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The Integration of Inquiry and Problem-Based Learning and Its Impact on Increasing the Vocational Student Involvement

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Vocational education is a learning process to enhance and explore potential so that graduates are prepared to work with competencies specific to their fields. Learning strategies that align with the desired results are required to achieve these abilities. It is vital to modify learning so that students are at the center of its activities because now, lecturers still have a dominant position in vocational education. In student-centered learning (SCL), a type of instruction, students are viewed as independent, active learners. Following these ideas, students are expected to learn complementing technical capabilities and soft skills. Instead of being the primary knowledge source, lecturers will serve as facilitators and learning partners. Problem-based learning (PBL) and inquiry-based learning (IBL) are two teaching strategies that use SCL. While the PBL approach teaches students how to adapt and solve issues in learning, the IBL approach aims to help students build the capacity for systematic and logical thought. A quantitative methodology and a 2x3 factorial quasi-experimental research design were used in this study. The findings revealed that (1) there was a substantial difference in learning outcomes between students who were taught using IBL, PBL, and traditional methods, and (2) there was a significant difference in learning outcomes between students who were high and low in involvement in learning, (3) there was no significant difference in learning outcomes between students taught using the IBL method and the traditional method, (4) there was no significant difference in learning outcomes between students taught using the IBL method and the conversion method, and (6) there was no significant difference in learning outcomes between students who are taught using the IBL method.

Keywords: vocational education, student-centered learning, inquiry-based learning, project-based learning, learning outcomes, traditional learning, student engagement

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INTRODUCTION

Education is one of the most important aspects of any country's progress. Education is a deliberate and organized attempt to establish an environment and learning process in which students actively develop their religious, spiritual, self-control, personality, and intelligence potential (the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, Article 1). Noble character and the abilities required by himself, the community to develop all student's potential through the learning process. Students are community members aiming to enhance their potential through a learning process available at various paths, levels, and forms of education, as stated in article 4. According to Billets (2011: 59), Vocational is an exciting product or service. A person's experience causes others to depend on or need to be called or invited to do a job. Vocation is related to the required capacity to carry out a work activity. Developing a person's vocational needs education and training are called vocational education (Hyland, 2014). Vocational Education or Vocational Education is education for the world of work (Pavlova, 2009). The vocational education tradition aims to prepare graduates for employment to be ready to work. Vocational education contains special training that tends to be reproductive according to the orders of lecturers or instructors, focusing on developing industrial needs, managing special skills, or market tricks. The primary motivation for vocational education lies in economic benefits for the future. Competency-based training was chosen as a vocational education model. Vocational education prepares a trained workforce with high skills subject to the employer (Rejewski, 2009).

In most nations, including industrialized countries like Germany, Finland, the United States, Korea, China, and Turkey, vocational education (VE) is a component of the higher education system (Gelişli et al., 2016). VE trains students in specific talents that can lead to financial gains. Vocational education is defined more broadly by UNESCO, including studying technology and allied disciplines and acquiring practical skills, attitudes, and information relevant to employment in various economic and social areas. As a result, vocational education provides graduates with different details and perspectives necessary for the workplace and everyday life. Self-awareness is one advantage of including practical knowledge and attitudes in vocational education. Self-awareness and self-esteem, as well as the development of interpersonal, citizenship, learning-for-learning, communication, and entrepreneurial skills, are advantages of incorporating material knowledge and attitudes into vocational education (UNESCO, 2013). Learning techniques that are in line with occupational traits are required to be able to satisfy all these talents. The unique quality of vocational education is its capacity to give students work skills.

To help students learn more, teachers must come up with creative ways to teach, especially when it comes to science. It urges science education to use more appropriate and innovative methods to improve students' logical thinking through inquiry methods that include cognitive and metacognitive activities (Martin-Gamez et al., 2016; Makarova et al., 2017; Osborne & Kind, 2017). It is essential to use the inquiry method to help students learn how to think, and science teachers should have good ways to teach

so that students can have meaningful learning experiences (Utomo et al., 2018). Several studies show that the inquiry strategy is more effective than the traditional method because it has a significant impact on how well students learn, how motivated they are, how creative they are, and how well they understand concepts (Sahyar & Hastini, 2017; Yanto, 2019; Artayasa et al., 2018; Nunaki, 2019). Some researchers say that learning should help students develop their logical thinking and problem-solving skills through creative and analytical investigation. Education builds and improves all possible scientific reasoning skills at the university level. Experts have different ideas about how to define reason. From these definitions, the scientific rationale should be used in the learning process to help students learn how to think critically and make good decisions (Yanto et al., 2019).

Currently, the teaching model in higher education tends to use a lecturing pattern, wherein the lecturer continuously explains the lecture material during one class session. At the same time, students are only listeners who occasionally ask questions in the middle of a lecture (Zohrabi et al., 2012). This method is one-way and tedious because lecturers dominate, and students tend to be passive. The level of student achievement usually largely depends on how well the lecturer conveys the learning material. The technology used in teaching is generally in the form of presentation slides prepared in advance and displayed using a projector. This method is called Teacher-Centered Content Learning (TCCL).

The TCCL system still has many shortcomings if applied in vocational education because: (1) at the level of vocational education institutions, the understanding theory is not a benchmark for the parameters of the graduates to be produced. Under Law No. 20 of 2003, article 15, it is explained that vocational education is higher education that prepares students to have jobs with specific applied skills at a maximum equivalent to a bachelor's program. Assessment in written exams does not show the applied practical competence that students should achieve, (2) the teaching burden is too focused on the lecturers by conveying the material in detail, carrying out written exams, checking them manually, and announcing the grades to students. When referring to the curriculum, Students must be triggered to become accustomed to independent learning, seek the broadest possible information, and are challenged with problems to grow their curious habits. That is, the vocational education system must focus on the willingness of students to seek solutions, practice, and implement specific answers, and (3) students are not familiar with the troubleshooting instinct because they are too fed up with the theory. As a result, students are not skilled when facing new problems. What exists is that students easily give up and are not persistent in finding solutions.

This research implements and evaluates the student-centered learning method that reverses these conditions so that student activity plays a role in achieving the successful absorption of knowledge through frequent questions, discussions, independent questions, practice, and others. The part of the lecturer is shifted to being a facilitator and motivator who provides direction to students to find information and knowledge needed in the learning process (Moustafa et al., 2013).

In short, this study has linked IBL to PBL learning for various objectives of vocational education and compared it to traditional learning. An investigation on learning outcomes, methods of teaching, and student engagement will be carried out. As a result of this study, we can see whether lecturers can connect IBL, PBL, and specific educational aims to distinct educational objectives.

Polytechnic Education

Polytechnic is a part of the National Education System, significantly higher education which develops Human Resources (HR) to have adequate practical skills. Polytechnic Education is a Vocational Education pathway at the tertiary level that equips graduates with skills that are supported by sufficient theoretical basic knowledge and a robust disciplinary attitude. With this provision, it is hoped that Polytechnic alumni will become vocational staff in their fields, especially in engineering and commerce (Law of the Republic of Indonesia No. 12 of 2012 concerning Higher Education).

The main objective of establishing polytechnic education in Indonesia is to produce graduates with knowledge and skills. It is under the qualifications required by the industry that polytechnic graduates have high competitiveness to get jobs. Polytechnic education is held to meet the needs of professional workers in the industry. In addition to producing qualified and skilled graduates, polytechnic graduates are educated to have an entrepreneurial spirit, be cultured, be environmentally friendly, and compete at national and international levels. In general, the purpose of the polytechnic namely preparing students to become productive human beings, work independently and fill job vacancies in the business and industrial world as middle-level workers according to the competencies in the skill program they choose. Currently, educational levels at the polytechnic include Diploma-III, Applied Bachelor (Diploma-IV), Applied Master, and Applied Doctor. The teaching and learning system and the polytechnic curriculum are different from the academic education program. Polytechnic education prioritizes practice with the lecture system, using a customized package system similar to that used in industry. Every student must follow all the courses listed in the curriculum. This system is translated as the number of courses with total credits per semester.

To achieve the goals of education in polytechnics, one must improve the quality of learning. Learning is a process of interaction between lecturers and students and its elements. Good quality learning will undoubtedly produce good learning outcomes (Tyler, 2007; Goodrum and Rennie, 2007). According to Clark (2009), lecturers must prepare learning scenarios carefully and clearly so that the learning process can take place well. One of them is that the lecturer can choose the proper learning method for teaching. If the learning method used by the lecturer is appropriate, then learning objectives will be more easily achieved so that the learning outcomes can increase.

Based on direct observations at the Department of Electronic Engineering, Cilacap State Polytechnic, in the 2016/2017 to 2019/2020 academic year, most learning still tends to be teacher-centered, identical to traditional methods. Traditional learning methods are also found in python programming courses, even though this method has several

weaknesses. One of the most dominant is the low student learning outcomes. Student learning outcomes for the last four years are presented in Table 1.

Table 1
Learning outcomes of python programming courses

Academic year	Class average results	Graduation standard
2016/2017	51.35	55
2017/2018	53.13	55
2018/2019	53.57	55
2019/2020	54.78	55

The acquisition of learning outcomes still much below the graduation of this course is influenced by many factors, one of which is student involvement in the learning process. It can be said that a satisfactory level of engagement is achieved if students not only pay attention to the class but also fully invest in their learning. Factors such as attendance, participation in activities, emotional involvement, motivation, or the ability to feel ownership of the teaching, thereby enhancing the experience, indicate the level of engagement. Feelings of belonging to a group or learning goal can also affect participation.

Many obstacles that can hinder learning in the electronics engineering study program are related to student involvement in the learning process. When the lecturer held a question-and-answer session hoping to cause student activity, it was unsuccessful because active students were more active, while passive students were more tolerant of following others. Thus, the critical nature of students has not appeared optimally. Many students do not want to ask the lecturers even though they do not understand the content of the material presented. When the lecturer asks which part has not been mastered, the students are often silent. After evaluating the learning, the lecturer knows that some students do not understand the material's content.

To overcome these problems, significantly improving the quality of learning can be done by changing the learning method. Understanding Python programming subjects can not only be done theoretically but also conceptually. Concept understanding can be obtained by scientific thinking, so it can be assumed that the appropriate learning methods are inquiry and problem based. In addition to instilling scientific thinking in students, these two methods follow learning characteristics in higher education. CEDEFOP (2011) stated that learning in vocational education must consider the learning experience (learning experience). Learning experiences can be formed by carrying out practical activities through these two learning methods.

Student Engagement in Learning

The work of Astin (1984, 1985, 1991), Pace (1984), Chickering and Gamson (1993), and Kuh et al. (2008), among others, discovered that student engagement is positively related to objective and subjective measures of gains in general abilities and critical thinking, gave rise to the student engagement theory. Student engagement is linked to grades and persistence rates, and levels of engagement on campus are influenced by institutional policies and practices. The Nationwide Survey of Student Engagement

(NSSE), designed by a panel of experts in the field (including those mentioned above) in 2000, became a national survey instrument in the United States and Canada in 2005. It collects data on student engagement in programs and activities offered by institutions for their learning and personal development annually and uses that data as a proxy for quality.

Engagement refers to students' degree of effort in educationally purposeful activities that directly contribute to desired outcomes. It is linked to institutions' efforts in utilizing successful educational practices (Kraus & Coates, 2008). Students were asked about their current study habits in and out of school. Students were asked to provide their perception of the learning experience they got from these questions. It also relates to how they contribute to the learning process in the classroom.

Furthermore, it refers to interaction and communication with other people (including colleagues) and learning plans. These questions are linked to five student involvement standards (or aspects). The following are the five benchmarks: First, the academic difficulty-the degree to which expectations and exams push students to learn. It includes time spent preparing for class, hard work; the quantity of reading and writing required; and coursework that emphasizes analysis, synthesis, making judgments about course contents, and applying theories and concepts to real-world issues or new circumstances. Second, participating in educational activities that widen one's horizons enriches one's educational experiences. Talking with students from various backgrounds, political beliefs, and religious affiliations; using electronic technology to discuss or complete tasks; and partaking in work experience, community service, study abroad, and foreign language study are just a few examples. Third, students' efforts to actively construct their knowledge are referred to as active and collaborative learning. It includes asking questions in class and participating in discussions, giving presentations, collaborating on projects with other students in and out of the course, tutoring or teaching other students, and discussing concepts from reading outside class. Forth, feelings of legitimacy within the community are aided by a supportive campus atmosphere. Satisfaction with academic and non-academic assistance and the quality of connections with other students, faculty members, and administrative staff and offices are all factors. Fifth, student-faculty interaction is the type of contact students have with teachers. Discussing grades and assignments with lecturers, discussing career prospects with academics, discussing ideas from class with lecturers, receiving prompt feedback on performance, and working on a research project with a faculty member are examples of this.

The five things mentioned above are then combined with Shunk et al. (2012, pp. 17-19) as indicators to measure the level of student involvement in this research, which includes: (1) having the desire and aspiration to succeed in the future; (2) having the drive to learn; (3) learning is a necessity; (4) there is an appreciation for learning; (5) learning activities are packaged appealingly; and (6) the existence of a conducive learning environment.

Learning Methods

Learning is something that we all understand and have done at some point in our lives. This engagement took place in various formal and informal settings, ranging from the constraints of a school classroom to the wide-open spaces of the countryside or a quiet corner where a chance chat led to a deeper grasp of a topic or another. According to Khalil & Elkhider (2016), the learning model is one approach to anticipating student changes in an adaptive or generative way. The learning method is a technique lecturers use when the learning process takes place in class. The learning method is the embodiment of implementing models, approaches, and strategies that the lecturer has planned. The learning method aims to realize learning objectives through lecturers carrying out a series of systematic activities to interact with students (Diep et al., 2017).

Gagné (1977) identified five domains or categories to consider when it comes to learning: linguistic knowledge, intellectual skills, cognitive skills, cognitive strategies, motor skills, and attitudes. While planning and designing learning, Gagné established nine conditions of learning: (1) eliciting performance and practice, (2) informing learners of objectives, (3) stimulating recall of prior learning, (4) presenting the content, (5) providing learning guidance, (6) eliciting performance and practice, (7) providing feedback, (8) assessing performance, and (9) improving retention and transferring it to the job. Furthermore, several considerations need to be considered in choosing a learning method, namely: (1) learning objectives; (2) subject matter; (3) class size; (4) the characteristics of students; (5) the ability of lecturers; (6) available facilities; and (7) available time. These considerations need to be considered so that the learning process can run smoothly (Gagné, 1985).

Inquiry-Based Learning Method

Over time, our societal needs have altered tremendously. We must think about our children and the challenges they will encounter. To ensure that our students are adequately prepared to meet the demands and expectations of the future, there has been a clear need for instructional strategies that stimulate critical thinking, reflection, questioning, cooperation, communication, and research. Inquiry-based learning (IBL) is a student-centered teaching technique that embeds learning in real-world situations through tasks like cases, issues, and research (Avsec & Kocijancic, 2016). Students are encouraged to work collaboratively to solve an issue, which helps them develop research skills and the ability to make trade-offs (Avsec, Rihtarisic, & Kocijancic, 2014). When students use IBL, they are more engaged in studying and making sense of the world around them. According to Alfieri et al., (2011), allowing students to interact with materials, and models, alter variables, study phenomena, and try to apply principles provides them the opportunity to spot patterns, discover underlying causalities, and learn in more robust ways. Implementing IBL, as a result, promotes students to participate in the learning process and maximizes learning. The purpose of this research was to learn more about student teachers' issues when introducing IBL in their classes. It also aimed to look into student instructors' viewpoints, attitudes, and opinions on IBL (Perdana et al., 2020).

Inquiry is a term used in education and everyday life to represent the act of asking questions to obtain answers or knowledge (Harlen, 2013). IBL is a teaching style in which students are at the center of the learning process and take control of their education by asking, researching, and answering questions (Caswell & LaBrie, 2017). It is also a form of self-directed learning in which students manage their education (Spronken-Smith & Walker, 2010). Bell, Smetana, and Binns (2005) proposed the phrase "active learning process" to describe the nature of the inquiry. Students must use data analysis and information exchange to address a research problem. IBL is a teaching method that enables students to develop problem-solving and critical thinking abilities (Maxwell, Lambeth, & Cox, 2015). According to Saunders-Stewart, Gyles, and Shore (2012), IBL includes analysis, problem-solving, discovery, and creative thinking. Even though inquiry is student-centered, Zangori, Forbes, and Biggers (2012) recommend that professors oversee students throughout the learning process since some novice students may require further teaching to enhance their inquiry skills. Juntunen and Aksela (2013) address inquiry from both the students' and teachers' viewpoints. IBL focuses on looking at an open issue or problem through the eyes of a learner. From the teacher's perspective, inquiry-based instruction focuses on moving students beyond basic curiosity into critical thinking and understanding domains.

IBL is founded on constructivism, a learning theory that asserts that people construct their knowledge and meaning based on their experiences (Tamim & Grant, 2013). As a result, rather than providing knowledge, the educator constructs it. According to John Dewey, constructivists and proponents of IBL, students should be actively engaged in the learning process in this setting and be reflective problem solvers (Flinders & Thornton, 2013). Jerome Bruner is a constructivist who wants to make education more relevant to the needs of students at all levels. He feels teachers may encourage students to participate actively in their studies (Roblyer & Doering, 2013). His discovery learning hypothesis, a kind of IBL, states that youngsters are more likely to comprehend and remember items they discover while engaging with the world. Social contact and critical thinking are two crucial components of the learning process, according to Lev Vygotsky, who is best known for his social constructivism theory (Liu & Chen, 2010).

Problem-Based Learning Method

In order to build twenty-first-century competencies, students must apply course content, take responsibility for their learning, successfully use technology, and collaborate. Problem-based learning is a pedagogical strategy that might be useful in the classroom (PBL). PBL is a student-centered, inquiry-based teaching method in which students work on a real-world, ill-structured topic that requires more research (Jonassen & Hung, 2008). Students identify knowledge gaps, research, and then apply what they've learned to design solutions and report on their findings (Barrows, 1996). Through cooperation and inquiry, students can develop problem-solving skills (Norman & Schmidt, 1992), metacognitive capacities (Gijbels et al., 2005), learning engagement (Dochy et al., 2003), and intrinsic motivation. Despite the advantages of PBL, many instructors lack the confidence or understanding necessary to implement it effectively (Ertmer & Simons, 2006; Onyon, 2005). Breaking down the PBL cycle into six phases begins with

developing, executing, and assessing PBL in the classroom. Using real-world situations to teach critical thinking and problem solving, problem-based learning encourages students to understand crucial concepts from lecture content (Darhim et al., 2020; Saputra et al., 2019).

Traditional Method

Unlike inquiry-based learning, traditional classes place the teacher at the center of the process (Gasser, 2004). In the United States, the National Research Council (1996) releases reports on how teachers deliver these lessons. IBL is now more specific than "inquiry." Different learning styles and best practice examples have been added. The implementation took later in German-speaking countries. According to Messner (2009), this type of learning is a prerequisite for problem-oriented, research/discovery-based, and problem-oriented scientific activity. Cognitive interest, investigation, hypothesizing, technique selection, dialogue, and results publications are essential components of Reitinger's (2013) definitions. In this work, such pre-scientific behavior will be referred to as "inquiry-based learning." Inquiry-based learning is crucial for developing scientific knowledge since experimenting solves problems (Gu et al., 2015).

Learning Outcome

Center for Teaching Support & Innovation, University of Toronto, (2008) describes learning outcomes as statements explaining the knowledge or abilities that students should have at the end of a specific assignment, class, course, or program. Moreover, it helps students understand why that knowledge and skills will be helpful to them. They assist students in connecting learning in different contexts and driving assessment and evaluation by focusing on the context and potential applications of information and abilities. The application and integration of knowledge are essential aspects of good learning outcomes. Rather than focusing on content covering, learning outcomes describe how students will apply the material both in and outside the classroom.

Learning outcomes are students' abilities after participating in the learning process (Marsh, 2007). Learning outcomes are changes in individual behavior that include cognitive, affective, and psychomotor aspects. The learning outcomes achieved by students are influenced by two main factors, namely, from within the student and those outside the student or environmental factors. Many factors come from students, especially their abilities. The student's ability factor dramatically influences the learning outcomes achieved. In addition to students' ability factors, there are other factors, such as learning motivation, interest, attention, attitudes and study habits, perseverance, socio-economic, physical, and psychological factors.

Moore & Stanley (2010, p.2) revealed that learning outcomes developed in Bloom's Taxonomy by Benjamin S. Bloom include three aspects, namely: (1) cognitive, describing students' academic learning outcomes; (2) affective, which describes the attitude of student learning outcomes; and (3) psychomotor, describing learning outcomes based on the skills and abilities of students. This study measured learning outcomes using Bloom's taxonomy, which Anderson and Krathwohl revised. The learning outcomes in this study are the level of success of the cognitive aspects that

students can achieve based on the experience gained after evaluation in the form of tests. Learning outcomes of cognitive elements include: (1) remember; (2) understand; (3) apply; (4) analyze; (5) evaluate, and (6) create. Success or failure in learning is due to several factors that affect learning outcomes, namely internal and external aspects. Internal factors include health, intelligence and talent, interests and motivation, and ways of learning. In contrast, external factors include family, school, community, and the surrounding environment (Gosling & Moon, 2001).

Python Programming Course

Python programming is one of the materials that must be mastered by students in industrial automation expertise in the electrical engineering department. This material teaches about (1) general programming concepts and modern object-oriented programming languages; (2) able to design and implement simple programs in python, (3) able to test whether a python program is running correctly; and (4) able to write programs based on the problems given by the lecturer. Python is a programming language widely used by developers to develop various desktop, web, and mobile-based applications. Then python became a programming language widely used in industry and education because it is simple, concise, intuitive syntax and has an extensive library (Schuerer & Maufrais 2010).

Students are taught Python programming since it relates to the knowledge and abilities required for the top ten talents for 2025, as identified by the World Economic Forum (WEF) in 2020. Companies predict critical thinking and problem-solving will be most in demand over the next five years. Since the initial report from the WEF in 2016, this has remained the same. However, self-management abilities, including active learning, resilience, stress tolerance, and adaptability, have become more prominent this year. The WEF predicts that a change in the ratio of human to machine labor might result in the loss of 85 million jobs by 2025. However, 97 million additional employments could be created in the future to better suit the new division of labor between humans, machines, and algorithms (Schwab, 2020).

Research Hypothesis

Learning python programming subjects is theoretical and tends to be practical, so learning methods are needed that follow the characteristics of these subjects. The learning method chosen is inquiry and problem-based learning, which can emphasize practical activities to provide a learning experience for students. These learning methods have a series of practical exercises in their implementation. Inquiry learning and PBL methods are student-centered, so students must be actively involved in the learning process. This direct involvement will create a learning experience for students (Evans et al., 2015; Morrison & Camargo-Borges, 2016). It is different from traditional methods, whose learning is centered on the lecturer, so it is possible to neglect students who are slow in understanding the subject matter. The use of traditional learning methods is inadequate for classes with diverse student conditions and abilities. The difference in treatment between student-centered learning methods and lecturers will undoubtedly produce different impacts on students, one of which is learning outcomes.

Although both inquiry learning and PBL methods are student-centered, these two learning methods have differences. In the IBL, the students must identify the problems, while the lecturer has identified the issues in the PBL method. Using the inquiry learning method, students formulate problems and then carry out inquiry activities to solve these problems. When using problem-based learning, students are given real problems in life and then investigated to solve the problem (Hastuti et al., 2020). Inquiry learning and PBL methods have their respective advantages. By using the inquiry learning method, students will be given space to study according to their learning styles. It is considered under the development of modern learning psychology, which believes that learning is a process of changing behavior thanks to experience. By using the PBL method, students will be trained to think critically and develop their ability to adapt to new knowledge so that students are allowed to apply their expertise in the real world.

Based on this description, it can be seen that the inquiry learning method tends to emphasize the need for learning styles, while the PBL method emphasizes changing mindsets. Adequate adjustment of learning styles will make it easier to receive subject matter to produce optimal learning outcomes. The philosophy is part of students' learning style, and each student has a different learning style so a different mindset will be formed. Learning that emphasizes the attitude means forcing students to adjust the learning style desired by the lecturer. It means that it can be assumed that the IBL method is more effective in improving student learning outcomes than the PBL method. Besides being influenced by learning methods, learning outcomes are also affected by student involvement in the learning process. Students who have high involvement in learning are very likely to succeed in education. On the contrary, success in learning is minimal if they are not involved in the learning process. Students with high involvement will generally show relatively high learning outcomes than those with low involvement motivation.

Based on these descriptions, the following hypotheses can be formulated: (1) there are significant differences in learning outcomes between students who are taught using inquiry learning, problem-based learning, and traditional methods; (2) there are significant differences in learning outcomes related to student involvement in the learning process; (3) there is a significant interaction between learning methods and student involvement in learning on learning outcomes; (4) there is a significant difference in learning outcomes between students who are taught using the inquiry learning method and the conversion method; (5) there is a significant difference in learning outcomes between students who are taught using the problem-based learning method and the traditional method;

METHOD

This study uses a quantitative approach with a 2x3 factorial quasi-experimental research design. This research was conducted at the Electronic Engineering Study Program, Cilacap State Polytechnic. The analysis was carried out in the odd semester of the 2019/2020 school year. The population of this research is the second year of students, semester 3 in the python programming class. Determination of the sample using a cluster

sampling technique with TE2A class as the experimental group I, TE2B class as the experimental group II, and TE3C as the control group.

This research design is quasi-experimental. This design was chosen because it is an experiment with elements of treatment, pretest, and posttest, but does not take samples at random so that the compared groups take from existing classes. Then the factorial design was chosen because the selection was grouped into two categories (Creswell, 2012, p.311).

The design of this study involved two experimental classes and one control class. The first experimental class used the IBL method, the second experiment used the PBL method, and the control class used the traditional method. Before the research was carried out, measurements were made on student involvement in learning by giving a questionnaire to each student. Before treatment, students were given a pretest. Then the treatment is given by using the IBL or PBL learning methods. Students are given a posttest to determine student learning outcomes in the final stage.

Table 2
Research design

Group	Pretest	Treatment	Posttest
Experiment I	O1	X1	O2
Experiment II	O1	X2	O2
Control	O1	X3	O2

Description: O1: Pretest (before treatment) in the experiment and control class
O1: Posttest (before treatment) in the experiment and control class
X1: Learning with the IBL method
X2: learning with the PBL method
X3: Learning with the traditional method

In maintaining the quality of research, the elements of validity that can be controlled can be presented in Table 3. This is done so that the study results can reflect the treatment given and can be generalized to the existing population and meet the requirements of hypothesis testing. Control of internal and external validity is critical in maintaining the quality of the research conducted (Guérin et al., 2013). One of the essential considerations in planning an experimental study is the possible threat to internal validity. Internal validity means that the observed difference in the dependent variable is directly related to the independent variable and not due to other unwanted variables (Fraenkel & Wallen, 2012: 186). It means that the research results are purely from the treatment results, not caused by other factors outside the therapy. An effort to control threats in the research's internal validity consists of identifying, eliminating, and as much as possible stopping these threats.

Table 3
Control validity

Control	Description
Subject Characteristics	Determination by random means is an excellent technique to control the threat of subject characteristics to internal validity. This consideration is carried out so that in determining the sample, it does not look at the background, making the research results invalid or less valid.
Maturity element	Provide treatment that spans not too long between pretest and posttest. In addition, it is also possible to include a control or comparison group in the study.
Location	Ensure that the location is neutral for all research samples and does not affect only a portion of the model because selecting a particular place or location may affect some examples.
Mortality	They control the presence of the sample every time the treatment is carried out.
Instrumentation	Ensure that there are no changes to the measurement method during data collection or scoring and any changes that will affect the instrument.
Element treatment material	The learning materials given to the experimental or control groups during treatment have the same substance
Test element	The learning outcomes test given to the experimental or control groups were conditioned the same. The test is multiple-choice with four alternative answer choices.
Subject's Attitude	Explain that the activity is not experimental but a regular exercise or learning activity. In addition, it also provides information to the action is a trial effort to improve the form of learning.

Quantitative data in this study were measured using two instruments. First, the learning outcomes test is used to determine student learning outcomes. The test instrument with multiple choice questions with four alternatives is used. The correct answer is given a score of 1, and the wrong answer is given 0. Second, a questionnaire related to student involvement in learning. The instrument used is a questionnaire sheet with a Likert scale and rating scale.

The analysis and description of the numbers from the results of statistical calculations is carried out in the data analysis and description. In addition, the analysis is based on hypotheses to interpret the values and numbers generated from the measures. Data analysis carried out in this study were: (1) Initial ability similarity test with one-way ANOVA; (2) descriptive statistics; (3) analysis prerequisite test; (4) Hypothesis testing with two-way ANOVA; and (5) t-test.

FINDINGS AND DISCUSSION

Before the research was carried out, the first step was to test the students' initial abilities between classes by giving a pretest to obtain initial data. Learning outcomes after treatment can be measured through posttest. The pretest and posttest data results can be seen in Figure 1.

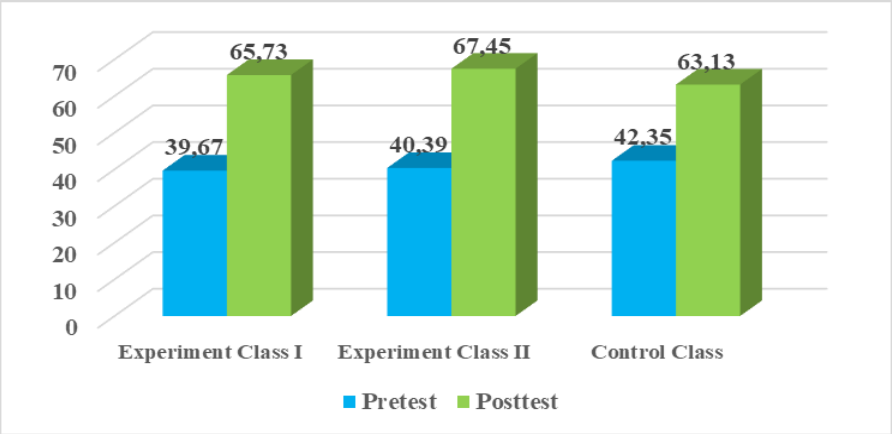

Figure 1
Pretest data results

Before testing the hypothesis, prerequisites must be tested. It consists of a test for the data distribution normality and a test for the homogeneity of variance. Testing the analysis requirements aims to determine the type of statistics to be used for data analysis. The description of the data prerequisite test results before and after being given treatment can be seen in Table 4.

Table 4
Results of data prerequisite tests before and after treatment

Data	Decision
Pretest	Same ability
Analysis Prerequisites	
Pretest	Normal and Homogeneous
Posttest	Normal and Homogeneous
Student Engagement	Normal and Homogeneous

Data analysis used parametric statistics with a two-way ANOVA test to test the differences and interactions of the independent variables of learning methods and student involvement in the learning process on the dependent variable of python programming learning outcomes. The results of hypothesis testing can be seen in the summary of hypothesis test results presented in Table 5.

Table 5
Hypothesis test results

Difference learning outcome	F	Sig	Decision
Experimental group I, experiment II, control	1000.321	0.000	No difference
Analysis Prerequisites	9.327	0.006	No difference
The interaction between learning methods and student involvement in the learning process on learning outcomes	0.212	0.833	No interaction

The student learning outcomes data show that the highest learning outcomes were obtained by students who were taught using the PBL method, followed by the inquiry learning method, and the lowest was the traditional method (μA2 = 67.45 > A1= 65.73 > A3 = 63, 13). The use of student-centered learning methods results will be better than using teacher-centered learning methods. The student-centered learning method is the inquiry learning method and PBL, while the student-centered method is the traditional method. Student-centered learning methods can overcome traditional barriers (Naicker & Bayat, 2012; Jo-An and Reigeluth, 2011).

PBL and IBL are both student-centered instructional pedagogies that promote active learning and critical thinking via conducting research. In both strategies, students are presented with a variety of challenging questions to consider. In addition, research has shown that both PBL and IBL are successful learning paradigms. Motivating students and maximizing learning are two of the primary benefits of PBL. Because inquiry is student-centered and supports the development of practical skills and higher-level thinking, it can be used at every level of education. The primary distinction we see between PBL and IBL is their beginnings. PBL originated in medical education and is based on medical expertise research that stressed a hypothetical-deductive reasoning approach (Barrows & Tamblyn, 1980). Text-based resources are frequently used in PBL for both issue data and self-directed learning. IL has its roots in scientific inquiry and lays a strong focus on posing questions, obtaining and evaluating data, and developing evidence-based arguments (Kuhn, Black, Keselman, & Kaplan, 2000; Krajcik & Blumenfeld, 2006). Kirschner et al. (2006) report on PBL research and meta-analyses, however, they missed many positive evaluations. This investigation shows that PBL medical students fared somewhat lower on basic science examinations but better on clinical tests than traditional medical students (Kirschner et al., 2006). In a recent meta-analysis of PBL's impacts, researchers found no effect on declarative knowledge assessments but a substantial effect on knowledge application (Dochy et al., 2003).

Students who are taught using inquiry-based learning, problem-based learning, or traditional techniques have different learning results, as may be demonstrated statistically. This is the study's initial goal. Other studies' explanations add to the evidence that PBL is the best learning technique, followed by IBL and traditional approaches. PBL is the best learning methodology.

The learning outcomes of students who are highly involved in learning are compared to students who are low involvement in learning (μB1 = 65.27 > B2 = 59.40). For highly involved students in education, the highest learning outcomes are obtained using the inquiry learning method (μA1B1 = 66.45). In contrast, the highest learning outcomes are obtained using the PBL method (μA2B2 = 65.25). Student involvement in the learning process is essential because it will increase student learning motivation and facilitate student learning and learning outcomes. Student engagement may also be defined as a student's level of interest, how they interact with others in the class, and their desire to learn about the topics (Handelsman et al., 2005; Mandernach, 2011).

There are three basic categories of engagement: behavioral, emotional, and cognitive (Fredricks et al., 27). Students' behavioral engagement is defined by these writers as

their efforts, attentiveness, and persistence while engaged in learning. In addition to feelings of interest, irritation, or boredom, emotional engagement encompasses students' social connections at school. Cognitive engagement refers to a student's focused effort to understand what is being taught (e.g., involvement in planning, monitoring, and evaluation of tasks). There are also behavioral, emotional, and cognitive aspects to dissatisfaction (Skinner, 2016). behavioral disaffection is characterized by a lack of interest in learning and an unwillingness to engage in classroom activities. In the classroom, students' feelings of boredom, anxiety, and frustration are all forms of emotional dissatisfaction. Cognitive dissatisfaction can be demonstrated by a lack of purpose or motivation, as well as feelings of refinedness, indifference, or pressure.

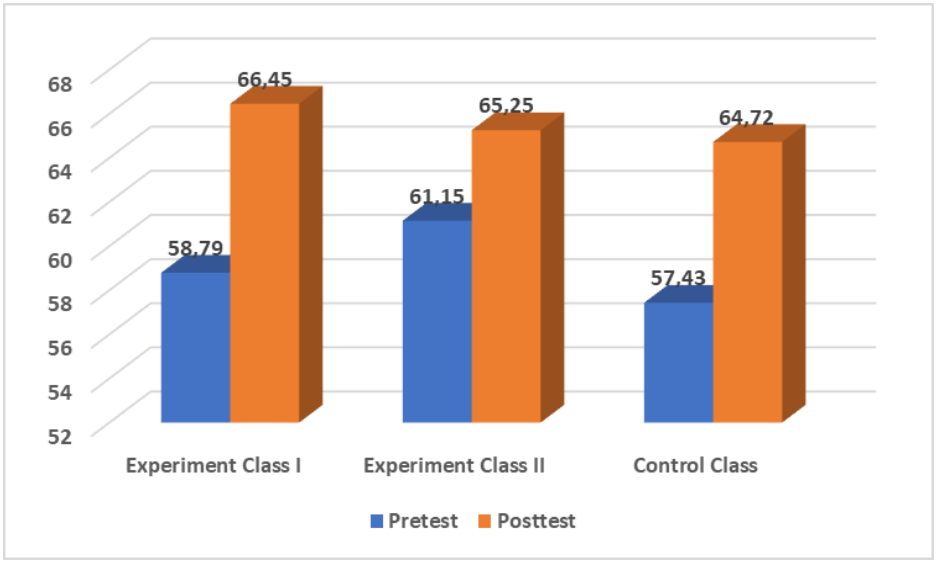

Figure 2
The results of post-test data on the level of student involvement in learning

IBL and PBL are essential factors to maximize student involvement. It will increase learning motivation, which impacts the magnitude of encouragement from within and outside students, influencing positive behaviour change in learning. Students with high motivation will be more enthusiastic about participating in the learning process than students with low motivation. Therefore, the learning outcomes of highly involved students tend to be higher than students with low involvement. From the two-way ANOVA analysis, it can be seen that there are differences in learning outcomes between students taught by inquiry learning, PBL, and traditional methods, and there are differences in learning outcomes between high and low student involvement. The results of the two-way ANOVA analysis were then continued with further tests using the t-test with the help of LISREL 8.8. The summary of additional test results can be seen in Table 6. This study's third objective is described in this analysis.

Table 6
Summary of advanced test results

Difference learning outcome	T	Sig	Decision
IBL and Traditional	1000.321	0.127	No difference
PBL and Traditional	9.327	0.113	No difference
IBL and PBL	0.212	0.466	No interaction

Based on the summary of different test results, it can be explained as follows. The results of the first further test showed no significant difference in learning outcomes between students who were taught using the inquiry learning method and the conversion method in python programming courses. In the inquiry learning method, students identify their problems related to the material. In learning the lecturer is only a facilitator who will help students if there are difficulties in finding issues. After students find problems, students will formulate hypotheses that will later be proven through data collection in practical activities. At the time of data collection, students establish the theory that has been developed and present it when it is finished proving the hypothesis.

In practice, students discuss with each other in determining problems and formulating hypotheses, although students still experience many difficulties. Students will be more active in active discussions, while passive participants will be more sedentary. To overcome this, the lecturer provides motivation, but the lecturer cannot reach all students. According to Subba et al (2019), inquiry learning will be less satisfying if the number of students is significant. The number of students in inquiry learning is 32 students. Therefore, lecturers find it difficult to supervise the inquiry learning process. Another obstacle in inquiry learning is the lack of knowledge possessed by students related to the material. Before formulating a hypothesis, Students need to study the material first independently. Learning material is sometimes less effective when compared to the delivery of material by lecturers using traditional methods because lecturers can control the order and breadth of learning materials so that lecturers can find out to what extent students master the material being taught (Sariyatun et al., 2021). The inquiry learning method will be suitable to be applied if students have high initial abilities. It is reinforced by Kirschner et al (2006), who state that inquiry learning requires high student intelligence. If students are less intelligent, the learning outcomes are less than optimal. The application of the inquiry learning method is likely to be successfully applied if high-level students carry it out.

The second further test results showed no significant difference in learning outcomes between the use of the PBL method and the traditional method. In the PBL method, the lecturer gives assignments in the form of problems students must solve. Students look for solutions to problem-solving with group discussions to exchange ideas and share knowledge with others from these various problems (Suryanti & Nurhuda, 2021). After these problems can be solved and proven into practical activities, proceed with class presentations. From this presentation, there will be discussions between groups to get new experiences and insights. In its implementation, there are still obstacles from students. Many have difficulty solving problems related to the material provided by the lecturer, so students tend to be passive in PBL learning. Even though Hmelo-Silver

(2004) revealed that students are the key to implementing the PBL method, students must manage their learning. Passive students are motivated by the lecturer, but passivity will reappear after a few minutes. The PBL method has the disadvantage of learning activities is challenging to monitor. It causes students to become passive again after being motivated because lecturers cannot supervise all PBL learning activities (Surur et al., 2020).

Given that students have their learning. The lecturers must play an active role in the PBL learning process to overcome this. This dynamic role of lecturers will result in the learning process tending to be traditional, even though Lim & Lew (2012) revealed that in PBL learning, lecturers should not interfere in student learning activities. Lecturers only act as facilitators and consultants in PBL learning. Some of the obstacles that occurred during the PBL learning process resulted in the study's results stating that there was no significant difference in learning outcomes between students who were taught using the PBL method and the conversion method in python programming lectures.

The third follow-up test results showed no significant difference in learning outcomes between students who were taught using the inquiry learning method and PBL. In the learning process using inquiry or PBL, many obstacles can still be encountered. As explained in the results of the first and second further tests, the impediments to inquiry learning are the difficulties in presenting problems, formulating hypotheses, and collecting data. In contrast, the obstacles in PBL learning are the difficulties in solving problems related to the material provided by the lecturer.

CONCLUSIONS

There are significant differences in learning outcomes between students who are taught using inquiry learning, problem-based learning, and traditional methods. Students who were prepared using the problem-based learning method were the highest learning outcomes, followed by the inquiry learning method, and the lowest was the traditional method. There is a significant difference in learning outcomes between students with high involvement in learning and those with expected learning outcomes. Students who are highly involved in education will improve their learning outcomes if they are taught using the inquiry learning method. In contrast, students who are now engaged in learning will enhance their learning outcomes if prepared using the PBL method.

There is no significant interaction between learning methods and learning motivation on learning outcomes. There is no significant interaction between learning methods and student involvement in learning outcomes from the results obtained. Furthermore, by looking at the average learning outcomes of the three ways, it can be said that the IBL, PBL, and traditional learning methods can improve learning outcomes. It means that these three learning methods are effectively used for low or high students involved in learning. However, the use of the inquiry learning method will provide higher learning outcomes for students who have increased participation in education. In comparison, the PBL method will provide higher learning outcomes for students who are low involvement in learning.

There is no significant difference in learning outcomes between the inquiry learning method and the conversion method in python programming courses. However, using the inquiry learning method will lead to higher student learning outcomes than using traditional methods (μA1 = 65.73 > μA3 = 63.13). There is no significant difference in learning outcomes using the PBL method with the traditional way in python programming lectures. However, using the PBL method will lead to higher learning outcomes than using traditional methods (μA2 = 67.43 > A3 = 63.13). There is no significant difference in learning outcomes between students who are taught using the inquiry learning method with PBL.

According to the study's findings, integrating inquiry-based learning and problem-based learning significantly increases students' interest in learning Python programming. As a result, the two teaching strategies can be employed as an alternative in other topic learning activities. The difference can influence the increase in student involvement in learning in the number of each learning group and the previous curriculum used, which is more inclined to a scientific approach. Therefore, it is hoped that researchers who will examine the same or related variables will be able to see aspects of the number and previous curriculum. For further research, it should be complemented by examining aspects that have not been touched by researchers, for example, the effect of learning achievement on Problem Based Learning and Inquiry-Based Learning when viewed from the aspect of motivation, age, gender, parental work background, economic situation, and from students' initial programming skills. The use of current digital technology developments, such as the use of information communication and technology as learning media and the integration with augmented reality, virtual reality, and mixed reality technology, can also be suggested as a recommendation for the implementation of PBL and IBL learning in vocational education.

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