaboration Ability And Creativity of Students). BIODIK, 8(4), 183-196. https://doi.org/10.22437/bio.v8i4.19123*.

Mashud, I. (2016). *Membangun Jiwa Wirausaha Peserta didik Melalui Kegiatan Jual Beli (Analisis Kegiatan Market Day Sekolah Dasar Islam YAKMI Kota Tangerang). Prosiding Seminar Nasional Inovasi Pendidikan, 501–510. https://jurnal.fkip.uns.ac.id/index.php/snip/article/view/8*.

Mathews, J. (2018). *Kepribadian Wirausaha: Pendekatan Konfigurasi. Dalam Jurnal Bisnis Kolombo (Vol.9, Edisi 1). https://doi.org/10.4038/cbj.v9i1.22*.

Mielniczuk, E., & Laguna, M. (2020). *Afek Positif Memediasi Hubungan Self-Efficacy dengan Perilaku Inovatif pada Wirausahawan. Jurnal Perilaku Kreatif, 54(2), 267–278. https://doi.org/10.1002/jocb.364*.

Muliadi, A., Mirawati, B. & Azmi, I. (2020). *Implementasi Konsep Bioentrepreneur melalui Pelatihan Pembuatan Nata De Coco. Intan Cendekia (Jurnal Pengabdian Masyarakat). 1(1): 35-41*.

Natadiwijaya, I.F., Rahmat, A., Redjeki, S. & Anggraeni, S. (2018). *Sikap Wirausaha Mahapeserta didik Pada Perkuliahan Bioteknologi Bermuatan Bioentrepreneur . MANGIFERA EDU: Jurnal Biologi and Pendidikan Biologi, 3 (1), 40-51. https://doi.org/10.31943/mangiferaedu.v3i1.11*.

Nurjamiah, N., Sumarno, S., & Gimin, G. (2020). *Pengembangan Model Pembelajaran E-Millenial Entrepreneur pada Pembelajaran Entrepreneur SMK. Jurnal Ilmu Pendidikan, 4(3), 657. https://doi.org/10.31258/jes.4.3.p.657-667.*

Park, S., Seo, S., Kim, E., Na, C., & Son, H. (2018). *Effects of Different Fermentation Temperatures on Metabolites of Kimchi Seong-Eun. Food Bioscience, 1– 22. https://doi.org/10.1016/j.fbio.2018.03.009.*

Putri, Y.S., Alberida, H. (2022). *Keterampilan Berpikir Kreatif Peserta Didi kKelas X Tahun Ajaran 2021/2022 di SMAN 1 Pariaman. Jurnal Ilmiah Pendidikan Biologi, Vol 8, No 2, Hal 112-117.*

Rizal, Y., Sudira, P., & Mutohhari, F. (2022). *Digital Entrepreneurship of Vocational Educations:* Enthusiasm *Level and Entrepreneurial Personality of Students. Journal of Education Technology, 6(4).*

Salmony, FU, & Kanbach, D. (2021). *Perbedaan ciri kepribadian antar tipe wirausaha: tinjauan literatur sistematis. Dalam Review Ilmu Manajerial (Edisi 0123456789). Pegas Berlin Heidelberg. https://doi.org/10.1007/s11846-021-00466-9.*

Schwab, K. (2018). *"the Fourth Industrial Revolution (Industry 4.0) a Social Innovation Perspective," Tạp chí Nghiên cứu dân tộc, vol. 7, no. 23, pp. 12–21, , doi: 10.25073/0866-773x/97.*

Selviani, S., & Azara, R. (2021). *The Effect of Age Of Cassava Tapai (Manihot esculenta) and Concentration on The Characteristics of Cassava Tapai Flour. Journal of Tropical Food and Agroindustrial Technology, 1(02), 30– 37. https://doi.org/10.21070/jtfat.v1i02.1571*.

Sugiyono. (2018). *Metode Penelitian Kuantitatif, Kualitatif dan R&D. Bandung: ALFABETA,CV*.

Sukardi, M. Giatman, S. Haq, Sarwandi, and Y. F. P. (2019). *"Effectivity of Online Learning Teaching Materials Model on Innovation Course of Vocational and Technology Education," J. Phys. Conf. Ser., vol. 1387, no. 1, doi: 10.1088/1742-6596/1387/1/012131* .

Sukmawijaya, Y., Suhendar, S., & Juhanda, A. (2019). *Pengaruh model pembelajaran stem-pjbl terhadap kemampuan berpikir kreatif siswa pada materi pencemaran lingkungan. Jurnal BIOEDUIN, 9(2), 28-43. DOI: https://doi.org/10.15575/bioeduin.v9i2.5893*.

Sundayana. (2016). *Statistika Penelitian Pendidikan. Bandung: CV. Alfabeta*.

Supratiwi, E., Zulnazri, Z., Hakim, L., Kurniawan, E., & Muhammad, M. (2023). *Pembuatan Tempe Berbahan Dasar Ampas Tahu Dengan Proses Fermentasi Dengan Menggunakan Ragi (Ryzopus Oruzae). Chemical Engineering Journal Storage (CEJS), 3(1), 129–138. https://doi.org/10.29103/cejs.v3i1.10219*

Suvittawa, A. (2019). *Minat dan antusiasme usaha kecil dan menengah (UKM): Sebuah studi kasus di provinsi Nakorn Ratchasima, Thailand. Masalah Kewirausahaan dan Keberlanjutan, 6(3), 1369–1379. https://doi.org/10.9770/jesi.2019.6.3(22)*

Tentama, F., & Paputungan, T. (2019). *Niat berwirausaha peserta didik ditinjau dari efikasi diri dan dukungan keluarga di SMK. Jurnal Internasional Evaluasi dan Penelitian Pendidikan, 8(3), 557–562. https://doi.org/10.11591/ijere.v8i3.20240*

Vernia, D. M. (2018). *Faktor-faktor yang Mempengaruhi Intensi Berwirausaha Peserta didik Kelas XI SMK Mitra Bakti Husada Bekasi. Jurnal Pendidikan: Vol. 9, No. 2.*

Wahyuningsih, E. A., Irmanda, L., Wisnu, Y., Aji, K., Hidayat, R., & Septiana Anindita, N. (2023). *Pengaruh lama fermentasi, penambahan ragi dan konsentrasi gula pada tape ketan. Prosiding Seminar Nasional Penelitian Dan Pengabdian Kepada Masyarakat LPPM Universitas 'Aisyiyah Yogyakarta, 1, 98–101*.

Wardhani, I. Y., Amanda, S. M., & Kusuma, A. R. (2020). *Bioentrepreneur Sebagai Upaya Meningkatkan Kreatifitas Dan Alternatif Bisnis Di Masa Pandemi. Journal Of Biology Education, 3(2), 99. https://doi.org/10.21043/jobe.v3i2.8475*.

Wardhani, J. P. K., Riani, A. L., & S. (2018). *Pembelajaran Kewirausahaan Berbasis Proyek. Prosiding Seminar Nasional Pendidikan Administrasi Perkantoran (SNPAP), 54–59. https://jurnal.uns.ac.id/snpap/article/view/27894/21756*.

Yang, H., Shi, H., Wu, YJ, Zhang, L., & Xie, S. (2021). (2021). *Semangat Wirausaha dan Kesediaan Kapitas Ventura untuk Berinvestasi: Peran Modal Relasional. Frontiers Dalam Psikologi, 12, 1–14. https://doi.org/10.3389/fpsyg.2021.728589*.

Yulian.S. (2018). *"Wirausaha dalam Pendidikan Abad 21," www.suaramerdeka.com,.*