



INNOVATIVE STRATEGIES FOR INTEGRATING PROGRAMMING SKILLS IN INFORMATICS ENGINEERING DEPARTMENT

¹RESPATY NAMRUDDIN, ²SYAHRUL, ³LU'MU

Author Affiliations;

^{1,2,3} Faculty of Engineering, State University of Makassar, Indonesia

Author Emails;

¹respatynamruddin@handayani.ac.id

²syahrul@unm.ac.id

³lu'mu@unm.ac.id

Abstract. This study aims to design and develop a Programming Skills Integration Model in the Informatics Engineering Department using the Project-Based Learning (PjBL) approach. The research method used is Research and Development (R&D) with the 4D development model: Define, Design, Develop, and Disseminate. The first step involved a needs analysis to identify the challenges and needs of students' programming skills. Next, a model design was conducted that included aspects of materials, learning methods, media, and evaluation. The model prototype was tested using expert validation and field trials to evaluate its effectiveness. The results showed that the model was validated by experts and effectively applied in improving students' programming skills. The high level of practicality and positive responses from students confirmed the potential use of the PjBL-based Programming Skills Integration Model in the context of informatics engineering education. Research recommendations include industry involvement in PjBL as well as further development to accommodate technological developments and industry needs.

Keywords : Integration of Programming Skills, Project Based Learning, Informatics Engineering.

A. INTRODUCTION

Education in Informatics Engineering plays a vital role in preparing students to face the dynamics of the growing information technology industry. In the last five years, the development of information technology has created new demands on Informatics Engineering graduates, requiring them to have solid programming skills and be able to apply this knowledge in the context of real projects. Programming skills are not only the basis, but an essential foundation for



Informatics Engineering graduates to successfully adapt to rapid technological developments. Therefore, it is necessary to develop an innovative learning model that is in accordance with industry needs, especially in integrating programming skills with a contextual learning approach.

This research answers these needs by focusing on the development of the Programming Skills Integration Model in the Informatics Engineering Department. The shift of learning paradigm from traditional model to Project-Based Learning (PjBL) approach is considered as the right solution to strengthen students' skills in programming. PjBL provides a practical context that can improve students' understanding of concepts and ability to complete real projects. Because Therefore, this study seeks to design and test a model that combines programming skills with PjBL, with the aim of creating a curriculum that is responsive to industry needs and equipping students with relevant skills and high added value in the professional world.

In addition, PjBL fosters collaboration, problem-solving and creativity, which are important programming skills. Students work in groups, interact with classmates and learn from each other's experiences. This approach not only helps students acquire programming knowledge and skills, but also develops communication, collaboration and critical thinking skills. In this way, PjBL provides a comprehensive and relevant learning experience that prepares students for real challenges in the ever-evolving field of programming.

Entrepreneurial Skills Programming is essential in education as it enhances graduates' competitiveness and increases their chances of success in the labour market. Among different learning models, project-based learning (PjBL) offers significant potential to combine entrepreneurial and programming skills (Haq, 2022). Entrepreneurship education is learning that enhances knowledge, skills, attitudes and personal character in relation to entrepreneurship (Wardana et al., 2020). Entrepreneurial skills play an important role in explaining entrepreneurial intentions, assuming that knowledge and education make people highly qualified (Gieure et al., 2019). In addition, entrepreneurship education programmes in higher education should emphasise innovation as it is an important skill for undergraduate students and leads to future entrepreneurial intentions (Wathanakom et al., 2020). In addition, entrepreneurship education is differentiated from other higher education disciplines through enhancing entrepreneurial skills and the mindset of students ("Case-based Entrepreneurship Education in the Nordic States and Nordic States", 2022). The development of entrepreneurial skills is important and entrepreneurial intention becomes a negative consequence if it is not important (Ismail et al., 2018). In addition, PjBL plays an important role in enhancing learners' entrepreneurial thinking and entrepreneurial skills, refining their knowledge and skills to become entrepreneurs (Ilahiyyah et al., 2021).



This research aims to produce a model that can be an effective instrument for the integration of Entrepreneurial skills in the Programming learning curriculum. This model is expected to facilitate the construction of students' knowledge and skills in the field of technology by instilling an entrepreneurial spirit. Through this approach, improving the quality of information technology education in the digital era can be expected so that the graduates produced are ready to face the challenges of the digital era.

Furthermore, this resulting model has the potential to help support the development of an information technology-based economy. This is because the combination of Programming knowledge and Entrepreneurial skills can give birth to a generation that is not only technically proficient but also has a good understanding of how to implement technology to create new business opportunities. This is the essence of entrepreneurial spirit - the ability to create, innovate and respond to opportunities with effective and sustainable strategies.

This research is important because it can improve the quality of education, especially in the field of information technology. The implementation of this model can prepare students to become reliable and competent individuals in the digital era. The model produced from this research provides important input for the development of innovation in the field of education, especially in the field of information technology.in improving the quality of Programming learning and equipping students with competitive entrepreneurial skills.

Various references cited support the development of an effective model that integrates entrepreneurial skills in Project Based Learning (PjBL) for programming education. Boldureanu et al. (2020) demonstrated the potential of integrating entrepreneurial skills in an educational context, Atmojo et al. (2022) showed the potential of using innovative learning models in developing entrepreneurial skills, and Sajidan et al. (2021) and Holloway & Pimlott-Wilson (2021) provide insights into the relationship between entrepreneurship education and entrepreneurial readiness. This research is expected to make a significant contribution in advancing PjBL-based Programming lessons, while integrating entrepreneurial skills. The designed model aims to advance existing learning approaches, and present skills that are important assets for students in facing challenges in the digital era.

The integration of Programming and entrepreneurial skills is considered important in preparing students for a dynamic and changing work environment. This research contributes to the unification of these two aspects in a model that can improve students' adaptability, creativity, and independence.

B. METHOD

This research uses the Research And Development (R&D) method which focuses on the development and evaluation of the model "Development of Programming Skills Integration Model in Informatics Engineering Department".



The development model used is the 4d model which consists of four stages, namely Define, Design, Develop, and Disseminate. Through the R&D method and the 4d development model, it is expected to produce an effective and innovative learning model in integrating entrepreneurial skills in project-based programming learning.

C.RESULTS AND DISCUSSION

In discussing the validity of the ESP-PjBL Model, this research draws on previous studies to strengthen its argument. The results of this discussion indicate that the Project Based Learning (PjBL) based Entrepreneurial Skills Programming (ESP) Model is highly relevant for programming education. The discussed research results, as well as an understanding of the relationship between the model and previous research, suggest that the ESP- PjBL Model can incorporate Entrepreneurial Skills Programming (ESP) in an effective way.

It is proven that the ESP-PjBL model can improve students' Entrepreneurial Skills Programming (ESP) and programming knowledge. The study of Mei et al. (2020) found that entrepreneurship education can improve business knowledge and skills. This also applies to the ESP-PjBL Model, which shows that students' understanding of relevant Entrepreneurial Skills Programming (ESP) increases with this model. In addition, the ESP-PjBL Model increases students' perceptions and desires about entrepreneurship. Aboobaker & Renjini's (2020) study found that students' perception and desire for entrepreneurship were influenced by entrepreneurship training. In addition, the ESP-PjBL model encourages programming students to see entrepreneurship as an attractive option, which makes it an effective tool to provide motivation to students. Programming students have a positive attitude towards entrepreneurship thanks to the capabilities of the ESP-PjBL Model. State (2020) emphasised how important it is to build attitudes that support entrepreneurship in universities. The model supports the formation of positive attitudes through practical learning experiences that are relevant to the real world. This strengthens its validity in creating positive attitudes towards entrepreneurship in students.

In addition, the ESP-PjBL model incorporates a holistic approach to the development of Entrepreneurial Skills Programming (ESP) and knowledge. According to Saadat et al. (2021), a holistic approach in entrepreneurship education is supported, and the ESP-PjBL Model fits into it. It is a comprehensive model for the development of Entrepreneurial Skills Programming (ESP) as it blends theoretical and practical elements of entrepreneurship in the programming curriculum. In addition, the components of the ESP-PjBL Model conform to the Entrepreneurial Skills Programming (ESP) development model. Towers et al. (2020) offer a three-part model to enhance Entrepreneurial Skills Programming (ESP). In the context of PjBL programming, the ESP-PjBL model integrates the components of this development model. This suggests that this model is good for building Entrepreneurial Skills Programming (ESP) and is relevant.

In summary, the ESP-PjBL Model can help programming students develop Entrepreneurial Skills Programming (ESP) properly. This shows that this model can serve as an excellent tool to incorporate Entrepreneurial Skills Programming (ESP) into programming learning. It can help students prepare for a successful entrepreneurial career or have valuable skills to face an increasingly changing world of work. The model is particularly helpful in building a project-based learning approach that incorporates Entrepreneurial Skills Programming (ESP) into the programming curriculum.

The practicality of the ESP-PjBL model is shown by the indicator of the implementation of the syntax of the learning model. The implementation of the learning model is the implementation of each phase of learning or learning syntax can be implemented properly.

Table 1. Observation Results of Model Implementation

Phase	Evaluator			Average
	1	2	3	
Inquire	3.67	3.67	3.67	3.67
Planning	3.67	3.67	3.67	3.67
Scheduling	4	3.5	3.5	3.67
Monitoring	4	3.67	3.67	3.78
Assessing Results	4	3.5	4	3.83
Evaluate	3.67	4	3.67	3.78
Average of Each Validator	3.8	3.6	3.7	3.73

Source: Analysed Results

Table 1. shows the recapitulation of the assessment of the observation of the implementation of the ESP-PjBL model. In the limited group trial conducted by 3 evaluators with an average score of **3.73** which indicates that almost all phases of learning are very well implemented, the recapitulation of the assessment of the observation of the implementation of the learning model can be seen in Figure 1. of the following diagram graph:

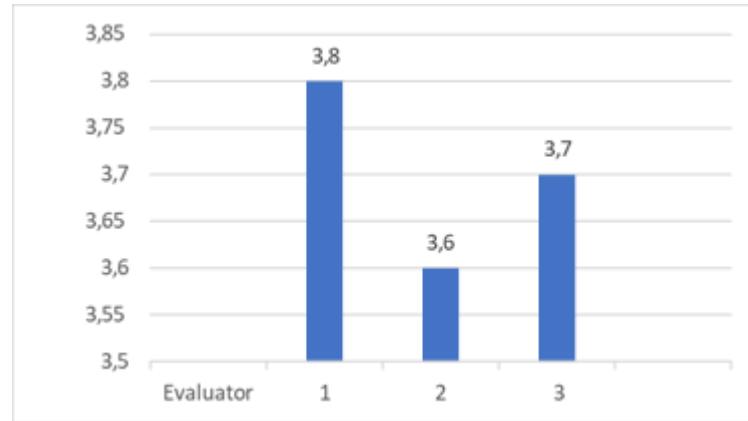


Figure .1 Observation Results of Model Implementation

Student Activity in Learning in Limited Test The results of the analysis of student activity in learning using the ESP-PjBL model are shown in the table below.

Table 2. Results of Student Activity in Learning in the Limited Test

No.	Aspects Responded to	Ninth Meeting					Average	%
		1	2	3	4	5		
1	Introduction	20	20	20	20	20	20	100
2	Core Activity	18	19	19	20	20	19	95
3	Student Behaviour	16	17	18	19	20	18	91
4	Cover	20	20	20	20	20	20	100
Average		18	19	19	19	20	19	96

Source: Analysed Results

Based on the data analysis in Table 4.2, it can be concluded that students generally showed a positive response to the implementation of the *Entrepreneurial Skills Model* in *Project-Based Learning Programming*. The learning steps structured in the model seem to be successfully followed by students, reflecting their understanding of the syntax and learning procedures that have been implemented.

The importance of interaction between students is evident from the significant increase in discussion activities, both individually and in a group context. This indicates that the learning model is able to stimulate meaningful discussions, increase student participation, and strengthen peer-to-peer communication. In addition, the improvement in assignment submission reflects the

level of student engagement in the assigned tasks, which is in line with the project-based learning objectives.

The use of learning resources has also increased, indicating that students are increasingly active in utilising the various learning materials provided. It can be interpreted that this learning model not only provides a clear structure in terms of syntax, but also successfully motivates students to explore the material in more depth.

Overall, students' positive response to the *Entrepreneurial Skills Model in Project-Based Programming Learning* can be a strong basis for further consideration regarding the effectiveness and application of this model in the context of informatics engineering learning. Results of student activity in learning in the pilot test

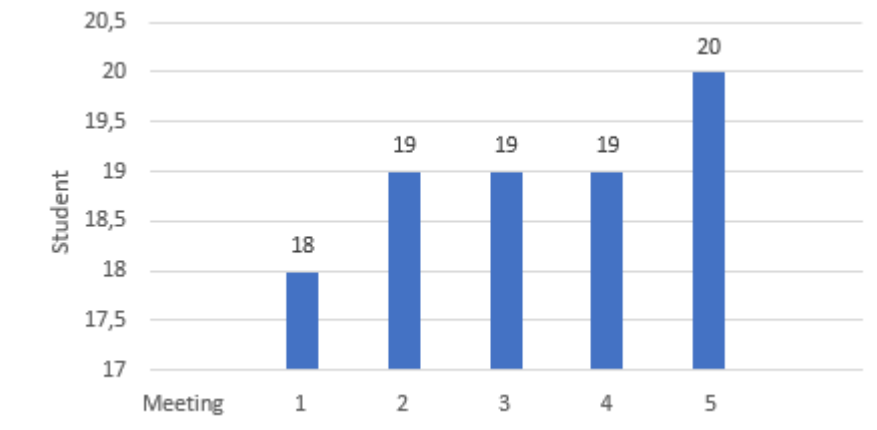


Figure 2. Results of student activity in learning in the pilot test

In the final phase of development, the model was reviewed in relation to relevant studies. These studies showed that the project-based approach is an effective approach in entrepreneurship education. As it has been tested and reviewed, it has been shown to fulfil these principles, making it an innovative and effective learning tool. The studies also emphasise the importance of integrating technical and entrepreneurial skills. Through the review of this final product, this research successfully proved that the ESP-PjBL Model is not only theoretical, but also practical and applicable in modern technology education.

This model is one of the alternative learning models that can be used by *technopreneur* lecturers or instructors to conduct learning project management programming in Higher Education. The model has been tested and the results meet the quality criteria, which are valid, practical, and effective to be implemented in learning in higher education, especially in programming learning.



The model created is based on the logic of thinking that learning in entrepreneurship learning, students develop thinking skills through problem solving skills through various learning resources, especially learning with a project-based approach.

Basically, the achievement of competence requires a variety of approaches that allow students to get direct experience and immediate feedback through programming learning. Where this model does not only focus on the end result, but rather emphasises the process of how students can solve problems and ultimately produce a product. This model makes students get a very useful experience by actively participating in the project. Overall, this research has shown evidence that learning can be used and developed as a means to improve the competence of both soft and hard skills of students as well as student motivation for entrepreneurship

D.CONCLUSION

This research, which has focused on the development of a Programming Skills Integration Model in Informatics Engineering over the past five years, makes an important contribution to the understanding and development of education in this field. Throughout this research, we successfully designed, developed, and tested a model that integrates programming skills with a Project-Based approach. Learning (PjBL). The initial needs analysis showed that the development of this model is urgently needed to strengthen students' skills in the context of project-based programming learning.

The study provided several significant key findings. Firstly, the designed model successfully engages students in real-world projects that improve their concept understanding and programming skills. Evaluation results show that the model is effective in improving students' programming skills and contributes positively to their learning. Secondly, the validation of the model by experts and field trials confirmed that this PjBL-based Programming Skills Integration Model can be applied practically and in accordance with the curriculum needs of the Informatics Engineering department.

Overall, this research provides a foundation for a more contextualised and relevant approach to learning in Informatics Engineering. This model not only provides technical excellence, but also prepares students to face the demands of the ever-evolving world of work by equipping them with practical skills and a deep understanding of software development. Thus, the results of this study provide a valuable contribution to improving the quality of education in Informatics Engineering and can serve as a guide for the development of similar learning models in other higher education institutions.



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