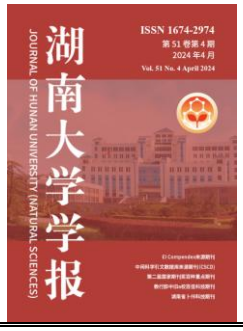

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Needs for Implementing a Production-Based Problem Learning Model on Technopreneurship Courses to Improve the Quality of Engineering Education for Graduates

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Abstract: This study delves into the necessity of incorporating effective teaching strategies to enhance the academic performance of engineering students. It explores the utilization of a learning model that integrates two approaches - production-based learning and problem-based learning. Additionally, it examines various teaching strategies, including modules utilized in lecturer-centered and student-centered learning environments. The culmination of these strategies results in the development of a production-based problem learning model. The process of merging two learning models to create a new, integrated approach emphasizes production-based learning with a problem-solving orientation at its core. This innovative method involves analyzing a problem thoroughly before generating a tangible solution. Ultimately, this results in the development of a product that addresses the initial issue. This study uses descriptive survey methods and quantitative and qualitative methods to analyze data. These findings show that there are clear needs for lecturers and students in the lecture process on technopreneurship courses, especially in aspects of modules, teaching materials, and learning models. The study also emphasizes the importance of developing learning models that contribute to the quantity and quality of graduates with an entrepreneurial mindset in engineering and computer science faculties.

Keywords: needs analysis, learning model, graduate, education quality.

实施基于生产的问题学习模式的科技创业课程需求，以提高研究生工程教育质量

摘要：本研究深入探讨了采用有效教学策略来提高工程专业学生学业成绩的必要性。它探讨了整合两种方法（基于生产的学习和基于问题的学习）的学习模式的利用。此外，它还研究了各种教学策略，包括以讲师为中心和以学生为中心的学习环境中使用的模块。这些策略的最终结果是开发了一种基于生产的问题学习模式。将两种学习模式合并以创建一种新的综合方法的过程强调了以解决问题为核心的基于生产的学习。这种创新方法涉及在产生切实可行的解决方案之前彻底分析问题。最终，这将导致开发出一种解决初始问题的产品。本研究使用描述性调查方法以及定量和定性方法来分析数据。这些研究结果表明，在技术创业课程的讲课过程中，讲师和学生有明显的需求，特别是在模块、教材和学习模式方面。该研究还强调了开发学习模式的重要性，以提高工程和计算机科学学院具有创业精神的毕业生的数

量和质量。

关键词：需求分析、学习模式、毕业生、教育质量。

1. Introduction

Numerous educated individuals struggle to secure employment opportunities as a result of the disparity between the rate of graduation and the speed of labor market absorption. Therefore, institutions are urged to shift students' mindset from seeking employment to creating job opportunities. One method to make a difference is to integrate entrepreneurial content into engineering education (entrepreneurship-technopreneurship) [1]. The goal of the technical expertise program at universities is to generalize the contents of Law Number 20 of 2003, which asserts that the primary objective of vocational education is to equip students with the necessary skills and knowledge to excel in specific occupations. In light of the overwhelming number of job seekers surpassing the available positions, it is imperative for educational institutions and relevant stakeholders to shift their focus toward exploring alternative career paths, particularly entrepreneurship. The technology sector, also known as technopreneurship, is currently the most rapidly growing industry, with the capacity to employ thousands of individuals within a short period [2], [3]. It is crucial for institutions of higher education, such as universities, to produce graduates who possess the necessary skills and competencies to thrive in today's competitive job market. This ability to cultivate a workforce that is well-equipped to succeed in the ever-evolving world of work is paramount. How the learning model may efficiently promote learning outcomes is one of the many elements that must be considered to build a synergy between the learning process and the intended outputs in engineering education.

Based on the fact that the unemployment rate for university graduates with degrees and higher according to the Central Statistics Agency (BPS) was 5.92 percent in August 2018 [4], decreased to 5.74 percent in August 2019 [5], and unexpectedly increased to 13.17 percent in August 2020 [6], this situation is very concerning. This situation raises concerns because, in Indonesia, intellectual unemployment is the country’s second-largest source of unemployment after the high school level [7]. This naturally occurs because of a variety of circumstances, one of which is the level of competence that graduates possess, which is directly tied to the caliber of the graduates themselves [8]. Universities can help to lower the unemployment rate by developing models and supporting tools, such as creative and innovative learning models with results. This is also apparent in the course on technopreneurship or technology-based entrepreneurship offered by the Information Systems Study Program of the Indragiri Islamic University (UNISI) Tembilahan, Riau.

Entrepreneurship can be summed up as having the mindset, spirit, and capacity to produce something novel and worthwhile. Entrepreneurs are those who are adept at seizing opportunities or possibilities to raise their standard of living [9]. Entrepreneurial education begins at the university level and extends to secondary and elementary schools and playgroups for children. However, the difficulty is that entrepreneurial education in schools has not yet achieved the level of internalization and application in daily life [10]. There is a growing recognition of the importance of young individuals who possess an entrepreneurial spirit, characterized by innovation, creativity, and a willingness to take risks. In addition, people are becoming more aware of the role of the entrepreneur as the engine driving the economic movement of a nation. This is one of the main reasons why entrepreneurship education is becoming more popular around the world. A country is deemed developed and rich on the basis of the number of entrepreneurs and businesspeople residing there [11].

The advancement of information technology nowadays has an effect on education as well, one of which is entrepreneurship education, where entrepreneurship courses are changed to include information technology-based entrepreneurship, orrtechnopreneurship [12]. On technopreneurship courses, teaching and learning activities are now conducted on students using traditional methods, where the process is conducted via the lecture approach [13]. The only real business principles covered in this technopreneurship course for students are those that are impacted by so-called software development. The method of education employed in technopreneurship courses currently lacks the stages and learning models that are regarded necessary to achieve the intended learning objectives ideally and has not been able to fully tap into the potential that students bring to the course.

The current implementation of the learning model focuses solely on understanding theoretical concepts and utilizing technology to foster entrepreneurship. However, it lacks emphasis on creating marketable products, which ultimately hinders the learning process. This deficiency results in decreased enthusiasm among students, diminished interest in the subject matter, and a lack of opportunities for students

to engage in problem-solving and practical application of their knowledge. Teachers can utilize various learning methods to improve the overall quality of education for students. These methods include inquiry-based learning, production-based learning, problem-based learning (PBL), and project-based learning, among others [14]. The solution must take the form of a product that can be sold, rather than just an answer to a specific set of questions. The PBL approach uses open-ended, real-world challenges that students must solve to improve their problem-solving, thinking, social, and autonomous learning skills as well as to create or acquire new knowledge [15], [16].

PBL is an educational approach designed to help students achieve academic objectives through hands-on, real-world experiences [17]. A problem that needs to be solved by the students is how the PBL learning paradigm gets students started. Students gain information, problem-solving abilities, and self-control as learners during the problem-solving process. All student-planned activities for the PBL learning process must be organized systematically. This is required to solve issues or overcome obstacles that will later arise in careers and daily life. According to Kwan's theory, Students will study how to interact and study in groups to address real-world problems. Thisstopic is intended to demonstrate students' subject-area interest, analytical abilities, and initiative. PBL encourages the development of students' analytical and critical thinking skills and capacity to discover and use learning resources [18]. This study suggests combining the two learning models. The model used in conjunction with PBL is called production-based learning, and it ensures that the solutions developed from the studied problems are in the form of products. In implementing the PBL model, students are presented with issues [19] to solve. However, the outcome they receive is merely an analysis of the challenges encountered.

The strategies and actions that educators must implement to provide students with the opportunity to actively engage in studying, participating, and communicating with a focus on competency are known as production-based learning models. This interaction can occur to create the product, including the necessary materials and services by a community [20]. Another meaning [21], [22] refers to a type of open, activity-based learning in which students work together to solve problems. A production-based learning model, according to Ganefri and Hidayat [20], is a set of procedures or actions that educators must implement to motivate students to actively learn, participate, and interact while maintaining a competency orientation to produce a product, including both goods and services, that will be required again. Product-based learning is designed to manage a structured learning environment and requires students to be active during the learning process. Product-based learning is a method that assesses students' comprehension through guided practice and ongoing encouragement to enhance their ability to practice with the guidance of a teacher or professor [23]. Prior to implementing this model, it is imperative to conduct a thorough diagnosis of students' prior knowledge and abilities. This step is crucial in ensuring that students are adequately prepared to engage in product-based learning practices and successfully complete tasks [24], [25]. Likewise with the application of technopreneurship courses, if students are often directly involved in learning, learning achievement (learning outcomes) may be more optimal to give birth to young entrepreneurs who are competitive in their expertise.

This study proposes a novel learning model known as the production-based problem learning (PBPL) model. This model integrates PBL with production-based learning, highlighting a production-oriented approach. Building upon the strengths of both models, this research emphasizes the importance of addressing real-world problems and providing practical solutions.

Fig. 1 illustrates the development of PBPL. It showcases the placement of the production-based learning and PBL models, culminating in the results of combining these two learning approaches.

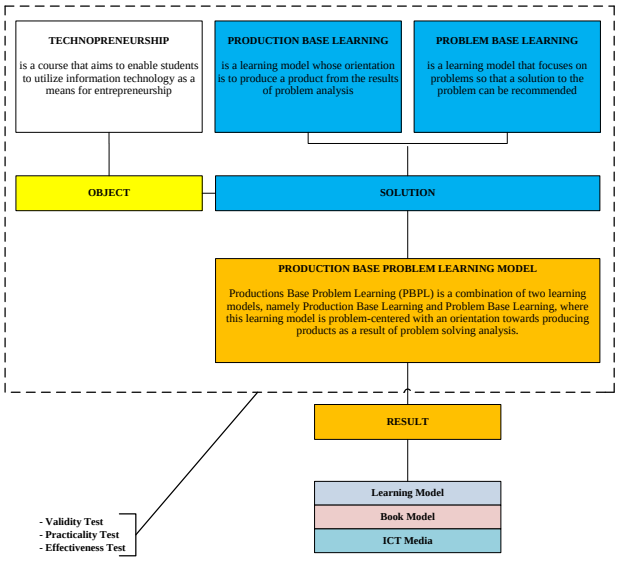

Fig. 1 Conceptual framework for developing the PBPL model (Developed by the authors)

Therefore, this study aimed to develop a problem-based, production-focused learning model to increase student engagement, creativity, and productivity. The ultimate goal was to improve the quality of learning outcomes.

The PBPL model begins with the formation of study groups and concludes with a strategy for implementing product manufacturing. Each group is presented with a problem in the form of a need, which will lead to the creation of a commercial product. To ensure the success of the commercial products, each group has to create a Business Model Canvas to identify key stakeholders.

Additionally, the PBPL model incorporates

interactive multimedia, specifically media information communication and technology (ICT), to facilitate independent learning. This technology allows students to review course material at their own pace, enhancing their understanding of technopreneurship concepts.

Implementing the PBPL model in the technopreneurship course is aimed at equipping higher education graduates with the necessary competencies to succeed in the workforce and entrepreneurship. This approach will help students develop the skills and character traits needed to pursue employment and entrepreneurial opportunities in the field of technopreneurship.

2. Method

2.1. Material

This study applied a requirements analysis model to describe the discrepancy between the existing state and student expectations regarding the end outcome of the technopreneurship course learning process. The survey was conducted as part of the Study Program at Indragiri Tembilahan Islamic University's Faculty of Engineering and Computer Science. Random sampling was used to select a representative sample of 75 students from three study programs who had taken technopreneurship courses.

Table 1 Respondents (The authors)

Respondent sample	Total number of respondents
Information System	45
Civil Engineering	15
Industrial Engineering	15

2.2. Instruments

This study utilizes two types of instruments: documentation and questionnaires. Documentation was employed to gather tangible data on entrepreneurial achievement (X3) and vocational technology ability (X4). Questionnaires were utilized to collect additional data on entrepreneurial interest (Y), independent attitude (X1), and social environment (X3).

3. Results and Discussion

Based on initial data related to respondents and existing instruments, several hypotheses are proposed. There is a significant direct relationship between independent attitude and entrepreneurial achievement of the Faculty of Engineering and Computer Science, Indragiri Islamic University. There is a significant direct relationship between independent attitude and vocational technology skills of students of the Faculty of Engineering and Computer Science, Indragiri Islamic University. There is a significant direct relationship between independent attitude and interest in entrepreneurship in the field of technology (technopreneurship). The commercial success of Indragiri Islamic University's Faculty of Engineering and Computer Science students is strongly associated with their social environment.

There is a significant link between the social environment and vocational technology skills of students at the university. There is a strong correlation between socioeconomic class, environment, and interest in entrepreneurship in the field of technology (technopreneurship). The autonomous attitudes and social settings of students at the Faculty of Engineering and Computer Science at Indragiri Islamic University significantly impact their entrepreneurial success. There is a direct and significant relationship between independent attitudes, the social environment, entrepreneurial achievement, and vocational technology skills of students of the Faculty of Engineering and Computer Science, Indragiri Islamic University. Through the entrepreneurial success of students in the Engineering and Computer Science Faculty at Indragiri Islamic University, there is a considerable indirect association between autonomous attitude and vocational technology abilities. There is a significant indirect relationship between independent attitude and interest in entrepreneurship in the field of technology (technopreneurship) students of the Faculty of Engineering and Computer Science, Indragiri Islamic University. There is an indirect and significant relationship between independent attitude and interest in entrepreneurship in the field of technology (technopreneurship) students of the Faculty of Engineering and Computer Science, Indragiri Islamic University.

Through the entrepreneurial accomplishments of Indragiri Islamic University's Faculty of Engineering and Computer Science students, a substantial indirect relationship exists between the social environment and the ability to use vocational technology. Students of the Faculty of Engineering and Computer Science, Indragiri Islamic University, have a large indirect relationship with their social surroundings and interest in entrepreneurship in the field of technology (technopreneurship). Through the vocational technology capabilities of students of the Faculty of Engineering and Computer Science, Indragiri Islamic University, a significant indirect relationship exists between the social environment and interest in entrepreneurship in the field of technology (technopreneurship).

There is a considerable indirect association between the social environment and interest in technology-based entrepreneurship (technopreneurship) leveraging the commercial success and vocational technology skills of Indragiri Islamic University's Faculty of Engineering and Computer Science students.

Fig. 2 shows the structural equations used to estimate the affected variables based on the above-mentioned hypothetical model. As illustrated below,

the following structural equation can be implemented:

$$X_3 = P\,x_3x_1\,X_1 + P\,x_3x_2\,X_2 + \varepsilon_1$$

$$X_4 = P\,x_4x_1\,X_1 + P\,x_4x_2\,X_2 + P\,x_4x_3\,X_3 + \varepsilon_2$$

$$Y = P\,yx_1\,X_1 + P\,yx_2\,X_2 + P\,yx_3\,X_3 + P\,yx_4\,X_4 + \varepsilon_3$$

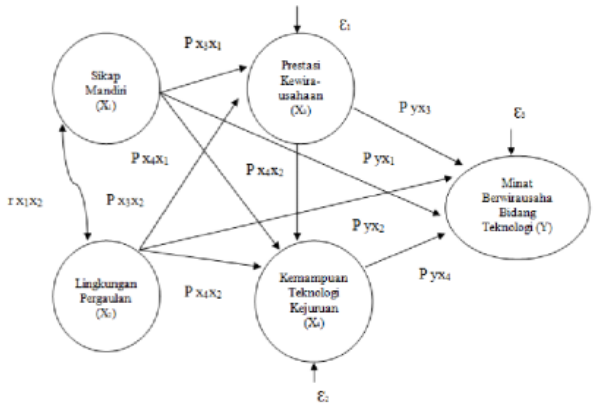

Fig. 2 Hypothetical model variables (Developed by the authors)

3.1. Current Higher Education

There have occasionally been changes in human conduct and behavior, along with development and changing periods. Additionally, this has altered the growth of the educational system globally, specifically in Indonesia. Through the teaching and learning process, the purpose of the education system is to equip students to actively reach their full potential [26]. The education system, which includes learning, teaching, curriculum, student development, learning techniques, learning tools and infrastructure, and graduation competencies, undergoes periodic changes that can be viewed as evidence of this transition. According to theories about learning, the interaction of inputs, stimuli, and responses results in a change in behavior that may be observed in action [27]. Because indirect changes in the economic order impact a nation's educational system, the global growth of education and the global development of the industrial revolution are inextricably linked [28]. The Industrial Revolution commenced in the 18th century with the invention of the steam engine. Industrial Revolution 2.0 was driven by the utilization of electricity, which led to reduced production costs. Industrial Revolution 3.0 emerged in the 1970s with the introduction of computers [29].

To equip students with the academic and professional skills necessary for using, developing, and creating science, technology, and the arts, higher education is a continuation of secondary education.

Higher education, as a scientific community, is expected to produce information that is relevant and applicable to real-world problems. By actively contributing to societal problem-solving, higher education plays a crucial role in addressing the challenges faced by society. To remain competitive on a global scale, colleges must produce graduates who possess strong personalities, exceptional abilities, intelligence, and creativity. As a result, universities play a significant role in the advancement of civilization.

3.2. Learning Model

Teachers use the learning model, a tiered framework, to design and conduct instruction in a way that satisfies the learning objectives [30]. The concepts of educators' and students' responses and other supports must be presented in a step-by-step learning paradigm.

The model is an analogy and representation of the variables in the theory as well as a representation of an object that contains information that is interconnected and is intended to concretize a theory [31]. Physical, computer, and mathematical models are among the most commonly utilized models. Models are strongly related to theory and have an "if-then" feature [2]. In the meantime, as stated by Robins in [8], "a model serves as an abstraction of reality, simplifying complex phenomena. It simulates various real-world factors such as gravity, electromagnetics, magnetohydrodynamics, and gravitational waves."

The term "model" encompasses three fundamental components: a framework, abstraction, or mental representation; a regular and integrated structure, and the utilization to guide thought and activities. These elements synergize to form a cohesive whole that must be embraced by a model, including a learning model. At the core of every model lies a theory as a model cannot exist without a theoretical foundation, whether derived from successful practical application or research endeavors. A theory is made up of several assumptions that can be syntactically merged and utilized to predict and explain phenomena (that is, they adhere to a set of rules that allow them to logically link to one another and to the observable data). visibleeobjects [2]. According to this idea, specialists develop a conceptual framework in the form of a regular or systematic procedure with descriptions and explanations, and researchers utilize the conceptual framework as a framework for their research and way of thinking. According to Shwartz et al. [33], employing learning models is crucial for students to have a thorough knowledge of what they are learning.

3.3. Opinions Regarding Graduate Quality

Human resources will be a source of strength for enterprises to fulfill their goals in today's information-based economy if these resources have trustworthy skills and are pertinent to the needs of the work to be done. Therefore, based on organizational development projections that have been stated in the long-term goals and strategies chosen, organizational leaders must plan the development of lecturer competencies in accordance with job designs and business development plans both now and in the future. A balance between intellectual, social, and emotional abilities should

ideally be achieved when developing the personal competencies of lecturers [9].

According to a 2002 survey conducted by the National Association of Colleges and Employers, employers in the workplace expect college graduates to possess a wide range of skills and abilities:

1. Organizational proficiency
2. Ability to collaborate
3. Interpersonal skills
4. A solid work ethic
5. Motivation and proactivity
6. Adaptability
7. Analytical skills
8. Computer skills
9. Organizational ability
10. Attention to detail
11. Leadership capacity
12. Confidence
13. Friendly disposition
14. Politeness
15. Wisdom
16. Understanding of Intellectual Property 3.0
17. Creativity
18. Sense of humor
19. Entrepreneurial mindset

According to the results, the achievement index ranked number 17 out of the expected points for a prospective employee. According to O'Brien [32], students should possess the following attributes:

1. Writing and verbal communication skills;
2. Organizational skills, including time management, motivation, and maintaining one's appearance and health;
3. Leadership abilities;
4. Logical thinking for problem-solving and innovation;
5. Strong work ethic, including a willingness to learn, drive, and ability to handle pressure;
6. Ability to work well in a team and improve interpersonal skills;
7. High moral standards.

As outlined in the accreditation form, a graduate's certification is defined by seven key variables [4]. These factors encompass integrity (ethics and morals), science-based expertise, professionalism, leadership, academic achievement, proficiency in English, communication, and self-development.

3.4. The PBPL Model in Technopreneurship Courses for Enhancing the Quality of Graduates from Higher Education Institutions

The PBPL model was developed because of the development of two theories and frameworks: production-based learning and PBL. Scientific research is the study of how theories and models can be combined to produce a scientific theory that can satisfy the requirements of a learning model. Following the process of elaborating on the traits of each learning model, syntaxes are developed that are thought to be capable of fulfilling the standard of learning in technopreneurship courses that are consistent with expectations from both educators' and students' perspectives.

The PBPL approach was developed and implemented in response to market demands that are based on actual work standards and processes. The PBPL paradigm simplifies the achievement of educational objectives for both students and teachers by addressing real-world issues through problem-solving. This model enhances the learning process beyond traditional lectures and exercises, transforming it into a dynamic experience that culminates in the creation of solutions to real-world problems.

Before embarking on projects and assignments, it is crucial to complete the sixth step of the six-stage PBPL model. This step is essential for ensuring that the learning process is practical and results in tangible outcomes that address specific needs within a given field. The successful implementation of the PBPL model hinges on a combination of practice and the creation of valuable by-products. Production and central business divisions can collaborate with associate members of allies or partner companies on projects as needed, to meet not only curriculum demands but also societal and commercial or industry demands. For business centers and production facilities to prosper, they must be managed with professionalism and precision, impacting future revenue streams through partnerships with institutions of higher education.

4. Conclusion

This research introduces a novel learning model that integrates two approaches: production-based learning and PBL. By merging the key elements of these models, a new approach called PBPL was created. PBPL consists of seven steps: problem formulation, forming study groups, problem identification, solution generation, technology integration, product development planning, and evaluation. The implementation of this learning model can stimulate student abilities.

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