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Enhancing Descriptive Statistics Learning through Project-Based Learning (PjBL) for Islamic Education Management Students

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Abstract

Educational statistics is a crucial course that students of Islamic Education Management must master. However, students whose majors are not directly related to mathematics often face difficulties in learning educational statistics. Therefore, it is necessary to develop a learning model that can improve students' understanding and is applicable to practical courses such as educational statistics. One promising alternative is the Project-Based Learning (PjBL) model. This study was conducted at IAIN Takengon Aceh and involved 23 fourth-semester Islamic Education Management students in the 2023/2024 academic year. The research data were collected in the form of video recordings, photos, and final project reports. The data were analyzed using qualitative techniques and presented through narrative description. The results showed that the PjBL model is effective in promoting an understanding of descriptive statistics, fostering collaboration, and providing opportunities for students to develop problem-solving skills.

Keywords: Project-Based Learning, Educational Statistics, Student Collaboration, Higher Education

1. Introduction

Educational statistics is a crucial course that Islamic Education Management students must master. This course plays a significant role in helping students analyze and interpret data, enabling them to make informed decisions both during their academic journey and in their future careers in educational administration(Trimurtini et al., 2020). A solid understanding of statistics is invaluable for students when completing their final projects (Astuti, 2019). Furthemore, in the professional realm, they can utilize statistical methods to process data obtained from school or educational institution administration activities(Sudijono, 2015).

Several studies indicate that students whose majors are not directly related to educational mathematics encounter difficulties in learning educational statistics(Astuti, 2019; Perdana & Ramadhona, 2021). They often lack proficiency in basic mathematics skills (Astuti, 2019). Moreover, their perception of statistics as boring and intimidating contributes to a loss of motivation for learning(Perdana & Ramadhona, 2021). Additionally, the traditional approach to

teaching statistics, which focuses heavily on formula derivation and problem-solving procedures, also adversely affects student learning outcomes(Habibie & Hidayat, 2022). Therefore, there is a pressing need for educational statistics using approaches that can enhance understanding and motivation among students whose majors do not directly involve mathematics.

The application of Project-Based Learning (PjBL) can be a solution to improve students' comprehension of educational statistics. Thomas (2000) describes six steps of PjBL: starting with a relevant question or problem, designing a good project, continuous investigation, creating a final product, assessment and reflection, and final presentation. Meanwhile, (Boss & Larmer, 2018) detail PjBL in eight steps: starting with a question, planning the project, managing time activities, facilitating students' research, encouraging student collaboration in groups, formative and summative assessment, group presentations, and concluding with reflection and evaluation. Generally, PjBL is a learning model that emphasizes greater student involvement in the learning process, from planning to the final outcome of a project.

Several studies have demonstrated the positive impact of PjBL on student learning processes. This model effectively engages students in understanding course material(Faradila, 2022; Made et al., 2022; Sariningsih et al., 2023). Additionally, PjBL which emphasizes learning through projects or integrated tasks, can enhance collaboration skills, creativity, and critical thinking, which are essential 21st century skills (Fitriani & Sarkity, 2023; Maor et al., 2023; Rahmadhani & Ardi, 2024; Yanti & Novaliyosi, 2023; Yu, 2024). Furthermore, the implementation of PjBL made learning more meaningful(Bell & Dirgantoro, 2023), as students gained direct experience in problem-solving, practiced gathering data, and acquired knowledge themselves(Supadol et al., 2014). Thus, the application of PjBL is highly suitable for teaching statistics with practical applications, such as educational statistics for education management students (Wahab et al., 2021).

Although much research has been conducted on PjBL, there is still a paucity of studies on its application in educational statistics courses in Indonesia. Our search on Google Scholar revealed only one study by Fitriani & Sarkity (2023), which examined student perceptions of project-based assignments in the form of video tutorials on statistical tests in an educational statistics course. Given the urgency of PjBL and the limited research on its application in educational statistics courses, more studies are needed to enrich information for researchers and readers to improve the quality of teaching in educational statistics courses. Therefore, this study aims to explore and describe the learning process in descriptive statistics material using the PjBL approach and to understand students' comprehension of the material they study through the assessment of their abilities in tendency analysis, variability analysis, and data presentation of their final reports.

2. Methods

This research used a descriptive method with a qualitative approach suitable for describing students' abilities and the learning process(Pertiwi & Prahmana, 2020). The research activities were conducted in May 2024. This study involved fourth-semester students of the Islamic Education Management program at IAIN Takengon in the Educational Statistics course. A total of 23 students participated, 20 females and 3 males. The students had different high school majors, 11 were from the science major (IPA), 8 were from the social studies major (IPS), and 4 were from other majors.

The learning activities during the research were conducted over five sessions using the Project-Based Learning (PjBL) model. The PjBL syntax, as referred to by Thomas (2000) and Boss & Larmer (2018), includes activities such as problem posing, project planning, scheduling project work, guidance and monitoring, presentation and evaluation, and reflection, as summarized in Table 1 below.

Table 1. Summary of PjBL Learning Activities

Meeting	
I	- Conveyed the learning objectives and explained the PjBL model to be used - Performed an apperception - Provided an explanation about the project that the students would work on - Formed student groups randomly (4 students per group) - Prepared a project completion schedule - Explained to the students how to create survey questions that they would design and
II	- Each group presented their survey question designs in front of the class - The lecturer and students discussed to refine the questions - explained the fieldwork ethics to the students for conducting surveys - Instructed the students to go to the field to collect data according to each group's survey questions, which had to be completed before the next meeting
III	- The lecturer explained how to present data in tables, diagrams, and histograms - Each group applied data presentation techniques to their data - Each group completed their report and prepared a presentation for the following week
IV	- The lecturer explained how to process data to find the mean, median, mode, variance, and standard deviation - Each group started processing the data they collected - The lecturer monitored and provided guidance to the groups in data processing
V	- Each group presented their project results in class - Conducted a discussion between the audience and presenters

- Students and The lecturer provided feedback and criticism
- The lecturer evaluated each presentation based on predetermined criteria
- Reflected on the PjBL process

Activities during the learning process were documented through videos and photos. In this case, the researcher was assisted by a documentarian to capture the video and photo recordings. Apart from being researchers, the researcher also acted as a lecturer during that learning period. Additional video and photo recordings were obtained from the documentation done by students in the field while conducting surveys. The final data consisted of the students' final project reports, which were the end products of the projects they carried out. Therefore, through video and photo recordings, as well as the students' final reports, a substantial amount of data was gathered to describe the implementation of PjBL from the beginning to the end of the study.

The collected research data was analyzed through a structured process. The data was reduced, presented, and concluded according to the qualitative data analysis techniques outlined by Miles et al., (2013). Subsequently, the data was described narratively, as done by Pertiwi & Prahmana (2020). The reduction of video and photo recordings involved replaying the recordings, coding the relevant information related to the identified aspects, analyzing the information, and then describing it. Finally, the students' project results were evaluated as an indicator of the success of PjBL in providing students with an understanding of descriptive statistics.[Office1]

3. Result and Discussion

First Meetin

The first learning session was conducted on Wednesday, May 10, 2024. The session began with greetings and an attendance check; 21 students were present, one had an excused absence, and one was sick. The learning activities commenced with the presentation of learning objectives and an explanation of the PjBL model that would be employed over the next four sessions. This was followed by an introductory session on descriptive statistics, which serves as the foundation for the upcoming lessons. This is illustrated in the following Dialogue 1.

Dialog 1

Lecturer	:	"What statistics topics do you remember studying in high school or middle school?";
Students	:	"Mean, median, mode";
Lecturer	:	"Try to explain them."

Students	:	"The mean is found by adding all the data and dividing by the number of data points. The median is the middle value after the data is ordered. The mode is the data point that appears the most";
Lecturer	:	"What about grouped data?";
Students	:	"We forgot how to find it, sir";
Lecturer	:	"What do you mean?";
Students	:	"We forgot how to group the data and the formulas used";
Lecturer	:	"What else do you remember about statistics?";
Students	:	"There are tables and diagrams";
Lecturer	:	"What types of diagrams do you remember?"
Students	:	"Bar charts and pie charts";
Lecturer	:	"Alright, we will revisit these topics in more detail and their practical applications".

During the dialog 1, it was noted that students still remembered topics such as measures of central tendency (mean, median, mode) and data presentation (tables, diagrams). However, they did not recall how to process grouped data. [Office2]This observation was a positive point for implementing project-based learning(Rufi'i & Utamayasa, 2023).

The session continued with a detailed explanation of the project that the students would undertake, covering the topic, objectives, and expected outcomes. The project topic involved collecting data from 50 students of IAIN Takengon, with each group proposing five questions. The objective of this project was to process and present data in accordance with the descriptive statistics material being studied. The final product was a comprehensive report to be presented in the fifth session. Students were randomly divided into six groups, with each group consisting of four members, except for one group which had three members. Subsequently, the researcher explained how to design survey questions, and the groups were tasked with drafting five survey questions to be presented and discussed in the next session.

Second Meeting

The second meeting was attended by all students. The focus of this session was to discuss the survey questions designed by each group in the first meeting. Each group presented their survey questions in front of the class. The presentations included the narrative of the questions, the types of questions, and how they planned to collect and ask the questions to the respondents. Figure 1 showed one of the student presentations.

Figure 1. Presentation of Survey Design by Group 1

Discussion activities between the lecturer and the students took place after each group completed their presentation to refine the survey questions that had been designed by the students. During these discussions, the lecturer or other groups provided suggestions and clarified any ambiguous or irrelevant questions. Below in Dialog 1 is an example of a discussion regarding an ambiguous question made by Group 3.

Dialog 2

Question asked	:	*What is your GPA?*
Lecturer	:	"What kind of answers do you expect to get from this question?"
Students	:	"The GPA of students from the previous odd semester, Sir."
Lecturer	:	"GPA or Grade Point?"
Students	:	"Grade Point, Sir".
Lecturer	:	"How would you ideally phrase that question?"
Students	:	"What was your GPA in the odd semester of the 2023/2024 academic year?" How about that, Sir?"
Lecturer	:	"Any suggestions from other groups?"
Other groups	:	(The question was approved)

In Dialog 2, Group 3 designed the question "What is your GPA?" the researcher asked about the type of answers they wanted from the respondents. Group 3 explained that they wanted to know the GPA from the previous semester. The researcher confirmed whether they were asking about GPA (Grade Point Average) or IP (Grade Point); they confirmed that they were asking about Grade Point. Therefore, the researcher asked the group to reformulate the question more ideally, which was also approved by other groups, "What was your GPA in the odd semester of the 2023/2024 academic year?" Through this discussion, the researcher guided the students to formulate an ideal question to obtain accurate answers and provided an understanding of the importance of discussion and clarification in designing survey questions.

Next, the researcher explained the guidelines for conducting surveys in the field. This explanation included how to obtain consent from respondents, maintain the confidentiality of respondents, and

exhibit professional behavior while collecting data. After providing the explanation, the researcher assigned the students to go to the field to collect data according to the survey questions they had created. The deadline for completing this task was before the next meeting.
[Office3]
Within one week, the students went to the field to collect data according to the survey questions they had designed. Documentation of activities, in the form of photos and video recordings, showed the students conducting surveys smoothly according to the guidelines previously provided. In Figure 2, there is a documentation of students interviewing respondents and recording the data directly on-site to avoid errors in data collection.

Figure 2. Students are conducting a survey

Third meeting

The third meeting was attended by all students. The core activity in the third meeting of this PjBL learning was the presentation of field survey data results conducted by each group. By the time of the third meeting, each group had completed their field tasks beforehand, and the researcher ensured this by checking each group's raw data.

In this meeting, the researcher provided an explanation of how to present data effectively. The researcher presented concepts and steps for data presentation in the form of tables, frequency distribution tables, histograms, polygons, and pie charts. The material delivery was accompanied by practical examples, and students directly practiced data processing on worksheets provided earlier to ensure their understanding of the data presentation methods. After receiving the explanation, each group began to work collaboratively to apply data presentation techniques to their own data. In this regard, the researcher acted as a guide for groups encountering difficulties in processing the data. Subsequently, this group work activity continued outside of face-to-face hours, with the target for the next meeting being for students to complete their data presentation projects. To ensure the timely completion of these projects, the researcher provided guidance online or offline for groups encountering obstacles.

Fourht meeting

The fourth meeting was attended by all students. The core activity of the fourth meeting was to explain the concepts and processing of central tendency data (mean, median, mode) and variability (range, standard deviation, variance). In this session, the researcher explained step by step the data processing to find central tendencies and variabilities with practical examples directly carried out by students on worksheets as seen in Figure 3.

Figure 3. Students Working in Groups

Subsequently, students in groups began to collaborate to complete calculations on their project data. During this session, The researcher actively guided students encountering difficulties, moving around to ensure each group processed the data correctly. Due to time constraints in the meeting, students continued processing their data outside of face-to-face hours. Before closing the learning activity, the researcher ensured that the next meeting would involve presentations and submission of project tasks. The students were asked to prepare their presentations and reports as thoroughly as possible to ensure that their projects received a good evaluation.

Fifth meeting

The fifth meeting was the final session for the student projects. This meeting focused on the presentation and evaluation of the completed projects. Each group presented their project results, covering the background, objectives, data collection methods, data processing, and the challenges encountered during the project. Each group had 13 minutes for their presentation, including the time for answering questions. During the presentation activity, students expressed their difficulties in collecting data in the field, as revealed by Group 2, where respondents they approached refused to provide answers. Other groups also encountered situations where they were rejected by a class when presenting their goals to that class. Some groups also mentioned that not all data could be analyzed to find their central tendencies and variabilities. the researcher addressed these findings at the end of the discussion session. After each group's presentation session, the researcher gave two other groups the opportunity to ask questions or provide feedback on the presentations given. This discussion session aimed to deepen each student's understanding of descriptive statistics. During the presentation activity, the researcher evaluated each presenting group, covering

presentation performance, quality of analysis, accuracy of data presentation, and the presenting group's ability to answer questions posed by other students.

The final activity in the fifth meeting was reflection and evaluation. Students and the the researcher jointly evaluated the PjBL activities from the first to the fifth meeting. The researcher provided students with the opportunity to express their impressions. Students appreciated the PjBL learning model, feeling that learning was more meaningful because they were given the opportunity to directly practice the material they had learned. However, they also noted that more time and effort were needed to complete the projects, and Students also hindered by group members who contributed less, thus placing a heavier burden on other group members. Therefore, the entire PjBL process could proceed smoothly and provide meaningful experiences for students, as each group could complete the projects assigned to them from designing to the final presentation.

The final project report was the last piece of data the researcher gathered in this study. In general, the assessment of the final reports focused on two points: the product outcomes and the product presentations, as done by Pahmi et al. (2022). In this study, the assessment of the final reports by students included writing, tendency analysis, variability analysis, data presentation, and presentation skills. The researcher used an assessment rubric that was adapted from (Agustina et al., 2021) to evaluate the tendency analysis, variability analysis, and data presentation. For assessing presentation skills, the researcher used a rubric that was modified from (Peeters et al., 2010). The evaluation results of the student project reports showed the success of the groups in completing their projects. It was clear that in data processing for trend analysis, variability analysis, and data presentation, the students received perfect scores. This indicates that all groups worked maximally in analyzing the data. The scores varied slightly in writing and presentation. Some were not meticulous in writing format or spelling errors. As for the presentation, there were also differences in the smoothness of delivery and the way of answering questions. The summary of the assessment results of the final student reports is shown in Table 2 below[Office4].

Table 2. Final Project Report Evaluation Results

Group	Writing	Tendency Analisyis	Variability Analisyis	Data Presentation	Presentation	Total Score
Group 1	16	20	20	20	16	92
Group 2	17	20	20	20	16	93
Group 3	15	20	20	20	17	92
Group 4	16	20	20	20	17	93
Group 5	17	20	20	20	17	94
Group 6	17	20	20	20	18	95

The assessment results of group reports, which serve as the final product of implementing PjBL in Islamic Education Management students, indicate that this model is effective in enhancing students' understanding and skills in descriptive statistics. All groups demonstrated a strong ability to analyze central tendency, variability, and data presentation. The group work demonstrated their proficiency in applying concepts such as mean, median, and mode to both single data sets and grouped data, as well as calculating data range, standard deviation, and variance. Additionally, the student groups were adept at presenting data appropriately using tables, diagrams, and histograms, according to the type of data they obtained. These findings support previous research that posits PjBL as an effective method for improving students' comprehension of the material (Faradila, 2022; Made et al., 2022; Sariningsih et al., 2023). Sariningsih et al. (2023) discovered that the implementation of PjBL enhanced students' statistical analysis skills in a Basic Statistics course. Similarly, research conducted by Made et al., (2022) demonstrated that the implementation of PjBL improved student learning outcomes in a Machine Tools and Production course. Thus, the implementation of PjBL positively contributes to various courses.

Furthermore, another positive aspect observed is the active collaboration among students within their groups. They effectively cooperated in collecting, processing, and presenting the data. This finding aligns with the research conducted by Fitriani & Sarkity (2023), which highlighted that collaboration in PjBL can motivate students and make them feel fully engaged in the learning activities. Additionally, Rahmadhani & Ardi (2024) mentioned in their literature review that several articles emphasized the great potential of PjBL in fostering good teamwork and positive learning experiences. However, there were some challenges, as a few members contributed less compared to others. This poses a unique challenge for group members to manage the distribution of tasks and ensure timely completion of their project. This issue is a common challenge in student-centered learning models, as indicated by previous studies(Le et al., 2018; Umar, 2019). Therefore, despite minor obstacles, the positive contribution of PjBL to students' collaboration skills aligns with the development of 21st-century skills in the education sector(Maor et al., 2023; P21, 2018) . Another fact highlighted by the researcher is the challenges encountered by students in collecting and analyzing data. The s tudents were ignored by respondents and even expelled from classes while gathering data. When analyzing the data, they found that not all data could be analyzed to determine its central tendency and variability. This experience enhances the meaning of learning and affords students the opportunity to confront real-world challenges and cultivate problem-solving skills (Bell & Dirgantoro, 2023; Supadol et al., 2014).

4. Conclusion

Project-based Learning (PjBL) can be utilized to enhance students' understanding of descriptive statistics in educational statistics courses. The learning activities follow the PjBL syntax, which includes posing a problem, planning a project, scheduling project work, guidance and monitoring, presentation and evaluation, and reflection. The first session focused on explaining the learning

model and presenting the problem as the foundational step for the students' projects. In the second session, students refined their survey designs through in-class discussions, followed by a one-week fieldwork period to collect data. In the third session, students analyzed the data to determine central tendencies and variability from their previously collected data. The fourth session focused on data presentation, while the fifth day involved group presentations and project result discussions[Office5].

The evaluation results of the final projects show that all student groups were successful in conducting data processing for trend analysis, variation analysis, and data presentation effectively. However, there were variations in the quality of writing and presentation. The implementation of Project-based Learning (PjBL) in the Islamic Education Management course has proven to be a successful approach in enhancing students' understanding and proficiency in descriptive statistics.

This study has several practical limitations. One limitation is the limited face-to-face time, which affected our ability to ensure equal contributions from each group member in data processing. Another limitation is the uniform assessment of the final product, which did not consider the varying abilities and contributions of group members. This could potentially lead to dissatisfaction among students who contributed more than others.

Based on these limitations, it is recommended that future research consider using a blended learning model to monitor student activities in real-time. Additionally, individual evaluations by the instructor or peer assessments should be conducted to ensure fairer assessments. Nevertheless, it is anticipated that future researchers will generate more intriguing ideas based on the findings of this study.

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