



Project Based Learning in Engineering Students as Character Development

Volume 15 Issue 2
(Oktober, 2024)
e-ISSN 2716-5191
doi: 10.30997/jsh.v15i2.15419

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ARTICLE INFO

Article history:

Received: 13-10-2024

Revised version received: 15-10-2024

Accepted: 16-11-2024

Available online: 19-11-2024

Keywords:

PjBL; ;education; caracter

How to Cite:

APA Style 7th

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ABSTRACT

The formation of student character through integration between courses that are collected through the Project Based Learning (PjBL) learning strategy. The PjBL method directs students to be critical and work together in order to solve problems. The study used a quantitative descriptive method, data was obtained through interviews with PjBL teachers and questionnaires to students. because it describes the situation that occurs, systematically and factually with the aim of analyzing data by describing or depicting the data that has been collected as a solution to the research problem. The focus of this study is the aspect of attitude, self-confidence, and cooperation. The results of the study are as follows: in carrying out the project, students have shown attitudes and ethics in accordance with the values of Pancasila as one of the courses with the project learning method, students also show a sense of responsibility during the project. Students show a more confident attitude when having to communicate with the PjBL management, in addition, students are more confident when presenting because as many as 84.6%, students understand the material and practice presentations. As many as 76.9% of students agree that cooperation is carried out by assigning work based on the expertise and strengths of each team member 76.9%. Thus, project based learning is proven to be able to develop the character of engineering students.

1. Introduction

In the generation theory (Generation Theory) proposed by Graeme Codrington & Sue Grant-Marshall in 2004, generation Z or Gen Z is everyone born between 1996-2010. So 2021 those aged between 11-24 years, are the age that is still active in education from elementary school to college. In relation to the above, the question arises what learning strategies are relevant to be applied to the current generation Z in Vocation.

Gen Z grew up with advanced technology and the internet, so they are very dependent on these digital devices. This can affect the balance of social life, such as the increasing tendency to interact virtually rather than face to face (Fitriyadi et al., 2023). This dependence is clearly a sign of excess. In addition, the use of social media and digital applications can also trigger anxiety and feelings of isolation. Project Based Learning.

However, with the development of digital learning methods, Gen Z must adapt to new learning methods. Some of them find it difficult and are hampered in understanding each material in depth in certain lessons, while others have difficulty due to limited access to educational resources (Mohamed et al., 2018).

And then, those who grow up amidst technological developments need the right learning methods. The right learning methods for Gen Z must consider their different characteristics and needs compared to previous generations. Gen Z grows up in a very digital (Far-Far, 2021) and fast-paced world, so conventional learning approaches may be less effective for them. Therefore, it is important to adapt methods that can optimize their potential, utilize technological advances, and create relevant and interactive learning experiences.

Project Learning is one of the learning strategies that can develop the character of students. Efforts to develop character in students are through integration between courses that are collected through learning strategies. Through its unique and comprehensive characteristics, the PBL (Project-Based Learning) method is quite potential to meet these learning demands. As explained by (Chen & Yang, 2019) project-based learning has a positive effect on student academic achievement, and on average is also influenced by the field of study, project location, time, and information technology support.

Project Based Learning is a learning method that focuses on student activity. This method aims to direct students to think critically and work together in order to solve a problem. As stated by (Szymkowiak et al., 2021) among GenZ, learning through mobile applications and video content is more interesting and enjoyable than traditional forms, in addition, by using technology, knowledge and information can be obtained quickly. Then (Maros et al., 2023) proved higher teaching efficiency using project-based learning compared to traditional verbal-visual teaching.

Project based learning involves students in solving problems that do not have a single solution and are difficult. Students can identify problems or challenges that need to be solved so that they can create a design to find a solution (Anazifa & Djukri, 2017). Then this process helps students to hone critical and creative thinking skills in solving problems. In Project Based Learning, students not only learn theory, but can also apply the knowledge they learn in context because students have the opportunity to explore topics more thoroughly, understand more complex concepts, and see how they are relevant (Guo et al., 2020).

Most projects in Project Based Learning are done in groups, which encourages students to be able to work together. The skills that each team member will get are being able to speak clearly and listen well to coordinate (Marnewick, 2023). Students also learn to divide responsibilities and manage roles in the team. So that they can negotiate and Resolve Conflicts. Project Based Learning requires students to do in-depth research to understand the topics they are studying. Students learn to search for information, analyze data, evaluate resources, and draw conclusions that are informative and evidence-based (Arifudin, 2021).

Project-based learning takes a long time and has a specific deadline. Students learn to manage their time efficiently, organize tasks that need to be completed, and complete projects within the allotted time. This teaches planning and organization skills that are very useful in professional life(Endah Pratiwi, 2018).

2. Methods

This study uses a quantitative descriptive method, because this study will describe the current situation systematically and factually with the aim of analyzing data by describing or depicting the data that has been collected as a solution to the research problem. The object of this study is the Project Based Learning Strategy for Engineering Students as Character Development. The subjects of the study were the Project Manager of the Industrial Electrical Automation Engineering Study Program at the Jakarta State Polytechnic and the lecturers of Project Based Learning, also 2nd-semester students of the Industrial Electrical Automation Engineering Study Program. The location of the study was at the Jakarta State Polytechnic, Industrial Electrical Automation Engineering Study Program. The data collection technique was carried out using a questionnaire and using a structured list of questions that were submitted to the respondents. While the interview was conducted with the Project Manager of the Industrial Electrical Automation Engineering Study Program at the Jakarta State Polytechnic as well as the lecturer of Project Learning. This research will be carried out with the following stages: Preparation or planning stage, implementation stage, and data analysis. The stages of the research method are as follows: Researchers conduct literature surveys, identify problems related to Attitude, problem-solving, self-confidence, and cooperation, field observations by searching for data sources to 2nd-semester students, and conclusions are drawn based on data analysis.

3. Results and Discussion

Gen Z is also more interested in measurable achievements rather than just taking standardized tests as the end result(Nurhidayah, 2021). Competency-Based Learning makes them learn by focusing on mastering specific skills (Guo et al., 2020). Measurable achievement is Allowing students to learn and master material at their own pace and providing assessments based on the skills they have mastered rather than based on time spent in class.

Effective learning methods are interactive, technology-based, life-relevant and support the development of skills needed in a changing world. Flexible approaches such as Problem Based Learning, which allow them to learn independently and collaboratively, and provide space for creativity and reflection, will be more successful than methods that are too rigid or traditional. As a generation that grew up with fast information and wide access to technology, Gen Z tends to prefer learning in more innovative and dynamic ways (Winata et al., 2021).

The focus of this research is on attitude, self-confidence, and cooperation. Below will be explained why these three things are important to focus on.

Table 1 Operational Concept

Concept	Dimensions	Indicators	Measures	Source Data Retrieval Techniques	Source
<i>Attitude</i>	Behavior, attitude and actions Have good manners, and friendly attitude towards others.	Level of politeness in speaking and a politeness in dressing (using special practice clothes), and a friendly attitude towards others.	The level of politeness in speaking and politeness in dressing (wearing special practice clothes), and a	Interview	Lecture and with PjBL supervisor

				friendly attitude towards others.		
Self-Confidence	Courage in making decisions Not hesitant in expressing opinions	Not hesitant in making decisions Not easily panicking in difficult situations	Decision making Ability to face failure	survey		Student and Lecture with PjBL supervisor
Teamwork	Cooperation Able to work together, provide trust	have solidarity Responsible for completing PjBL learning.	tudents are able to work together and synergize Interview	Interview		Results of the interview

Source: personal documents

3.1 Attitude

Ethics for students between PBL teams are very important, to create an effective and harmonious collaborative environment. PBL requires students to work in teams, interact with colleagues, and collaborate with other teams. Therefore, there are several ethical principles that must be upheld by students to ensure the learning process runs smoothly and productively. The following is the level of student politeness during project-based learning

Student Ethics between PBL teams.

"The project work they do, for the implementation of Pancasila, of course, they apply the ethics of Pancasila seriously"

"Students demonstrate good ethics during PBL work. Good ethics are demonstrated in activities related to students with Building Management"

Being in a dynamic PBL environment, students need to be flexible and learn to adapt to changes or challenges that arise. Students must be ready to adjust plans and strategies based on feedback or developing situations.

By complying with every regulation during the learning process, students can create a conducive, productive, and harmonious working atmosphere during the project-based learning process, so that they can achieve optimal results both for themselves and for the team. In terms, attitude is defined as a person's way of thinking about other people or something that is shown in the form of attitudes or behavior (Howe & Krosnick, 2017). Attitude can also be defined by (Vaughan-Johnston et al., 2023) as a form of language or physical response that represents a person's attitude and mental condition. In psychology, attitude has a special meaning, namely a collection of emotions, beliefs, and behavior of a person towards an object, person, or event that they face directly. Therefore, a good attitude is needed in everyday life.

Given that attitude will reflect the way we think, respond, and act in various situations (Albarracin & Shavitt, 2018) Attitudes that show attitude are like when students submit reports verbally to the PjBL supervisor. The most important thing that must be considered when delivering the results of the report verbally is to convey the results of the report with polite language, a clear voice, and good articulation. As many as 90.9% of electrical and civil engineering students understand the attitude values well and apply them during PjBL-based learning. Darwin Une's opinion in (Shofwatal Qolbiyyah, 2017) that there is a division of ethics into three, namely descriptive ethics, normative ethics, and metaethics. Descriptive ethics describes and explains awareness of moral experiences in a culture descriptively. Then

normative ethics according to the explanation (Idram, 2021) is called philosophical ethics, the scope of the discussion lies in the concept of the necessity to improve behavior. While metaethics only emerged in the 20th century, which specifically investigates and determines the meaning and significance of normative terms.

The goodness contained in ethics does not require thinking about the impact of the actions taken. Ethical and moral freedom as motivational drives, that as long as what is done is good. According to him, the rightness or wrongness of an action cannot be determined from the consequences of the action, because all of that comes from moral obligations and laws (W et al., 2019). Ethics are absolute, not a matter of agreeing or not with the actions of others. But morals are absolute rules. Because the destruction of a nation is due to a moral or ethical crisis that is no longer a priority. Uncontrolled ethical behavior will give rise to violations (Gussevi & Muhfi, 2021).

3.2 Self-Confidence

Individualized learning gives students the opportunity to develop at their own pace and style. When they feel that learning is tailored to their abilities and interests, students, also known as GenZ, are more likely to achieve small successes that can boost their self-confidence (Sandi, 2019).

From the observations, it was found that: Students practiced presentations several times before the delivery day 84.6%; Students understood the material and practiced presentations several times before the delivery day 15.4%. As explained by (Tsybulsky & Muchnik-Rozanov, 2019) through PBL students can overcome every challenge and engage in useful and supportive collaboration with their peers, so that they can demonstrate professional growth, empowerment, and substantial increases in self-confidence. Delivering project results according to (Chang & Hwang, 2018) in addition to gaining material knowledge, also adds skills needed for life.

Examples of confident student attitudes

“They all compete to present their experiences while working on the project, and make reports” Person 1

“Students are increasingly confident in using measuring instruments in real conditions and demonstrating the implementation of K3 well”. Person 2

When delivering the results of the report in front of the class, the researcher saw the students' confidence by observing the following things (Anitasari et al., 2021): Students read the entire report without stopping; Students avoid eye contact with the audience; Students use difficult language to look smart; students practice presentations several times before the delivery day, Students understand the material and practice presentations several times before the delivery day. Project-based learning (Endah Pratiwi, 2018) and collaboration allow students to learn how to work in teams, where they will learn to overcome challenges together, and feel a sense of accomplishment through collaboration. This is very important for building self-confidence, especially for Gen Z students who tend to be more open to teamwork. When students successfully complete a project with their friends, they will be able to feel a sense of collective accomplishment that can increase their confidence in working with others. That achievement can be easily achieved when working together (Damayanti, 2019). In a collaborative environment, students can also see their own strengths and weaknesses, while learning from the skills and ideas of others. This strengthens their confidence in their own abilities and ability to contribute to the group.

3.3 Team work

Teamwork encourages students to be more active in their learning. Group discussions often lead to more critical learning, where students are encouraged to analyze, question, and find solutions together (Chang & Hwang, 2018). While teamwork focuses on collaboration, it also teaches students to be independent. Each team member is usually given specific responsibilities, allowing them to manage time, resources, and tasks efficiently (Maros et al., 2023). This helps students develop organizational and planning skills. Equally important, differences of opinion or conflict often arise during teamwork (Lim et al., 2023). This experience teaches students to manage and resolve conflict constructively, which is an important life skill outside of the learning environment.

Examples of students' cooperative attitudes in teams during PjBL.

"All students work on projects according to their respective tasks"

"With PBL which has several outputs, students are required to work together to implement and complete all outputs. The ability to work in a team increases, because the group is composed of semesters 1, 3, and 5".

In carrying out the task, the researcher observed cooperation between students by observing the following things: Dividing tasks randomly to be fair; Assigning work based on the expertise and strengths of each team member; Giving all the work to one person who is considered the most competent; Allowing each team member to choose their own work. From the results of the researcher's observations, the following results were obtained: Dividing tasks randomly to be fair 15.4%; Assigning work based on the expertise and strengths of each team member 76.9%. The teamwork (Pranitasari, 2019) learning method has given a significant influence on the learning process and skill development. In teamwork, students must always interact, communicate, and collaborate with other group members. So learning as a team has helped them develop social skills.

Then students can learn to convey ideas and listen to other people's opinions, such as negotiation, namely finding solutions together when there are differences of opinion. Then cooperation dividing tasks and contributing according to ability (Suryadi & Budimansyah, 2016). However, not all aspects of teamwork always go smoothly. Some challenges that may be faced are first, some members may not contribute equally (Nancarrow et al., 2013), which can cause tension, second If communication between team members is not effective, the learning process can be disrupted (Klasmeier & Rowold, 2022). third, Team members with different working styles may have difficulty reaching agreement or coordination (Gersdorf-Van den Berg et al., 2024). Overall, despite the challenges, the teamwork learning method is very beneficial in developing the social, cognitive, and emotional skills needed for success in both education and professional life.

4. Conclusion

Research on Project Based Learning (PBL) that focuses on the development of Engineering students' character that must be carried out continuously. The following is the mastery of soft skills in students as part of character development:

1. Students have carried out projects by paying attention to ethical values.
2. As many as 84.6% practiced presentations several times before the delivery day so that students have increased self-confidence during the presentation.

3. As many as 76.9% of students agree that working together can make work easier, by dividing tasks based on the expertise and strengths of each team member, so that each is responsible and the project will be completed on time.

Acknowledgment

This research is internal research with an independent research scheme. The funding for this research comes from the DIPA of the Jakarta State Polytechnic for the 2024

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