

Creating a Technopreneurship-Based Life Skills Education Model with Methods of Project-Based Learning

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Article Info

Article history:

Submission December 13, 2024

Revised January 14, 2025

Accepted July 2, 2025

Published July 30, 2025

Keywords:

Education Model

Technopreneurship

Project Based Learning

Package C Equivalency



ABSTRACT

Low interest in sustainable learning among adult learners in the Paket C equivalency education program stems from learning materials that do not align with the needs for work skills or entrepreneurship. **This research aims** to develop a technopreneurship-based life skills education model using a Project-Based Learning (PjBL) method to enhance IT-based entrepreneurial skills, strengthen competitiveness, and instill character values in students. **The study adopts** the ADDIE model within the Research and Development (R&D) framework. The research population consists of adult dropout learners enrolled in the Paket C equivalency program implementing the independent learning curriculum in 2023. **Data collection methods** include in-depth interviews, observations, documentation, and Google Form questionnaires. Expert and practitioner validation tests of the model were conducted using semi-open questionnaires. Data analysis involved interactive models, descriptive statistics, N-gain, and the Wilcoxon test. **The results** indicate that the conceptual model was designed by incorporating graduate competency standards, content standards, and process standards, using a PjBL approach. Validation tests by experts and practitioners confirmed that the model is valid and applicable in learning practices. The trial results of the hypothetical model showed that the technopreneurship-based life skills education model effectively improves entrepreneurial skills and supports character development in line with the Pancasila student profile. This model can increase students motivation to complete the equivalency program and achieve graduation.

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DOI: <https://doi.org/10.34306/att.v7i2.576>

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1. INTRODUCTION

Indonesians in the era of globalisation are required to be lifelong learners, to face the development of industry 4.0 towards society 5.0. The qualifications of human resources required by stakeholders in the world of work are graduates who have social skills and critical thinking in problem-solving, in addition to technical and scientific knowledge [1]. The rapid changes in society at local and global levels require the quality of technologically advanced human resource competencies without abandoning traditional values that are holistic and integrative in sustainable development [2]. In this condition, it is important to create innovations in a knowledge-based society that involves collaboration between universities, government policymakers, and industry, impacting local to international collaboration networks as described by the Triple Helix model [3].

Education in Indonesia aims to improve human resource competencies through formal, non-formal, and informal education [2]. The life skills education program, part of non-formal education, equips youth to tackle social and economic challenges, preventing issues like unemployment and early marriage. Life skills development, focusing on both soft and hard skills, is essential for addressing global challenges in the 4.0 era and Society 5.0 [4]. This study applies life skills education in the Package C equivalency program to engage adults who have dropped out of school, emphasizing principles such as readiness to learn and learning by doing. The Phase F independent learning curriculum prepares both soft and hard skills for 21st-century competencies, with entrepreneurial skills empowerment subjects. The government promotes PjBL, which has proven effective for adult education, as seen in Tanzania and India. Efforts to improve education for adults who have dropped out support the government's Back to School Movement policy. Innovations in education, in collaboration with the government, universities, and industry, aim to boost the Human Development Index (HDI). In Central Java, the HDI is 72.79, close to the national figure of 72.9, but improvement is needed, particularly in Brebes District, which has high dropout rates [5].

Despite efforts to improve the Human Development Index and collaboration with stakeholders, the annual target of the Back to School Movement to address adult dropouts has not been achieved. Non-formal education, such as the Package C equivalency program at the Community Learning Activity Centre (PKBM), faces management challenges. These obstacles include graduates lack of adaptability to work competency standards required in the Industry 4.0 and Society 5.0 era. The learning process, which tends to be expository, results in passive students. However, applying the PjBL model has been shown to effectively increase students' interest in learning computer-based network vocational skills in vocational schools. Entrepreneurship education in Norway also proves effective with PjBL. In contrast, other studies indicate that experiential learning methods, cooperative learning, and holistic, student-centered learning approaches are more effective for mobilizing youth entrepreneurship.

The main challenges faced by Community Learning Centres (PKBM) in managing the Package C program are inconsistent interest in continuing education, with 1,630 dropouts in grades 10 and 11, and graduates unable to apply their skills in the workforce, leading to an unemployment rate of 8.74%, higher than the national rate of 8.57% [5]. A solution is needed to develop a content structure for the Package C curriculum, focusing on entrepreneurial skills within the independent learning curriculum [6, 7]. The PKH model should promote self-development in technical, interpersonal, creative, and critical thinking skills, aligned with SDGs and vocational and entrepreneurial education [8]. The government aims for 2% of the population (4.8 million) to be entrepreneurs by 2030, with 79.78% of out-of-school adults capable of mastering digital technology [9]. Technopreneurship integrates technology into business practices, encouraging innovative solutions and shifting traditional business models to modern, tech-driven approaches.

2. LITERATURE REVIEW

The curriculum structure for work competency preparation (entrepreneurial skills empowerment subjects) has failed to actively engage students in producing products and fostering a culture of critical thinking, creativity, independence, cooperation, and strong moral character [10]. This issue results in low learning interest among adults (over 25 years old) and a low completion rate for the 12 years of compulsory education at the senior high school level [11].

The problem in managing community empowerment with an entrepreneurial focus in the Package C equivalency program is the underuse of local resources and information technology [12]. Technopreneurship has transformed students mindsets, equipping them with the skills and confidence to become start-up entrepreneurs, as seen in the Philippines and Singapore [13], [14]. It encourages innovation and fosters sustainable competitive advantage through character development. In Indonesia, adopting technopreneurship in product, process, and organization innovations has improved business competitiveness, as demonstrated in Gorontalo.

Given this, there is a need for innovation in creating a technopreneurship-based life skills education (PKH) model using the PjBL method. The innovation lies in applying PjBL to build hard skills while developing soft skills, especially character values. PjBL balances technological and human development, and work-based learning, integrated with internships, enhances expertise [15]. The independent curriculum supports the Pancasila student profile, aiming to develop Indonesian students as lifelong learners with global competencies, emphasizing critical thinking, creativity, and noble character [16].

Digital technology in entrepreneurship covers product production, promotion, and marketing. Success in Industry 4.0 and Society 5.0 relies on technopreneurship, supported by advances in information technology [17]. The government encourages the younger generation to pursue entrepreneurship [18]. This study aims to test the effectiveness of the technopreneurship-based life skills education (PKH) model using PjBL within the independent learning curriculum [19]. The result is improved work competency values for out-of-school adults, with the Package C equivalency program at PKBM effectively preparing graduates to meet workforce needs and ensure sustainable learning.

3. RESEARCH METHODE

3.1. Research Design

The Research and Development (R&D) approach is utilized with the ADDIE model, which is widely recognized for its systematic structure in instructional design. This model is effective in developing products that are both efficient and aligned with user needs. Each stage in the model is interconnected, ensuring that the final product meets the intended objectives and quality standards, consisting of five stages:

- Analysis, gathering data to identify learner needs.
- Design, creating models and prototypes based on analysis.
- Development, refining prototypes through expert evaluations.
- Implementation, testing the prototype and collecting feedback.
- Evaluation, assessing effectiveness with pre/post-tests, N-gain scores, and the Wilcoxon test.

Through these stages, the study not only produces a valid and reliable product but also allows for adjustments based on feedback gathered during the development process. This approach ensures that the resulting model can be implemented more broadly, while maintaining its quality and relevance to the learning needs.

3.2. Population and sample

The research population is Package C equivalency program students at PKBM Brebes Regency who have registered to implement the Merdeka Belajar curriculum in 2022 and 2023. There are 10 PKBMs and 1 SKB, namely PKBM Trimulya Pratama, PKBM Roudhotut Tholibin, OKBM LMDH Wana Karya, PKBM Tunas Perjuangan, PKBM Harapan Jaya, PKBM Tunas Mandiri, PKBM Amarilah, PKBM Budi Utomo, PKBM Bina Sejahtera, PKBM Generasi Mandiri and SKB Brebes. The limited trial of the hypothetical model by random sampling determined 1 PKBM namely PKBM Bina Sejahtera in Brebes sub-district.

3.3. Data collection techniques and research instruments

Data collection involved in-depth interviews with Package C Phase F students to assess learning needs, processes, and outcomes at PKBM [20], [21]. Focused observations (1-4 scale) were used to evaluate instructor skills and student activities during PjBL. Documentation techniques reviewed lesson plans prepared by instructors [22]. Expert validation used a semi-open questionnaire (1-4 scale for closed questions and open questions for feedback) to assess the feasibility of the syllabus, lesson plans, teaching materials, and worksheets [23]. Four experts and three practitioners provided feedback for revisions [24]. A Likert-scale closed questionnaire was used for pretest and posttest data on the impact of the product trial on entrepreneurship skills and character development, based on the Pancasila student profile [25], [26]. Each sub-element was rated on developmental achievement: undeveloped (BB), starting to develop (MB), developing as expected (BSH), and developing very well (BSB).

3.4. Data Analysis

Data analysis of the exploration of model development needs using an interactive model. Analysis was carried out since the data collection process, data reduction, data presentation, and conclusion drawing. Expert and practitioner validation tests were analyzed with descriptive statistics and data analysis of innovation effectiveness tests using parametric statistics T-Test or nonparametric statistics Wilcoxon Test, the difference between pre-test and post-test [27], [28]. The determination of data analysis techniques takes into account the requirements of normality and homogeneity tests.

4. RESULT AND DISCUSSION

The results of the research based on the 5 stages of the ADDIE model can be described as follows.

4.1. Analysis Stage

Less than 10% of Paket C graduates continue their education, with most opting for work, facing long job search times and low wages [29]. Many lack interest in entrepreneurship due to limited capital and fear of failure [30]. The curriculum doesn't meet workforce needs, especially in Industry 4.0, and focuses mainly on cognitive skills, neglecting creativity and practical abilities [31]. Low participation in learning, especially among adults, stems from overly conceptual textbooks and limited problem-solving training [32]. Group discussions also lack real-world relevance. Paket C students need life skills education focused on entrepreneurship, using local resources (ethnoprpreneurship) and technology (technoprpreneurship) [33], [34]. A new learning model is needed, integrating broad education principles and PjBL with five stages: introduction, contextualization, planning, action, and reflection and follow-up [35].

4.2. Design Stage

A conceptual model and prototype for a life skills education model have been developed, considering graduate competencies, content, process, and management standards [36]. The head of the Community Learning Activity Centre manages the program, with tutors guiding learning and students as both subjects and objects, supported by regional potential [37]. The product aims to create a technoprpreneurship-based life skills education prototype using the PjBL method, grounded in relevant theories [38]. The prototype is shown in Figure 1.

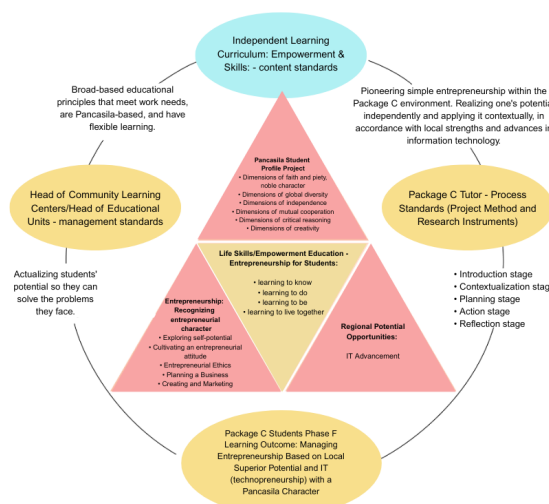


Figure 1. Prototype of the Conceptual Model of Technoprpreneurship-Based Life Skills Education in the Package C Independent Learning Curriculum

Figure 1 shows the prototype of the technoprpreneurship-based life skills education model in the Merdeka Belajar Curriculum for Package C, aimed at enhancing entrepreneurial skills and the Pancasila Student Profile, aligned with 21st-century competencies and Industry 4.0 and Society 5.0 developments [39]. These components integrate the curriculum, learning process, and management to develop entrepreneurial skills, supported by Technoprpreneurship and the Pancasila Student Profile [40].

The Ethnoprpreneurship-Based Life Skills Education Project for Phase F learners (Grade 11 Package C / SMA / SMK) implements the Pancasila Student Profile-based programme, focusing on values like faith, character, independence, cooperation, critical thinking, and creativity through local wisdom and Technoprpreneurship [41], [42].

This project is designed for Phase F learners (Grade 11) in the Package C / SMA / SMK program, with 20 Competency Credit Units (SKK) per week, totaling 720 SKK for 1 year (36 weeks). Learning occurs face-to-face for a maximum of 2 JP per week or 72 JP per year, with each meeting lasting 45 minutes [43], [44].

Table 1. Stages of Technopreneurship Learning and Activities

No	Stage	Description	Activities	Hours (JP)
1	Introduction stage	Recognising the meaning, characteristics and role of entrepreneurship in human life.	Getting to Know Entrepreneurship	4
			Exploring Your Potential	
			Cultivating an Entrepreneurial Attitude	4
2	Contextualisation stage	Realising entrepreneurship in accordance with personal potential (passion) and regional potential as well as opportunities to utilise digital technology.	Knowing Regional Potential, Local Wisdom	4
			Regional Resource Analysis	4
			Ethics of IT-based Entrepreneurship	4
3	Planning stage	Seek and develop ideas, inventory resources, and plan innovative and sustainable ventures.	Exploring Business Ideas	4
			Planning an Innovative Business	4
			Collaborating and Cooperating	4
4	Action Stage	Applying the knowledge and skills gained through meaningful action.	Business Product Creativity Strategy	6
			IT-based Promotion and Marketing	8
			Independent Entrepreneurship and Managing Risk	10
5	Reflection stage	Evaluating performance and reflecting.	Technopreneurship Work	4
			Business Evaluation	4
			Sustainable Entrepreneurship	4

Table 1 presents the curriculum for the Paket C equivalency program, focusing on the Pancasila student profile, vocational skills, professional attitudes, and entrepreneurship. It integrates local wisdom, IT, and equivalency education features.

The model integrates curriculum development, life skills education, and learner-centered theories [45]. It views the curriculum as a tool for knowledge reconstruction, aligning with the Pancasila student profile [46]. Life skills education prepares individuals for challenges, improving vocational skills and labor absorption [47]. Entrepreneurship training fosters creativity, innovation, and motivation, contributing to Indonesia's development [48].

4.3. Development Stage

At the development stage, the prototype is validated by experts and practitioners to create a hypothetical product [49]. This product includes the curriculum structure and learning tools for life skills education, such as RPS and teaching materials for tutors to manage Technopreneurship-based learning using constructivism and project methods to strengthen learner profiles [50]. The empowerment and entrepreneurship modules follow the independent learning curriculum for Package C/SMA/MAN/SMK, totaling 70-72 JP per year. After completing the curriculum structure in Table 1, the next step is to define the dimensions and elements of the Pancasila Student Profile as shown in Table 2.

Table 2. Dimensions, Elements, and Sub-elements of the Pancasila Student Profile

Dimensions	Sub-elements	Target Achievement at the end of Phase E (high school, 15–18 years old)	Related Activities
Independent	Self-awareness and understanding the situation.	Recognizing your qualities, interests, and challenges.	[1], [2], [3], [4], [5], [13]

Dimensions	Sub-elements	Target Achievement at the end of Phase E (high school, 15–18 years old)	Related Activities
Creative	Generate original ideas	Generate ideas, evaluate them, and assess risks with ethics and values.	[7], [8], [9]
	Produce original works and actions	Express thoughts and feelings through actions, evaluating impacts and risks.	[7], [8], [9]
	Flexible in thinking to find alternative solutions.	Experiment with creative options to adapt to changing environments and technology.	[10], [11], [12]
Critical reasoning	Able to process information objectively	Understand a problem by clearly writing its information.	[5], [7], [8]
	Connect different pieces of information.	Identify the linkage of a question and the concept of a problem.	[7], [10]
	Analyse the information	Solve a problem with correct steps and calculations.	[1], [2], [4], [12]
	Evaluate and conclude	Draw conclusions from a problem correctly.	[11], [13]
Mutual aid	Collaboration - cooperation	Build teams and manage cooperation to achieve goals.	[9], [12]
Believing, fearing God Almighty, and having noble character	Personal morals - integrity	Embrace religious and social rules as principles to apply wisely and contextually.	[6], [13]

A rubric was developed for each dimension and its sub-elements, which can be used as a reference in preparing lesson plans and developing teaching materials. The following is an example of a rubric for the development of the sub-elements of the independent dimension presented in Table 3.

Table 3. Rubric Table for the development of Sub-elements of the Self-Directed Dimension

Sub-elements	Not yet developed (BB)	Starting to develop (MB)	Developing as expected (BSH)	Very well developed (BSB)
Recognising your own qualities and interests and the challenges you face	Describe how their qualities impact life skills and entrepreneurship, considering technology and feedback.	Assess entrepreneurial abilities and development priorities based on learning and technology.	Identify local strengths, tech challenges, and digital entrepreneurship options.	Plan an entrepreneurship strategy based on self-potential, local strengths, market, IT, and risks.

In addition, a sample rubric for the development of the sub-elements of the gotong royong dimension is presented in Table 4.

Table 4. Rubric Table for the Development of Sub-elements of the Mutual Aid/Cooperation Dimension

Sub-elements	Underdeveloped (BB)	Starting to develop (MB)	Developing as expected (BSH)	Developing Very Well (BSB)
Collaboration - co-operation	Demonstrate positive expectations of others in order to achieve the goals	Align one's own actions with those of others to carry out problem-solving	Build teams and manage cooperation to achieve shared goals in the field	Build teams and manage cooperation to achieve common goals in the field

Sub-elements	Underdeveloped (BB)	Starting to develop (MB)	Developing as expected (BSH)	Developing Very Well (BSB)
	of the entrepreneurship life skills group in the neighbourhood (school and home).	activities and achieve the goals of entrepreneurial groups in the neighbourhood, and encourage others to work effectively and achieve common goals.	of technopreneurship in accordance with the initial targets that have been determined.	of technopreneurship in accordance with predetermined development targets.

The developmental rubric for each sub-element of the 6 dimensions of the Pancasila student Profile, a learning module was developed. Here is one example of a module for the first topic, Knowing Entrepreneurial Character as show Table 5.

Table 5. Activity 1: Getting to Know the Entrepreneurial Character

Learning Objectives	Students/learners can explore the meaning of entrepreneurship. Students/learners can recognise the characteristics of an entrepreneur.
Time: 4JP	Materials: books, audio-visual devices, computers with internet, resource persons. Teacher/Tutor Role: Moderator/Facilitator/Narrator/Consultant.
Preparation	The teacher introduces the entrepreneurship theme through the project Exploring Regional Potential Through Young Entrepreneurs. Following this, there will be a discussion about learners' expectations for the program, followed by the establishment of class agreements regarding learning attitudes.
Implementation	The lesson begins with a discussion on learners' understanding of entrepreneurship. Students are asked if they can distinguish between pictures of entrepreneurs and employees, and how their characteristics differ. The teacher then plays a video on entrepreneurial activities and defines an entrepreneur as someone skilled and innovative in recognizing, producing, marketing products, and managing business operations and capital. Learners read articles and watch documentaries of successful entrepreneurs in Indonesia. They are encouraged to identify the attitudes of the entrepreneur in the content, reflecting on questions like: What are the entrepreneur's traits? Do you share the same traits?
Duties	Find entrepreneurial family/community members. Identify their attitudes: <i>Do you know an entrepreneur? What are their traits? Do you share the same traits?</i> (Introduction stage, problem orientation).

The following data presents the results of the feasibility of teaching material module products from 4 experts consisting of life skills education experts, entrepreneurship education experts, learning technology experts (adult learning design), and curriculum development experts.

Table 6. Results of the Feasibility Test of Textbook Products from Experts

No	Appraiser	Feasibility of material content (9 items)		Appropriateness of presentation (5 items)		Language appropriateness (8 items)		Graphics feasibility (7 items)	
		Score	Average	Score	Average	Score	Average	Score	Average
1	PKH	30	3.33	17	3.4	30	3.75	25	3.57
2	KWU	33	3.66	18	3.6	31	3.87	26	3.71
3	TP	32	3.55	18	3.6	27	3.37	24	3.42
4	PK	32	3.55	19	3.8	27	3.37	25	3.57
Total		127	14.09	72	14.4	115	14.36	100	14.27
Average		31.75	3.52	17.25	3.6	28.75	3.59	25	3.57

Based on Table 6, expert assessments show that all components of the product are highly feasible, with scores above 3.5 on a 1-4 scale. Content feasibility scored 3.52, presentation 3.6, language 3.59, and graphical layout 3.57, all categorized as very feasible. The material aligns with the conceptual model, supporting Pancasila student profile dimensions like independence, cooperation, critical thinking, creativity, and moral values.

It develops technopreneurship competencies and engages students in real-life contexts [51]. The presentation supports intellectual and cognitive development, following PjBL and the independent learning curriculum. The language is clear and accessible, while the layout and graphics meet standards, with an attractive cover and organized content. Expert feedback confirms that the product is ready for use with minimal revisions, as detailed in Table 7.

Table 7. Criticism and Input by Experts for Improving the Implementation of Technopreneurship-Based Life Skills Education Model

No.	Assessment Aspect	Comments and Suggestions
1	Appropriateness of material content	Up-to-date material comes from journal articles. Add source of reference material from reputable journals.
2	Appropriateness of material presentation	Abstract material needs to be added links from relevant audiovisual (video) or image/visual (iconic) sources, in order to make it easier for students to understand the reading content.
3	Linguistic appropriateness	Use standardized, straightforward Indonesian language to narrate the material in a coherent, developmentally appropriate manner for Package C students, so that it is easy to understand.
4	Graphic or layout feasibility	The author's name is written on the front cover without mentioning the title, the number of authors is adjusted to the research team members. The picture on the cover is relevant to the content of the book.

Expert feedback guided material revisions, enhancing content relevance by adding reputable journal references. The inclusion of audio-visual resources made learning more interactive, while using standardized Indonesian improved accessibility for Package C students. Adjustments to the number of authors and cover image relevance gave the material a more professional and aligned identity. These revisions strengthened the quality, attractiveness, and effectiveness of the materials.

The product feasibility test of the conceptual model by practitioners was carried out by 3 tutors/learning assistants of the Package C equivalency education programme. The practitioner validation test instrument has a scale of 1 - 4, consisting of the component of ease of understanding the contents of the book from each topic or chapter, which consists of 12 chapters and each chapter is confirmed by 5 statement items filled in through a questionnaire. The question items include, (a) ease of understanding the RPS, (b) ease of understanding the material, (c) ease of applying learning methods, (d) clarity of worksheets, (e) clarity of development rubrics. Thus each topic x 5 statement items were rated @ a scale of 1- 4.

Table 8. Product Validation Test of Technopreneurship-Based Life Skills Education Model Textbook for Equivalency Education Package C

No.	Textbook Chapter	Pamong Belajar-1		Tutor 2		Tutor 3		Total	
		Score	Average	Score	Average	Score	Average	Score	Average
1	Getting to know Entrepreneurship	17	3.4	18	3.6	18	3.6	53	3.53
2	Exploring Your Potential	17	3.4	18	3.6	17	3.4	52	3.46
3	Cultivating an Entrepreneurial Attitude	17	3.4	18	3.6	18	3.6	53	3.53
4	Getting to know the Regional Potential of Local Wisdom	18	3.6	16	3.2	17	3.4	51	3.4
5	Regional Resource Analysis	16	3.2	18	3.6	16	3.2	50	3.33
6	IT-based Entrepreneurial Ethics	16	3.2	16	3.2	17	3.4	49	3.3
7	Product Creativity	18	3.6	17	3.4	18	3.6	53	3.53
8	IT-based promotion/marketing	16	3.2	19	3.8	18	3.6	53	3.53
9	Managing risk	16	3.2	18	3.6	18	3.6	52	3.46
10	Technopreneurship showcase	18	3.6	19	3.8	17	3.4	54	3.6
11	Business Evaluation	18	3.6	16	3.2	17	3.4	51	3.4
12	Sustainable Entrepreneurship	17	3.4	17	3.4	19	3.8	53	3.53
Total		204	40.8	210	42	210	42	624	41.6
Average		17	3.4	17.5	3.5	17.5	3.5	52	3.46

Based on Table 8, it can be explained that the average score of practitioners' assessment of learning module/device products is 3.46 from a scale of 1-4, including very feasible to use in learning, with the criteria: (a) RPS is easy to understand, (b) material is easy to understand, (c) learning methods are easy to understand and apply, (d) worksheets are clear, in accordance with learning outcome indicators, (e) development rubrics can be understood and applied.

The three practitioners gave a balanced assessment on the conclusion that the product could be applied with a slight revision, namely at the end of each learner worksheet, an assessment rubric was given so that Package C students could measure or self-assess their learning achievement abilities.

4.4. Implementation Stage

The implementation stage involves testing hypothetical products in the learning process within the Paket C equivalency education environment, managed by PKBM, as show in Table 9. After the conceptual model is revised and validated by experts, it is tested on users, including PKBM managers, tutors, and learners. The trial is conducted on a small scale at one PKBM Bina Sejahtera institution, with 15-20 learners and two tutors. Topics include fostering entrepreneurial spirit, local wisdom, IT-based entrepreneurship ethics, business planning, and evaluation of business products.

Table 9. Technopreneurship-Based Entrepreneurship Learning Process Project Method

Project Stages	Topic	Tutor Activity	Learner Activities
Introduction: problem orientation	Fostering the spirit of entrepreneurship.	Prepare key questions on entrepreneurial spirit and invite discussion.	Participants ask fundamental questions on how to solve the problem.
Contextualisation: exploration of business potential, opportunities and challenges	Regional potential, business opportunities IT advancement and business feasibility.	Create a SWOT analysis table to explore business potential.	Completing the SWOT analysis table, identifying alternative types of entrepreneurship, prioritising the types of business.
Business planning	Planning the business.	Monitor learners in developing a business plan.	Develop a business plan for the type of business according to the results of the analysis.
Action work	Production and marketing practices.	Monitor learners participation and engagement in practice. Observe the progress of the designed project. Guiding if there are any obstacles.	Make the project according to the schedule. Write the stages of project development in the report.
Reflection	Evaluation of usefulness and development.	Provide feedback or follow-up direction regarding the project.	Develop a development plan.

Table 9 shows that the implementation stages in the technopreneurship-based learning process provide a clear picture of the role of the instructor and the activities undertaken by students in developing entrepreneurial skills. With structured stages ranging from problem orientation, exploring business potential, to evaluating results, it is hoped that each participant will gain practical experience that will hone their skills in planning and managing a business. The implementation of this stage prioritizes the development of student competencies through activities directly related to achieving business goals, as well as integrating technology and innovation into the teaching and learning process.

4.5. Evaluation Stage

The evaluation stage collects data on the assessment of the technopreneurship-based life skills education model using project learning methods. It evaluates the effectiveness of the product in improving entrepreneurial skills and achieving the Pancasila student profile for Package C equivalency students. The method involves observation, using a guide that focuses on the dimensions, elements, and sub-elements of the Pancasila profile. The instrument covers 6 dimensions, 20 elements, and 42 sub-elements, with scores ranging from BB (1) to BSB (4). Table 10 shows the frequency distribution of the developmental achievements of the Pancasila student profile for 18 Package C learners. The percentage of achievements at each level is calculated based on the sub-elements achieved. With 6 dimensions and 18 learners, the maximum possible intensity of developmental achievements is 108. Before the application of the technopreneurship model, 16.6% of learners were at BB (1), 49.07% at MB (2), 22.22% at BSH (3), and 12.03% at BSB (4). This data is summarized in Table 10.

Table 10. Achievement of Pancasila Student Profile Development before Project Method Technopreneurship Life Skills Education Model (PjBL)

Progress	BB (1)		MB (2)		BSH (3)		BSB (4)	
Dimensions	Total	%	Total	%	Total	%	Total	%
Faith, piety and morality Your Honour	3	16.66	8	44.44	4	22.22	3	16.66
Global Diversity	3	16.66	10	55.55	3	16.66	2	11.11
Working together	4	22.22	6	33.33	6	33.33	2	11.11
Independent	3	16.66	9	50	4	22.22	2	11.11
Critical Reasoning	3	16.66	10	55.55	3	16.66	2	11.11
Creative	2	11.11	10	55.55	4	22.22	2	11.11
Total	18	16.66	53	49.07	24	22.22	13	12.03

Based on Table 11, it can be noted that the majority of the developmental achievements of the Pancasila student profile in the 6 dimensions are limited to starting to develop (49.07%) of learners, and there are even 16.6% of learners who have not developed. The effectiveness of the application of the hypothetical model after applying the textbook prepared based on the technopreneurship-based life skills education model with the project learning method can be seen in the frequency distribution in Table 11 below.

Table 11. Development of Pancasila Student Profile After Learning Process of Technopreneurship Life Skills Education Model PjBL Method

Progress	BB (1)		MB (2)		BSH (3)		BSB (4)	
Dimensions	Total	%	Total	%	Total	%	Total	%
Faith, piety and morality	0	0	2	11.11	11	61.11	5	27.77
Mulia	0	0	2	11.11	11	61.11	5	27.77
Global Diversity	0	0	3	16.66	8	44.44	7	38.88
Working together	0	0	0	0	9	50	0	0
Independent	0	0	3	16.66	7	38.88	8	44.44
Critical Reasoning	0	0	3	16.66	7	38.88	8	44.44
Creative	0	0	2	11.11	8	33.33	8	55.55
Total	0	0	13	12.04	50	46.30	45	41.66

The decrease in learners at the BB (0%) and MB levels (from 49.07% to 12.04%) shows that almost all learners have progressed to higher levels. Meanwhile, 46.30% of learners were at the BSH (As Expected) level and 41.66% at the BSB (Very Good) level. This increase reflects the effectiveness of the Technopreneurship-Based life skills learning model with the PjBL method in improving learner competencies, especially in the aspects of creativity, cooperation, critical thinking, and independence, which are in line with the Pancasila profile. The comparison before and after applying the hypothetical model of technopreneurship skills education with project learning method can be visualised in the following diagram.

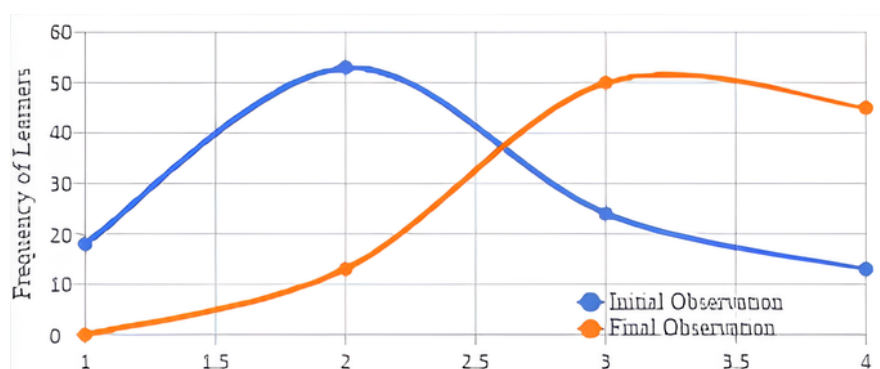


Figure 2. Diagram of Differences in Developmental Outcomes of Pancasila Student Profile

Based on Figure 2, it can be explained that the initial observation before the application of the blue-striped model, the frequency of students who still reached level 1 (Not Developing or BB) there were 18 sub-elements (16.66%). Whereas in the final observation after the application of the model marked with a red line, there was no 1 learner who still reached the Pancasila profile dimension at level 1 (BB) or 0%. The peak of the blue diagram (before the application of the model) is at level 2 or Starting to Develop (MB) = 55.55%, while the peak of the red diagram (after the application of the model) is at level 3 or Developing as expected (BSH) = 49.07%, even after applying the model, learners who reach level 4, Developing Very Well (BSB) increased from 12.03% to 41.66%.

The results of the hypothesis test "whether or not there is an effect of the application of the technopreneurship-based life skills education model with the PjBL method on the achievement of the development of the Pancasila student profile", the Wilcoxon Test is used, because the sample size is small (18 students), so it does not require normally distributed data and the type of data is ordinal. The Wilcoxon test is an alternative to the paired sample t-test. The results of the Wilcoxon Test with SPSS 23, obtained the following output data, as show in Table 12.

Table 12. Wilcoxon Test Ranks Table

Post Test - Pre Test	N	Mean Rank	Sum of Ranks
Negative Ranks	0 ^a	.00	.00
Positive Ranks	18 ^b	9.50	171.00
Ties	0 ^c		
Total	18		

Negative rank shows that the difference between the learning outcomes of package C phase F students in the Post Test - PreTest of the empowerment subject of entrepreneurial skills is 0, both in N, mean rank, and sum of rank. Positive ranks showed that all 18 learners had an increase in learning outcomes for the Pancasila student profile. The average increase was 9.50, with a positive rank of 171.00.

Table 13. Test Statistics for Post-Test - Pre-Test

Test Statistics	Post-Test - Pre-Test
Z	-3.724
Asymp. Sig. (2-tailed)	.000

Based on Table 13 the output of the Wilcoxon Test Statistics, it is known that Asymp. Sig (2-tailed) is 0.000 smaller than <0.05 , it can be concluded that the hypothesis is accepted. That is, there is a significant effect of the application of the technopreneurship-based life skills education model with the PjBL method on the achievement of the development of the Pancasila student profile. The results of the N Gain calculation to interpret the effectiveness of the technopreneurship life skills education model to achieve the Pancasila student profile using projects, are as follows:

$$\begin{aligned}
 \text{N-Gain} &= \frac{\text{Skor Post-test} - \text{Skor Pre-test}}{\text{Skor Ideal} - \text{Skor Pre-test}} \\
 &= \frac{127,77 - 74,33}{168 - 74,33} \\
 &= \frac{53,44}{93,67} \\
 &= 0,57072 \\
 \text{N-Gain (\%)} &= 0,57072 \times 100\% = 57,072\%
 \end{aligned} \tag{1}$$

Based on the category of interpretation, an N-Gain percentage between 56% and 75% is considered quite effective. The calculated N-Gain score of 0.572 falls within the range of $0.3 \leq g \leq 0.7$, indicating that.

5. MANAGERIAL IMPLICATION

The development and implementation of the technopreneurship-based life skills education model, using PjBL, present significant implications for educators, policy makers, and business leaders in the context of adult education and entrepreneurship development. For educators, this model offers a structured, hands-on approach that can enhance engagement and foster critical skills such as creativity, problem-solving, and teamwork, which are essential in the Industry 4.0 and Society 5.0 eras. Managers in educational institutions should consider adopting this model to align their curricula with workforce needs, focusing on both technological proficiency and entrepreneurial mindset. For policymakers, this study highlights the importance of integrating technopreneurship into non-formal education programs to improve the employability of adults, reduce dropout rates, and meet national goals for entrepreneurship. Additionally, this model can be adapted to different educational settings to address diverse community needs, thus contributing to the achievement of SDG targets, particularly in terms of quality education and economic growth.

6. CONCLUSION

The development design of the conceptual model of technopreneurship-based life skills education in the independent learning curriculum includes several components. The content standard component focuses on meeting work needs or pioneering simple entrepreneurship by utilizing self-potential, local excellence, and IT with Pancasila character. The process standard component involves contextual learning with the PjBL method, which includes introduction, contextualization, planning, action, reflection, and evaluation. The management standard aims to actualize the potential of learners in solving problems by applying the four pillars: learning to know, learning to do, learning to be, and learning to live together. Lastly, the learning outcome components focus on managing entrepreneurship based on the potential of local excellence and IT (Technopreneurship) while achieving the six dimensions of the development of the Pancasila student profile.

Based on expert testing, the development design of a technopreneurship-based life skills education model with PjBL method is declared feasible or valid to improve entrepreneurial skills with Pancasila character based on aspects of material content feasibility, presentation feasibility, linguistic feasibility, and graphic/layout feasibility. Expertise in the fields of curriculum and educational technology, adult learning design experts, experts in life skills education and entrepreneurship. Based on the practitioner test by tutors and learning assistants of Package C, it is declared feasible from the aspects of ease of understanding the content of the material, compatibility with the independent learning curriculum and attracting reading interest for Package C students.

In terms of practical application, the technopreneurship-based life skills curriculum shows that it is highly feasible from the aspects of understanding content, compatibility with independent learning, and engagement of Package C students. Through the implementation of the PjBL method in the independent learning curriculum, the program has been effective in improving learning outcomes, particularly in IT-based entrepreneurial skills. It also contributes to strengthening the character profile of Pancasila students, as reflected by an N-Gain Score of 0.572. This indicates a significant positive impact on students' entrepreneurial capabilities and character development.

7. DECLARATIONS

7.1. About Authors

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7.2. Author Contributions

Conceptualization: TS, JS, YS, and AD; Methodology: TS, JS and YS; Software: TS, JS and AD; Validation: TS, JS, YS; Formal Analysis: TS, JS and AD; Investigation: TS, JS and AD; Resources: JS, YS, and AD; Data Curation: TS, JS and AD; Writing Original Draft Preparation: TS; Writing Review and Editing:

JS, YS, and AD; Visualization: TS, TS, YS AD; All authors, TS, JS, YS, and AD, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The datasets used to support the findings of this study are available from the direct link in the dataset citation.

7.4. Funding

The research team would like to thank the UNNES Institute for Research and Community Service for funding this research activity with DIPA UNNES funds in 2023.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

REFERENCES

- [1] R. Mulyany, S. Muhammad, T. A. Geumpana, H. Halim, C. D. Pertiwi *et al.*, “A potential framework for an impactful technopreneurship education,” *Indonesian Journal of Business and Entrepreneurship (IJBE)*, vol. 9, no. 2, pp. 208–208, 2023.
- [2] S. D’Angelo, R. Marcus, and E. Ngabonzima, “Teaching and learning for life skills development: Insights from rwanda’s 12+ programme for adolescent girls: Special issue youth & adolescent skills development: Preparing young people for diverse global challenges,” *Development Policy Review*, vol. 40, p. e12622, 2022.
- [3] N. Antony and S. Tripathi, “Life skills to be developed for students at the school level,” *International Journal of Educational Management*, vol. 37, no. 6/7, pp. 1425–1444, 2023.
- [4] E. F. Ayu and S. Trihantoyo, “Optimisation of the special job exchange in channeling,” *Journal of Education Management Inspiration*, vol. 9, no. 4, pp. 932–941, 2021.
- [5] B. C. J. Province, *A Decade of Education in Central Java 2011-2021*. Central Java Provincial Statistics Agency, 2022.
- [6] M. of Education and Culture, “Curriculum structure for equivalency education (package a, package b, and package c programmes),” 2022, curriculum Structure for Equivalency Education (Package A, Package B, and Package C Programmes).
- [7] Ministry of Education, Culture, Research, and Technology of Indonesia, “Collaboration partnership portal,” <https://partnership.kemdikbud.go.id/>, Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia, 2025, accessed on July 30, 2025.
- [8] United Nations, “Sustainable development goals,” <https://sdgs.un.org/goals>, 2024.
- [9] BPS, “Proportion of youth and adults 15-59 years of age with information and computer technology (ict) skills by region of residence,” In BPS, 2020. [Online]. Available: https://www.bps.go.id/indikator/indikator/view_data/0000/data/1449/sdgs_4/1
- [10] J. P. Takona, “Research design: qualitative, quantitative, and mixed methods approaches,” *Quality & Quantity*, vol. 58, no. 1, pp. 1011–1013, 2024.
- [11] J. DeJaeghere and E. Murphy-Graham, *Life skills education for youth: Critical perspectives*. Springer Nature, 2022.
- [12] Z. Y. Lim, J. H. Yap, J. W. Lai, I. A. Mokhtar, D. J. Yeo, and K. H. Cheong, “Advancing lifelong learning in the digital age: A narrative review of singapore’s skillsfuture programme,” *Social Sciences*, vol. 13, no. 2, p. 73, 2024.
- [13] B. L. Edo and S. Nwonkwo, “Triple helix partnership in educational administration and planning in tertiary institutions in nigeria,” *International Journal of Educational Management, Rivers State University.*, vol. 1, no. 2, pp. 325–338, 2025.
- [14] U. Rahardja, C. T. Sigalingging, P. O. H. Putra, A. Nizar Hidayanto, and K. Phusavat, “The impact of mobile payment application design and performance attributes on consumer emotions and continuance intention,” *Sage Open*, vol. 13, no. 1, p. 21582440231151919, 2023.
- [15] A. Pambudi, N. Lutfiani, M. Hardini, A. R. A. Zahra, and U. Rahardja, “The digital revolution of startup matchmaking: Ai and computer science synergies,” in *2023 Eighth International Conference on Informatics and Computing (ICIC)*. IEEE, 2023, pp. 1–6.

- [16] A. Faiz and I. Kurniawaty, "The urgency of value education in the era of globalisation," 6(3), pp. 3222–3229, 2022.
- [17] B. Huntington, J. Goulding, and N. J. Pitchford, "Expert perspectives on how educational technology may support autonomous learning for remote out-of-school children in low-income contexts," *International Journal of Educational Research Open*, vol. 5, no. October 2022, p. 100263, 2023. [Online]. Available: <https://doi.org/10.1016/j.ijedro.2023.100263>
- [18] W. Guo *et al.*, "Innovating arts education in higher education: A decade of arts entrepreneurship education in the united states," *Foundations and Trends® in Entrepreneurship*, vol. 21, no. 4–5, pp. 464–496, 2025.
- [19] T. Li, Q. Feng, B. Niu, B. Chen, F. Yan, J. Gong, and J. Liu, "Mapping urban villages based on point-of-interest data and a deep learning approach," *Cities*, vol. 156, p. 105549, 2025.
- [20] A. C. Pramono and W. Prahiawan, "Effect of training on employee performance with competence and commitment as intervening," *Aptisi Transactions on Management*, vol. 6, no. 2, pp. 142–150, 2022.
- [21] E. a. M. Nugroho Adi Saputro, "Measuring the effectiveness of constructivism theory in learning," *Journal of Education and Instruction*, vol. 4, pp. 24–39, 2021. [Online]. Available: <https://journal.ipm2kpe.or.id/index.php/JOEAI/article/view/2151/1354>
- [22] I. Machdi and W. e. Widyati, *Statistics Indonesia 2023*. Central Bureau of Statistics of Indonesia, 2023, catalogue/Ca.
- [23] R. Machmud, N. F. Wuryaningrat, and D. Mutiarasari, "Technopreneurship-based competitiveness and innovation at small business in gorontalo city," *International Journal of Sustainable Development & Planning*, vol. 17, no. 4, 2022.
- [24] J. W. Creswell and M. Inoue, "A process for conducting mixed methods data analysis," *Journal of General and Family Medicine*, vol. 26, no. 1, pp. 4–11, 2025.
- [25] M. Miranda, Saiz-linares, A. Costa, and J. Castro, "Active, experiential and reflective training in civil engineering: evaluation of a project-based learning proposal," *European Journal of Engineering Education*, vol. 45, no. 6, pp. 937–956, 2020. [Online]. Available: <https://doi.org/10.1080/03043797.2020.1785400>
- [26] N. Lutfiani, D. A. Astrieta, V. Wildan, H. Sulistyaningrum, M. R. Anwar, and E. D. Astuti, "Emotional well-being and psychological support in infertility a multi-modal ai approach," *International Journal of Cyber and IT Service Management*, vol. 5, no. 1, pp. 81–92, 2025.
- [27] V. Mutalimov, G. Volkovitchkaia, A. Buymov, S. Syzdykov, and D. Stepanova, "Professional entrepreneurial competencies and creativity skills formation under the influence of educational practices of start-up projects development," *Journal of Technical Education and Training*, vol. 13, no. 4, pp. 42–55, 2021.
- [28] M. Hardini, Q. Aini, U. Rahardja, R. D. Izzaty, and A. Faturahman, "Ontology of education using blockchain: Time based protocol," in *2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS)*. IEEE, 2020, pp. 1–5.
- [29] Y. Li, D. Chen, and X. Deng, "The impact of digital educational games on student's motivation for learning: The mediating effect of learning engagement and the moderating effect of the digital environment," *PloS one*, vol. 19, no. 1, p. e0294350, 2024.
- [30] A. Nayla, F. Nurgayyah, W. Naila, N. R. Desianti, and N. Arta Utami Zulkifli, "The relevance of ki hajar dewantara's philosophy of education in modern education," *Available at SSRN 5057233*, 2024.
- [31] M. S. Patil and U. A. Kamerikar, "Learning by doing through project based active learning technique," *Journal of Engineering Education Transformations*, pp. 125–129, 2020.
- [32] A. Susanto, Y. Efendi, B. Santoso, P. Untoro, Suyitno, and A. Primartadi, "Development of vocational life skills learning model based on entrepreneurship in automotive engineering education students," in *AIP Conference Proceedings*, vol. 2671, no. 1. AIP Publishing LLC, 2023, p. 040003.
- [33] A. Abudaqa and I. Noburu, "Optimizing digipreneurship in the growth of the digital millennial creative economy ecosystem," *Startupreneur Business Digital (SABDA Journal)*, vol. 4, no. 1, pp. 24–34, 2025.
- [34] H. Shafiee Rad, E. Namaziandost, and M. H. Razmi, "Integrating stad and flipped learning in expository writing skills: Impacts on students' achievement and perceptions," *Journal of Research on Technology in Education*, vol. 55, no. 4, pp. 710–726, 2023.
- [35] V. Ratten and P. Jones, "Entrepreneurship and management education: Exploring trends and gaps," *The International Journal of Management Education*, vol. 19, no. 1, p. 100431, 2021.
- [36] R. Rauf, H. Wijaya, and E. Tari, "Entrepreneurship education based on environmental insight: Oppor-

- tunities and challenges in the new normal era,” *Cogent Arts & Humanities*, vol. 8, no. 1, p. 1945756, 2021.
- [37] R. Saputra, S. Rochmiyati, and B. H. C. K., “Embodiment of the sixth profile of pancasila students in the project activity of strengthening the profile of pancasila students making pencil holders from used plastic bottles,” *Elementary School: Journal of Elementary Education and Learning*, vol. 10, no. 1, pp. 87–98, 2023. [Online]. Available: <https://es.upy.ac.id/index.php/es/article/view/4077/2540>
- [38] S. Susanto, A. W. Ritonga, and A. Desrani, “Islamic boarding school paradigm: As a religious education institution and strengthening student character,” *Munaddhomah: Jurnal Manajemen Pendidikan Islam*, vol. 4, no. 4, pp. 878–887, 2023.
- [39] R. Aprianto, R. Haris, A. Williams, H. Agustian, and N. Aptwell, “Social influence on ai-driven air quality monitoring adoption: Smartpls analysis,” *Sundara Advanced Research on Artificial Intelligence*, vol. 1, no. 1, pp. 28–36, 2025.
- [40] S. Rouvrais, B. Remaud, and M. Saveuse, “Work-based learning models in engineering curricula: insight from the french experience,” *European Journal of Engineering Education*, vol. 45, no. 1, pp. 89–102, 2020.
- [41] A. Hermawan, W. Sunaryo, and S. Hardhienata, “Optimal solution for ocb improvement through strengthening of servant leadership, creativity, and empowerment,” *Aptisi Transactions on Technopreneurship (ATT)*, vol. 5, no. 1Sp, pp. 11–21, 2023.
- [42] M. Saimon, Z. Lavicza, and T. Dana-Picard, “Enhancing the 4cs among college students of a communication skills course in tanzania through a project-based learning model,” *Education and Information Technologies*, vol. 28, no. 6, pp. 6269–6285, 2023.
- [43] A. Sutarnan, R. Aprianto, R. Adyatama, K. C. Pokkali, and M. Yusup, “Influence of digital technology & data analytics on strategic decision making,” *Startupreneur Business Digital (SABDA Journal)*, vol. 4, no. 1, pp. 12–23, 2025.
- [44] S. Setiyaningsih, P. Master, P. Elementary, F. Postgraduate, U. N. Surabaya, F. Postgraduate, and U. N. Surabaya, “The role of teachers as applicators of the pancasila student profile in merdeka belajar curriculum,” *JIME*, vol. 8, no. 4, pp. 3041–3052, 2022. [Online]. Available: <https://doi.org/10.36312/jime.v8i4.4095>
- [45] M. Hartt, H. Hosseini, and M. Mostafapour, “Game on: Exploring the effectiveness of game-based learning,” *Planning Practice & Research*, vol. 35, no. 5, pp. 589–604, 2020.
- [46] C. Lukita, M. Hardini, S. Pranata, D. Julianingsih, and N. P. L. Santoso, “Transformation of entrepreneurship and digital technology students in the era of revolution 4.0,” *Aptisi Transactions on Technopreneurship (ATT)*, vol. 5, no. 3, pp. 291–304, 2023.
- [47] S. W. Ramadhan, B. Rusli, and N. K., “Implementation of the entrepreneurial skills education (pkw) programme at non-formal education institutions in bandung city (case study of lkp karya duta),” *AKSARA: Journal of Nonformal Education Science*, vol. 08, pp. 595–608, January 2022.
- [48] B. A. Soomro and N. Shah, “Technopreneurship intention among nonbusiness students: a quantitative assessment,” *World Journal of Entrepreneurship, Management and Sustainable Development*, vol. 17, no. 3, pp. 502–514, 2021.
- [49] M. Zembylas, “On the entanglement of epistemic violence and affective injustice in higher education: A conceptual analysis,” *Higher Education*, vol. 89, no. 3, pp. 791–805, 2025.
- [50] E. Susilawati, S. Sarifuddin, P. Data, and K. Education, “Assisted platform merdeka mengajar: Internalisation of pancasila values in learning through implementation of pancasila student profile with ”merdeka mengajar” platform,” *Jurnal Teknodik*, vol. 25, pp. 155–168, 2021. [Online]. Available: <https://jurnalteknodik.kemdikbud.go.id/index.php/jurnalteknodik/article/view/897/500>
- [51] E. B. Vroom, O. T. Massey, S. Yampolskaya, and B. L. Levin, “The impact of implementation fidelity on student outcomes in the life skills training programme,” *School Mental Health*, vol. 12, no. 1, pp. 113–123, 2020. [Online]. Available: <https://doi.org/10.1007/s12310-019-09333-1>