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The Effectiveness of Task-Based Learning (TBL) Models on Improving Students' Problem-Solving Skills

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Abstract: The Task-Based Learning (TBL) instructional model refers to an approach that emphasizes the presentation of structured tasks progressively, aiming to train students' problem-solving skills from simple to more complex problems. This study applied a quantitative approach using descriptive methods and an ex post facto research design. The research aims to evaluate the effectiveness of implementing the TBL learning model in enhancing students' understanding of concepts and statistical analysis skills. Participants in this study were students taking Statistics in the third semester of the Biology Education program at the State Islamic University of Mataram during the 2022/2023 academic year. The research instruments included a statistical data concept test and statistical analysis practice. Data analysis was conducted descriptively by comparing the mean scores of students' conceptual tests and analysis practices over 11 meetings. The research findings indicate that students' understanding of statistical concepts fluctuates in line with the complexity of the assigned tasks. Additionally, students' statistical analysis skills vary with the difficulty level of the tasks, but a positive trend in students' performance improvement is observed over time.

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Introduction

In the current digital era, problem-solving skills are becoming increasingly crucial as individuals face more complex problems that require innovative solutions. When confronted with challenges, one must connect one's knowledge and skills to the real situations they encounter. This enables them to find appropriate and effective solutions to problems. Problem-solving skills also involve thinking critically, creatively, and analytically when dealing with complex issues. Additionally, the ability to collaborate in groups is essential for solving complex problems that require innovative solutions. Therefore, problem-solving skills should be cultivated early through education, so individuals have the capabilities to tackle challenges in their daily lives.

The ability to solve problems using acquired knowledge and skills is called problem-solving skills. Problem-solving skills are high-level cognitive (metacognitive) abilities that involve knowledge, understanding, application, analysis, and synthesis (Mayer, 2003). Krulik and Rudnick, as cited in Carson (2007), state that there are five stages of problem-solving: reading, exploring, selecting a strategy, solving the problem, and evaluating and discussing it. These problem-solving stages align with the task implementation stages in the Task-Based Learning (TBL) instructional model.

TBL is a learning approach that emphasizes the meaningful and relevant completion of tasks (Murphy, 2023). In this approach, students are presented with tasks that stimulate active learning individually and in groups. These tasks are designed to train students in creative thinking and encourage them to seek and manage information independently. In TBL, students are given challenging and contextual tasks that allow them to apply learned knowledge and skills in real-world situations. These tasks may involve problem-solving, analysis, synthesis, and evaluation. Moreover, students are encouraged to collaborate in groups to achieve common goals, honing their collaboration and leadership skills. Implementing TBL involves learning steps where students must read, explore, plan strategies, solve tasks (problems), and evaluate through class discussions.

In statistics learning, problem-solving skills are divided into problem-solving through conceptual approaches and statistical analysis practice. Statistical analysis skills involve collecting, organizing, and analyzing data using statistical methods. These skills are a key competence in statistics education and have broad applications, proving essential for both academic and professional purposes. Specifically in education and teaching, statistical analysis skills are required for (a) analyzing students' learning outcomes as a basis for decision-making, (b) developing teacher competencies, (c) improving the quality of classroom learning, (d) conducting classroom action research, and so on.

In addition to statistical analysis skills, students must master a conceptual understanding of statistical data. Statistical data is a discipline that explores the scientific and systematic ways of collecting, storing, analyzing, and interpreting data. Concepts related to statistical data include methods in (a) data collection, (b) data screening, (c) data exploration, (d) data analysis, and (e) interpretation and presentation. Concepts about data science help students understand the methods used in statistical problem-solving, while analytical skills assist students in solving problems practically. Therefore, both problem-solving approaches in statistics need more attention so students acquire comprehensive and contextual statistical knowledge and skills.

Efforts to improve statistical problem-solving skills have been made in research by implementing various scientific learning models. However, the improvement of statistical problem-solving skills through the Task-Based Learning (TBL) model has not been widely explored and published. Furthermore, TBL has not been extensively applied in science classrooms, especially in Biology. Despite this, TBL's instructional steps can encourage learning to be more contextually autonomous and can train students in scientific methodology. Additionally, TBL can help learners master the concepts and skills needed in specific subject areas, especially for those with insufficient initial abilities (Nunan, 2004). Therefore, this research is expected to serve as a reference in implementing the TBL learning model in science education, particularly in Biology, to enhance problem-solving skills.

Research Method

This research employs a quantitative approach with a descriptive method, utilizing an ex post facto research design. This study aims to evaluate the effectiveness of implementing the Task-Based Learning (TBL) instructional model in enhancing students' statistical problem-solving skills. Statistical problem-solving is divided into two categories: conceptual problem-solving and statistical analysis. The research was conducted on students enrolled in the Statistics course during the third semester, specifically in classes C and D of the Biology Education Department at the State Islamic University of Mataram. The study spanned one semester, and data collection was carried out using test instruments in 11 sessions. Data analysis employed a descriptive method by comparing the average test scores between the two classes. The TBL instructional steps used in this research were modified by Ellis (2006).

Table 1. Syntax of Task-Based Learning

TBL stages	Lecturer activities	Student Activities
Pre-task	• Presenting the general topics to be studied. • Presenting the lesson plan and objectives and addressing the student's needs in the learning process. • Exploring the students' initial capabilities.	• Prepare for lectures by taking notes and seeking information. • Develop a study plan, and assignments, and predict the final results. • Take note of necessary learning resources. • Ask about assignments and their completion methods.
Task	• Monitoring and supporting students during task completion. • Providing consultations throughout the learning process, both inside and outside the classroom. • Evaluating the extent of students' learning progress. • Offering recommendations and suggestions for improvement.	• Completing individual tasks through discussion. • Exploring various online and offline learning resources that can be accessed independently. • Presenting assignments in each meeting. • Confirming the results obtained from the tasks. • Evaluating learning achievements/competencies in each session.
Review	• Presenting final assignments and motivating students to work on tasks independently. • Providing consultations for students in need. • Evaluating and assessing student assignments. • Offering reinforcement and constructive feedback.	• Preparing the final assignment. • Presenting the final assignment. • Providing and receiving feedback through open discussions. • Evaluating one's learning achievements/competencies.

Hasil Penelitian dan Pembahasan

The effectiveness of the Task-Based Learning instructional model in statistical problem-solving is examined from the perspective of statistical data concepts and statistical data analysis. The students' statistical data analysis abilities are presented in Table 2.

Table 2. Recapitulation of students' statistical data analysis abilities.

Class	Task								Mean	Criteria
	1	2	3	4	5	6	7	8		
C	80.5	70.7	79.6	76.5	73.5	80	77	77.5	76.91	Very good
D	84.56	74.38	86.25	78.13	76.25	85.00	76.25	82.50	80.41	Very good

Table 2 shows the scores of statistical data analysis abilities in classes C and D. There is a fluctuation in students' statistical data analysis abilities in classes C and D throughout eight assignments. Overall, students in class C have an average statistical analysis ability of 76.91, while class D has a higher average statistical analysis ability of 80.41. According to

the academic assessment guidelines of the State Islamic University of Mataram, both classes received a conclusion of "very good." The variation in statistical analysis abilities in both classes is depicted more clearly in Figure 1.

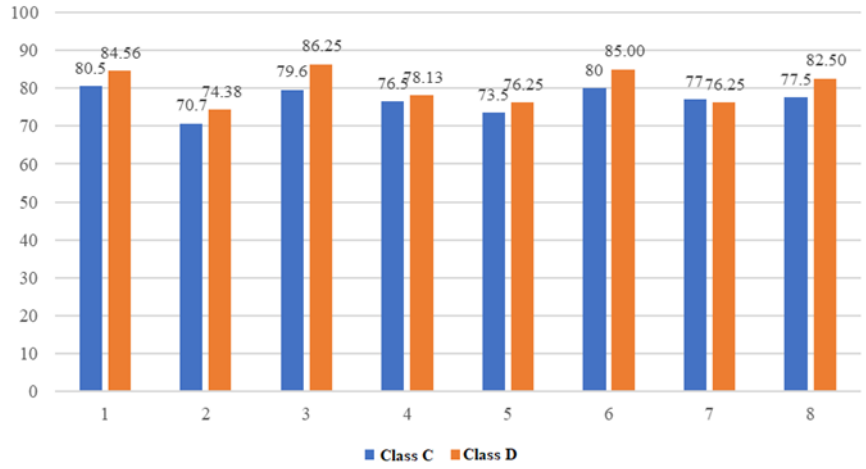

Figure 1. Variation of statistical analysis abilities in classes C and D.

Figure 1 shows that students' statistical data analysis abilities improved in tests 3, 6, and 8. However, there is a decrease in scores on tests 2, 4, 5, and 7. Despite several instances of declining scores in students' analytical abilities, an overall upward trend in scores is observed in both classes. The data indicates that the Task-Based Learning (TBL) model effectively develops students' statistical data analysis abilities. However, on the flip side, the decrease in scores suggests that the difficulty level and complexity of tasks also influence students' problem-solving success.

The assignments/tests in TBL are strategically arranged, ranging from low to high levels of complexity. Elliot (2006) states that tasks must be strategically organized to guide learners in achieving the desired competencies. The significance and value of tasks will increase in complexity, which can be observed through performance. The data on the mastery of the statistical data concept is presented in Table 3.

Table 3. Recapitulation of statistical data concept mastery data.

Class	Task			Mean	Criteria
	1	2	3		
C	78	92.5	81.5	84.00	Satisfying
D	64.06	78.28	76.88	73.07	Good

Table 3 shows the scores of students' mastery of statistical data concepts in classes C and D. The comparison of these scores indicates an improvement in both classes. Students in class C have an average mastery score of statistical concepts higher, namely 84.00, with satisfactory criteria. Meanwhile, class D has an average score of 76.88 with a criteria of good. The variation (changes) in the mastery of statistical data concepts in classes C and D are displayed in Figure 2.

Figure 2 shows the trend of increasing mastery of statistical data concepts over three assignments. Although there is a decline in the third task, there appears to be an overall improvement in mastery of statistical data concepts. This variation (fluctuation) can occur due to several factors, such as the complexity/difficulty of different tasks in each assignment, motivation, and students' lack of ability to analyze and sift through relevant information.

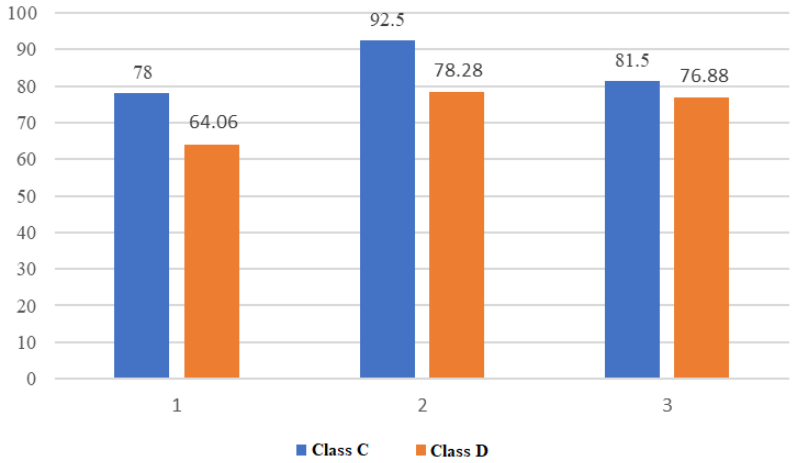

Figure 2. Variation in the mastery of statistical data concept abilities in classes C and D.

Implementing Team-Based Learning (TBL) allows participants to apply knowledge productively (Buyukkarci, 2009). TBL can enhance students' abilities in analyzing, communicating, and collaborating to solve problems (Sumardeni et al., 2023). Additionally, TBL can improve students' writing skills (Marashi & Dadari, 2012), as writing skills correlate with problem-solving abilities (Ahmad and Setyowati, 2023).

Another fact discovered during the lecture process is that students' motivation and engagement in the course play a crucial role in their learning success, particularly in solving statistical problems. Mustika and Kusdiyati (2015) showed that students with high levels of engagement tend to exhibit diligent and perseverant learning behaviour. In the statistics course, engagement refers to students' involvement in planning and choosing appropriate learning sources and strategies, emotional attachment, where students perceive statistics as a necessity (for completing studies and future professions), and students' effort and initiative in solving statistical problems. Good engagement will enhance and maintain students' motivation to complete assigned tasks. In TBL, motivation is a fundamental factor underlying students' decision-making and task completion (Huang, 2016; Aprizawati, 2017).

The assignments given in the statistics course are problem-solving tasks based on case studies, where students must reanalyze data from previous research. This data can be obtained from articles, theses, and dissertations accessible online or offline. In solving problems, students are also required to use specific software such as SPSS. Thus, through TBL, students not only develop practical statistical problem-solving skills but also master technology and information, enhance digital literacy, and practice critical analysis, sensitivity, and scientific thinking.

In addition to training students to solve problems, the TBL learning design is capable of creating a competitive learning environment. Although students are given the freedom to work independently or in groups, surprisingly, their competitiveness increases during task completion. This may be influenced by several factors: (1) the feedback, rewards, and reinforcement provided by the instructor immediately after task submission, (2) the sense of responsibility for each individual to complete the task and report/present it, (3) increased self-confidence of students, (4) transparency in assessment, (5) the need to use the knowledge and skills possessed to solve problems within the specified time frame.

The perceived urgency by students in the TBL model during lectures can also increase their responsibility and autonomy in learning. Ahmad and Setyowati (2023) state that TBL has great potential to enhance students' autonomy in learning. This is because, in the application of TBL, students are allowed to (1) explore relevant learning sources, (2) determine learning strategies to complete tasks, (3) plan and evaluate the achievement of

competencies/learning success, and (4) determine ways and approaches to completing tasks. Safitri (2018) emphasizes that autonomy correlates with motivation and positively influences students' problem-solving abilities.

Conclusion

The Task-Based Learning (TBL) instructional model emphasizes providing structured, authentic, and meaningful tasks. The implementation of TBL in Statistics lectures has proven to be relevant to the course's competency requirements and students' needs. This model provides opportunities for students to develop critical-analytical thinking skills, practice applying statistical software and scientific methods, and enhance self-confidence, motivation, and independent learning. All of these aspects can assist students in developing and improving their statistical problem-solving abilities.

Recommendations

The ability to solve statistical problems is the most crucial component of the expected competence in the statistics course. Generally, problem-solving skills are high-level skills needed by every learner to address everyday life issues. On the other hand, TBL is a highly suitable model for use at the university level and with students. Therefore, the implementation of TBL in lectures or science learning needs to be enhanced. Additionally, in applying TBL, the presented tasks must be designed as effectively as possible to be authentic, meaningful, and relevant, capable of guiding learners to achieve multi-competencies from simple to complex levels. Thus, the implementation of TBL becomes more valuable and meaningful.

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