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OPTIMIZING LEARNING OUTCOMES THROUGH FLIPPED CLASSROOM STRATEGIES AND GENERATIVE AI TOOLS INTEGRATION

Aprilla Suriesto Madaun[1], Vetronella Panannangan[2]
Universitas Sanata Dharma, Indonesia
Universitas Kristen Indonesia Toraja, Indonesia

Abstract: Inovasi pembelajaran ini merupakan integrasi antara metode *flipped classroom* dan penggunaan *generative AI tools* untuk meningkatkan kualitas pembelajaran. Di satu sisi, metode *flipped classroom* memberikan kesempatan bagi mahasiswa untuk mempelajari materi secara mandiri sebelum pertemuan di kelas. Di sisi lain, *generative AI tools* seperti Claude.ai, Custom GPT Consensus, DeepSeek, dan Gamma digunakan untuk menyiapkan materi pembelajaran yang lebih interaktif dan menarik. Implementasi dilakukan selama lima (5) pertemuan pada mata kuliah Statistika Inferensial, yang melibatkan satu kelas berisi 37 mahasiswa dari Program Studi Manajemen. Penelitian ini menggunakan pendekatan kuantitatif dengan desain kuasi-eksperimen berupa desain *one-group pre-test – post-test*. Hasil penelitian menunjukkan adanya peningkatan signifikan dalam pemahaman konsep, yang tercermin dari kenaikan rata-rata nilai ujian dari 63,73 (ujian tengah semester) menjadi 80,05 (ujian akhir semester). Persentase mahasiswa yang memperoleh nilai A, A-, B+, B, dan B- meningkat dari 21,60% (ujian tengah semester) menjadi 100% (ujian akhir semester). Tingkat kepuasan pembelajaran berdasarkan evaluasi pada Sistem Informasi Akademik mencapai 3,5 dari 4 (Sangat Baik). Inovasi ini terbukti efektif dalam mengatasi kesulitan mempelajari materi statistika yang kompleks serta mendorong keterlibatan mahasiswa dalam proses pembelajaran.

***Kata-kata kunci: flipped learning, generative AI tools,* statistika, kinerja akademik, manajemen**

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[1] E-mail: *april@usd.ac.id* (*Correspondence Author)*
[2] E-mail: *vetronelapanannangan@gmail.com*

OPTIMALISASI HASIL BELAJAR MELALUI INTEGRASI STRATEGI *FLIPPED CLASSROOM* DAN *GENETAVE AI TOOLS*

Aprilla Suriesto Madaun[1], Vetronella Panannangan[2]
[1]Faculty of Business and Economics, Sanata Dharma University, Indonesia
[2]Faculty of Economics and Business, Universitas Kristen Indonesia Toraja, Indonesia

Abstract: *This learning innovation is an integration of the flipped learning method with the use of generative AI tools to improve the quality of learning. On the one hand, the flipped learning method provides an opportunity for students to study the material independently before class meetings. On the other hand, generative AI tools such as Claude.ai, Custom GPT Consensus, DeepSeek, and Gamma are used to prepare more interactive and engaging learning materials. The implementation was carried out over five (5) meetings in one of the courses, namely Inferential Statistics, involving one class of 37 students from the Management Study Program. This study used a quantitative approach with a quasi-experimental design in the form of a one-group pre-test – post-test design. The results showed a significant increase in conceptual understanding in the form of an increase in exam scores from 63.73 (mid-term exam) to 80.05 (final exam). The percentage of students who received grades A, A-, B+, B, and B- increased from 21.60% (mid-term exam) to 100% (final exam). Learning satisfaction based on learning evaluation in the Academic Information System was 3.5 / 4 (Very Good). This innovation has proven effective in overcoming the difficulties of learning complex statistics and triggering student involvement in the learning process.*

Keywords: flipped learning, generative AI tools, statistics, academic performance, management

1. INTRODUCTION

Quantitative courses such as statistics often present challenges for students due to their complex nature and the high demand for conceptual understanding and data analysis skills. Difficulties in understanding this material are often caused by conventional learning methods, which tend to be one-way, where lecturers dominate the learning process through lectures, leaving insufficient space for students to explore concepts independently. As a result, students struggle to connect theory with everyday practicalities and lack opportunities to practice data analysis independently. Yet, this course would yield optimal impact if students were able to leverage it to solve problems in their surroundings.

The impact of this less interactive learning method is significant on student learning effectiveness. Most students simply memorize formulas without being able to apply them in their daily lives. According to Serin (2018), this one-way learning method results in low levels of student engagement in class, thus decreasing learning motivation, which ultimately impacts suboptimal academic outcomes. This condition demonstrates the need for innovation in more interactive, adaptive, and technology-based learning methods to improve students' understanding of Inferential Statistics material. This proposed method should be capable of enhancing student engagement and motivation within classroom dynamics, thereby leading to improved academic performance.

To address this issue, learning innovations that integrate flipped learning methods and the use of Generative AI tools are believed to be an effective strategy. According to Bishop & Verleger (2013), the flipped learning method is a learning approach in which students are presented with learning materials independently before class sessions, allowing face-to-face time to be more focused on discussion, problem-solving, and the application of concepts in real-world contexts. Through this method, students have the flexibility to understand the material according to their individual learning abilities before deepening it through classroom dynamics.

On the other hand, the use of generative AI tools in Inferential Statistics learning can help students understand complex concepts through more visually engaging and interactive presentations. Generative AI tools can also help lecturers prepare and present material more quickly, in-depth, and visually appealing. Thus, the benefits are not only for students, who gain a better and more engaging theoretical understanding, but also for lecturers, who have more opportunity and time to deepen the material presented so that it is relevant to students' needs.

This innovation was chosen based on various studies showing that the flipped learning method can improve student understanding and engagement in the learning process. Furthermore, the increasingly sophisticated development of Artificial Intelligence technology has provided new opportunities to support more interactive and adaptive learning. Therefore, the combination of these two approaches is believed to provide an effective solution to improve the quality of learning in Inferential Statistics courses. By integrating these two methods, students will not only understand the material more easily but also become more engaged in class dynamics.

2. LITERATURE REVIEW

Classroom Management in Higher Education

Today's classroom management approaches emphasize a shift from teacher-centered to student-centered learning, where students are positioned as active learners who acquire knowledge through experiential learning. Research shows that classroom management that supports active learning significantly improves students' conceptual mastery and academic performance (Binoy, 2024). Classroom management is the faculty member's ability to structure, organize, and control the learning environment to create a conducive and effective learning environment. In the context of higher education, classroom management no longer focuses on controlling behavior but on managing encounters, learning activities, and learning resources that facilitate active student engagement. Effective classroom management directly contributes to increased student participation, learning motivation, and learning outcomes.

Flipped Learning Theory in Higher Education

Flipped learning is a learning model that "flipped" the conventional pattern,

where learning materials are delivered before class, usually through digital media. Face-to-face class time is used for discussions, solving case studies, and other learning activities. This learning method is based on constructivism and active learning theory, which believes that learning will be more effective if students actively develop their own knowledge. Numerous scientific studies have found that flipped learning can improve theoretical mastery, student participation, and learning outcomes compared to conventional methods. A meta-analysis of dozens of studies found that flipped classrooms have a significant positive impact on students' academic performance and learning experience (Naing et al., 2023). Furthermore, flipped learning has been shown to improve student attendance, active participation, and critical thinking skills, especially in complex and analytical courses (Md Zainuddin et al., 2024).

Generative AI Tools in Higher Education

The use of generative AI tools (Gen AI) in higher education has been shown to encourage independent learning, digital literacy, and student confidence in understanding difficult material. Recent research has found that the integration of AI-based technology can optimize student learning experiences and boost academic performance when used in a structured manner and supervised by lecturers (Yan et al., 2023). In quantitative courses such as statistics, Gen AI plays a crucial role in providing step-by-step explanations, relevant example problems, and data visualizations that help students understand abstract concepts (Rehan & Gek Mui, 2025). Gen AI itself is an artificial intelligence technology that can generate text, visuals, problems, and explanations tailored to user needs. In the learning context, Gen AI acts as a learning assistant, supporting personalized learning activities, simplifying complex concepts, and providing rapid feedback.

Integrating Flipped Learning and Generative AI in Classroom Management

Research by Liu et al., (2024) found that this integrative model can significantly encourage student emotional, cognitive, and behavioral engagement and consistently improve academic achievement. The integration of flipped learning with generative AI tools creates an adaptive, flexible, and student-centered learning ecosystem. Flipped learning provides the pedagogical structure, while Gen AI acts as a cognitive and technological support. This combination enables lecturers to organize classes more effectively by maximizing face-to-face time for deeper learning activities.

Conceptual Framework

The conceptual framework used in this research is depicted in Figure 1 below.

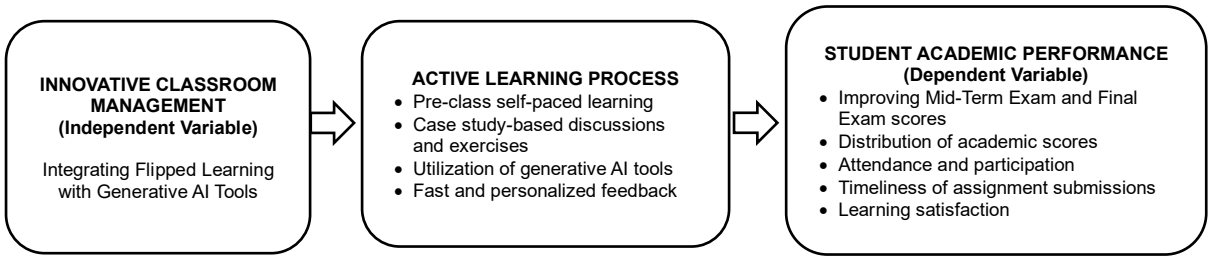


Figure 1. Conceptual Framework
Source: researcher's primary data

3. RESEARCH METHOD

This study used a quantitative approach with a quasi-experimental design in the form of a one-group pretest–posttest design. Quasi-experimental or quasi-experimental is an experimental study conducted on only one group called the experimental group without a comparison group or control group (Arikunto, 2019). The one-group pretest–posttest design is an experimental study conducted on only one group and does not conduct tests on the stability and clarity of the group's condition before the intervention. This design was chosen to measure the effectiveness of the implementation of classroom management based on the integration of the flipped learning method and the use of generative AI tools on improving student academic performance. Measurements were carried out by comparing student learning outcomes before and after the implementation of learning innovations, which were represented by mid-term exam scores as the initial condition and final exam scores as the final condition after the treatment. The quasi-experimental approach was deemed appropriate because the study was conducted in an established class without a control group, as is commonly used in learning innovation research in higher education (Naing et al., 2023).

The subjects of this study were 37 Class B Management Study Program students from the Class of 2024 at XYZ University who were taking the Inferential Statistics course in the Even Semester of the 2024/2025 Academic Year. The learning innovation was implemented over five meetings after the Midterm Exam, with learning stages encompassing pre-class, in-class, and post-class activities. In the pre-class phase, students studied the material independently through the Learning Management System (LMS) and utilized generative AI tools to deepen their understanding. The in-class phase focused on initial quizzes, interactive discussions, case study-based practice questions, and data analysis practices using SPSS. Furthermore, in the post-class phase, students completed group assignments and exercises to reinforce concepts. This pattern aligns with the principles of flipped learning, which emphasize active learning and the use of face-to-face time for high-level cognitive activities (Binoy, 2024).

Research data were collected through several techniques, namely learning outcome tests (mid-term and final exam scores), student attendance documentation, learning evaluation questionnaires in the Academic Information System (SIA), and observations of student engagement during the learning process. Data analysis was conducted using quantitative descriptive methods to observe changes in academic grades, the distribution of grades achieved, attendance rates, and the accuracy of assignment submissions, as well as qualitative descriptive methods to interpret student perceptions of learning effectiveness, satisfaction levels, and improvements in critical thinking skills and learning independence. This analytical approach is commonly used in studies of the effectiveness of flipped learning and the integration of learning technology, especially when the research objectives focus on the implementation and practical impacts in the classroom (Mengesha et al., 2024).

4. RESULTS AND DISCUSSION

Innovations Implemented

The innovations implemented in the Inferential Statistics course consist of two main innovations. The first innovation is an innovation in the learning method or strategy. This innovation adopts the flipped learning method, where students study the material independently before class sessions. This method maximizes face-to-face class time for discussion activities, practice problems, and case study-based problem-solving in groups. This approach increases student active participation in the learning process, enhances conceptual understanding, and supports the creation of a better literacy culture. The uniqueness of this method compared to traditional approaches is the flexibility in learning and increased interaction between students and lecturers in class.

The second innovation is the use of generative AI tools in learning. The use of generative AI tools allows lecturers to prepare teaching materials more efficiently, present them more interactively, and provide direct feedback to students. Generative AI tools help produce engaging yet meaningful presentations. Generative AI tools can also generate sample questions and answers and provide step-by-step guidance for solving statistical problems, although they still require review by the lecturer to ensure accuracy. With AI, students learn more independently and experience a more personalized and adaptive learning experience.

These two innovations directly support the learning outcomes of the course, such as improving basic mastery of Inferential Statistics, encouraging the internalization of academic values in data analysis, improving collaborative skills in groups, and facilitating the use of data processing tools such as SPSS with a more personalized approach.

Learning Innovation Implementation Process

Implementation was carried out in five (5) learning meetings as detailed in Table 1 below.

Table 1. Details of Implementation Stages

Meetings	Lecture Activities	References
1	**Preparation (Pre-Class):** The lecturer prepares the provisions for the use of Gen AI tools, prepares quizzes, prepares raw data for class dynamics, deepens the material to be presented, and creates a PPT with the topic Introduction to Parametric Statistics and Two-Sample Comparative Hypothesis Testing with the help of claude.ai, Quizizz, Custom GPT Consensus, DeepSeek, and Gamma. **Implementation (In-Class):** The lecturer briefly explained the terms and conditions for using Gen AI Tools. Next, the lecturer and students discussed and agreed on these terms. Afterward,	Fridayani, J.A. & Kusuma, S.E. (2023). *Statistika Inferensial untuk Organisasi dan Bisnis*. Yogyakarta: SDU Press. (Fridayani & Kusuma, 2023)

	students took a quiz on the material to assess their learning outcomes independently. The lecturer briefly discussed the quiz as immediate feedback and then presented an introduction to parametric statistics and two-sample comparative hypothesis testing. Next, the lecturer and students discussed and explored the material, including the manual application of statistical formulas related to two-sample comparative hypothesis testing and hands-on practice using SPSS. The lecturer and students continued the class interaction and dynamics by working on practice questions in the form of case studies. Students who successfully completed the exercises received appreciation. **Evaluation (Post-Class)**: The students work on practice questions prepared by the lecturer in groups of 4-5 people.	Rangkuti, A.A. (2017). *Statistika Inferensial untuk Psikologi dan Pendidikan.* Jakarta: Kencana. (Rangkuti, 2017) Sugiyono. (2014). *Statistika untuk Penelitian.* Bandung*:* Alfabeta. (Sugiyono, 2014)
2	**Preparation (Pre-Class):** Students independently study the material provided by the lecturer and enrich their understanding with the help of generative AI tools. The lecturer prepares quizzes, prepares raw data for class dynamics, deepens the material to be presented, and creates a PPT for Comparative Hypothesis Testing k Samples in Parametric Statistics, specifically related to the One-Way ANOVA Test with the help of claude.ai, Quizizz, Custom GPT Consensus, DeepSeek, and Gamma. **Implementation (In-Class):** Students take a quiz on the material to be covered to independently assess their learning outcomes. The lecturer briefly discusses the quiz as immediate feedback and then provides an explanation of Comparative Hypothesis Testing with k Samples in Parametric Statistics, specifically related to the One-Way ANOVA Test. Next, the lecturer and students discuss and explore the material, including the application of statistical formulas related to Comparative Hypothesis Testing with k Samples in Parametric Statistics, specifically related to the One-Way ANOVA Test, manually and through direct practice using the SPSS application. The lecturer and students continue the interaction and class dynamics by working on practice questions in the form of case studies. Students who successfully complete the exercises will receive appreciation.	Salafudin, H. & Dewi, H.L. (2022). *Statistika Inferensial untuk Penelitian dan Pengembangan Pendidikan.* Jakarta: Kencana. (Salafudin & Dewi, 2022) Relevant internet sources

	Evaluation (Post-Class): The students work on practice questions prepared by the lecturer in groups of 4-5 people.
3	**Preparation (Pre-Class):** Students independently study the material provided by the lecturer and enrich their understanding with the help of generative AI tools. The lecturer prepares quizzes, prepares raw data for class dynamics, deepens the material to be presented, and creates a PPT for Comparative Hypothesis Testing k Samples in Parametric Statistics, specifically related to the Two-Way ANOVA Test with the help of claude.ai, Quizizz, Custom GPT Consensus, DeepSeek, and Gamma. **Implementation (In-Class):** Students take a quiz on the material to be covered to independently assess their learning outcomes. The lecturer briefly discusses the quiz as immediate feedback and then provides a presentation on Comparative Hypothesis Testing k Samples in Parametric Statistics, specifically related to the Two-Way ANOVA Test. Next, the lecturer and students discuss and explore the material, including the application of statistical formulas related to nonparametric statistics and descriptive hypothesis testing tools manually and through direct practice using the SPSS application. The lecturer and students continue the interaction and class dynamics by working on practice questions in the form of case studies. Students who successfully complete the exercises will receive appreciation. **Evaluation (Post-Class)**: The students work on practice questions prepared by the lecturer in groups of 4-5 people.
4	**Preparation (Pre-Class):** Students independently study the material provided by the lecturer and enrich their understanding with the help of generative AI tools. The lecturer prepares quizzes, prepares raw data for classroom dynamics, deepens the material to be presented, and creates a PPT on Correlation Hypothesis Testing in Parametric Statistics with the help of claude.ai, Quizizz, Custom GPT Consensus, DeepSeek, and Gamma. **Implementation (In-Class):** Students take a quiz on the material to assess their learning outcomes

	independently. The instructor briefly discusses the quiz as immediate feedback and then provides a presentation on Correlation Hypothesis Testing in Parametric Statistics. Next, the instructor and students discuss and explore the material, including the application of statistical formulas related to Correlation Hypothesis Testing in Parametric Statistics, both manually and through hands-on practice using SPSS. The instructor and students continue the classroom interaction and dynamics by working on practice questions in the form of case studies. Students who successfully complete the exercises will receive a reward. **Evaluation (Post-Class)**: The students work on practice questions prepared by the lecturer in groups of 4-5 people.
5	**Preparation (Pre-Class):** Students independently study the material provided by the lecturer and enrich their understanding with the help of generative AI tools. The lecturer prepares quizzes, prepares raw data for classroom dynamics, deepens the material to be presented, and creates PPTs on Data Instrument Testing, Classical Assumption Testing, and Multiple Linear Regression Analysis with the help of claude.ai, Quizizz, Custom GPT Consensus, DeepSeek, and Gamma. **Implementation (In-Class):** Students take a quiz on the material to assess their learning outcomes independently. The instructor briefly discusses the quiz as immediate feedback and then provides a presentation on Data Instrument Testing, Classical Assumption Testing, and Multiple Linear Regression Analysis. Next, the instructor and students discuss and explore the material, including the application of statistical formulas related to Data Instrument Testing, Classical Assumption Testing, and Multiple Linear Regression Analysis, both manually and through hands-on practice using SPSS. The instructor and students continue the classroom interaction and dynamics by working on practice questions in the form of case studies. Students who successfully complete the exercises will receive a reward.

	Evaluation (Post-Class): The students work on practice questions prepared by the lecturer in groups of 4-5 people.

Source: researcher's primary data

Impact of Innovation

1. Quantitative Achievements

The implementation of this learning innovation shows positive results in various aspects:

a. Student Understanding

1) The average course grade increased from 63.73 (mid-term exam) to 80.05 (final exam) as seen in Table 2 below. This improvement demonstrates that the flipped learning method, integrated with generative AI tools, can significantly impact students' level of understanding in the Statistics course.

Table 2. Average Mid-Term and Final Exam Scores

	Mid-term Exam	Final Exam
Average	63.73	80.05

Source: researcher's primary data

2) The percentage of students who received grades A, A-, B+, B, and B- increased from 21.60% (mid-term exam) to 100% (final exam) as seen in Table 3 and Table 4 below. This improvement also demonstrates that the flipped learning method, when integrated with generative AI tools, can have a significant impact on students' level of understanding.

Table 3. Obtaining Grades A, A-, B+, B, and B- in the Mid-Term Exam

Grades	Quantity	Percentage
A	2	5.40%
A-	1	2.70%
B+	3	8.10%
B	1	2.70%
B-	1	2.70%
Total	**8**	**21.60%**

Source: researcher's primary data

Table 4. Obtaining Grades A, A-, B+, B, and B- on the Final Exam

Grades	Quantity	Percentage
A	9	24.32%
A-	12	32.43%
B+	16	43.25%
B	0	0%
B-	0	0%
Total	**37**	**100%**

Source: researcher's primary data

b. Student Participation

1) The attendance rate reached 84.32% as shown in Table 5 below. This indicates that the flipped learning method, when integrated with generative AI tools, is interactive, thereby enhancing student participation.

Table 5. Student Attendance Rate

Meetings	Total Attendance	Total Absences	Maximum Attendance	Attendance Percentage
1	33	4	37	89.19%
2	32	5	37	86.49%
3	30	7	37	81.08%
4	30	7	37	81.08%
5	31	6	37	83.78%
Total	**156**	**29**	**185**	**84.32%**

Source: researcher's primary data

2) Timeliness of assignment collection reaches 100%. This also demonstrates that the flipped learning method, when integrated with generative AI tools, can enhance students' learning motivation, thereby prompting them to fulfill their obligations on time.

c. Flexibility and Interactivity of Learning

Data collection to measure this aspect was conducted using a Google Form questionnaire using a Likert scale. A score of 1 indicates "strongly disagree", while a score of 5 indicates "strongly agree".

1) As many as 48.6% of students agree and 24.3% strongly agree with the statement “The lecturer's presentation media (PPT) produced with the help of Generative AI tools makes presentations interesting and meaningful”. This underscores the vital role of generative AI tools in creating learning materials that are more engaging than standard PowerPoint presentations.

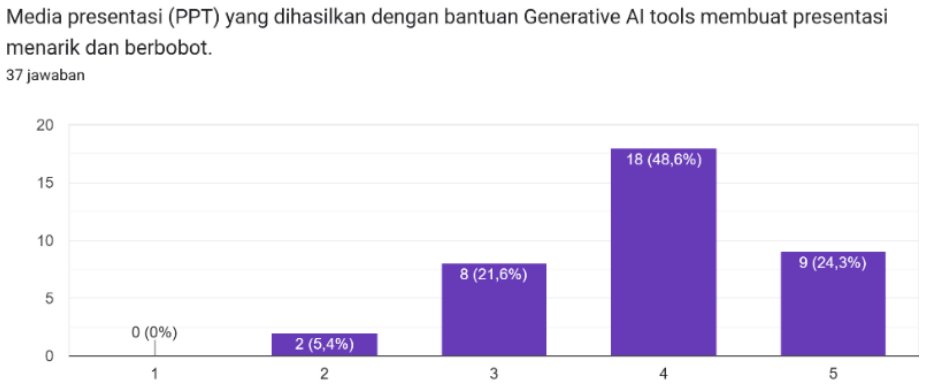


Figure 2. Assessment of PPT

Source: researcher’s primary data

2) As many as 45.9% of students agree and 43.2% strongly agree with the statement “The material presented by the lecturer is comprehensive so that it deepens insight”. This underscores the vital role of generative AI tools in enriching the materials prepared by lecturers. However, it is important to note that the lecturer's role remains essential in determining which materials are relevant for students.

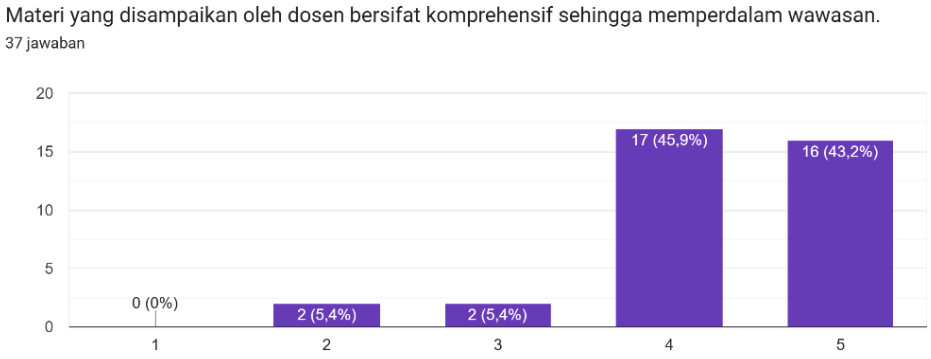


Figure 3. Assessment of learning materials

Source: researcher’s primary data

3) As many as 37.8% of students agreed and 51.4% strongly agree with the statement “The examples and practice questions given in class have clear instructions so they can be understood.” This confirms that the time allocated for students to prepare before class proves effective in making it easier for them to understand classroom instructions.

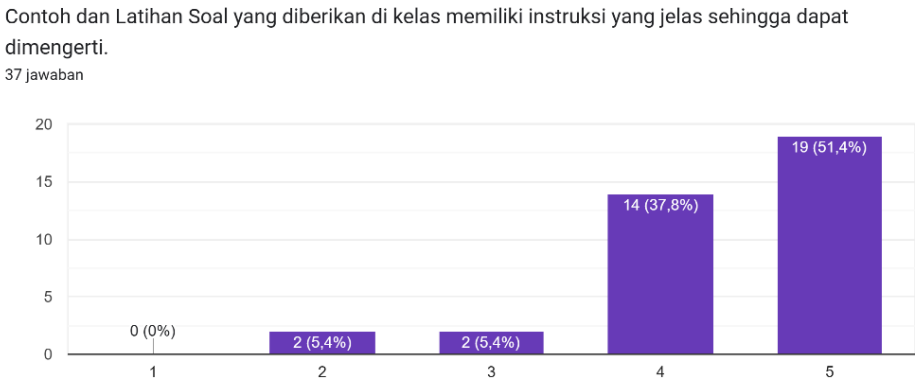


Figure 4. Assessment of examples and practice questions

Source: researcher’s primary data

4) As many as 32.4% of students agreed and 59.5% of students strongly agreed with the statement “Completing practice questions is supported by step-by-step guidance until a solution to the statistical problem is produced”. This confirms that the time allocated for students to prepare before class effectively facilitates their understanding of the step-by-step guidelines leading to the resolution of statistical problems.

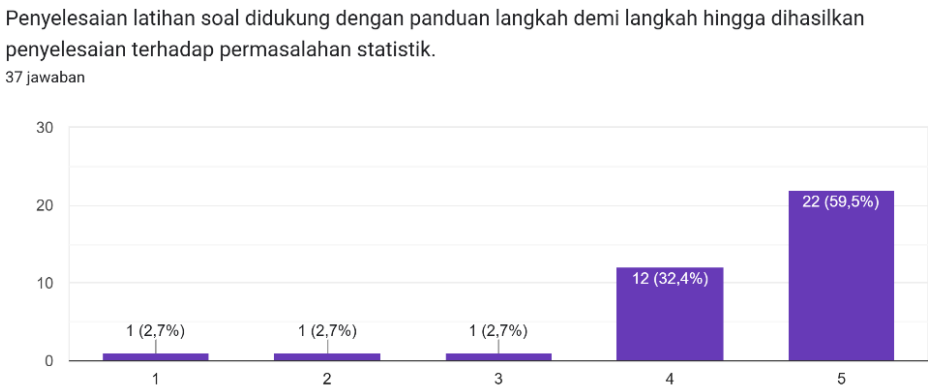


Figure 5. Assessment of the process of solving practice questions

Source: researcher’s primary data

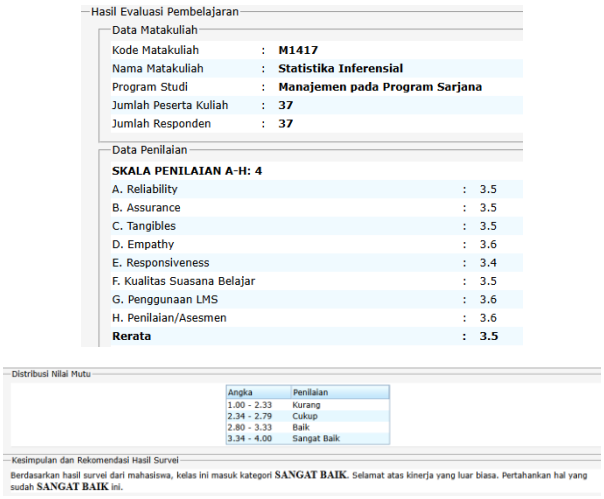
5) As many as 43.2% of students agreed and 32.4% strongly agreed with the statement “Generative AI tools help them to learn more independently and get a more personalized and adaptive learning experience”. This clearly demonstrates that the use of generative AI tools during pre-class preparation helps students gain a more comprehensive understanding of the material they are studying.

Figure 6. Assessment of the effectiveness of Gen AI Tools

Source: researcher’s primary data

2. Qualitative Achievements

a. Students reported being more motivated to learn using the flipped classroom method. They felt more confident in dealing with statistics material because they were allowed to utilize Gen AI tools and demonstrated high enthusiasm in discussions and exercises in class. This was also supported by the average learning evaluation score in the Academic Information System (SIA), which showed an achievement of 3.5 on a scale of 4 (very good).


Hasil Evaluasi Pembelajaran

Data Matakuliah

Kode Matakuliah	:	**M1417**
Nama Matakuliah	:	**Statistika Inferensial**
Program Studi	:	**Manajemen pada Program Sarjana**
Jumlah Peserta Kuliah	:	**37**
Jumlah Responden	:	**37**

Data Penilaian

SKALA PENILAIAN A-H: 4		
A. Reliability	:	3.5
B. Assurance	:	3.5
C. Tangibles	:	3.5
D. Empathy	:	3.6
E. Responsiveness	:	3.4
F. Kualitas Suasana Belajar	:	3.5
G. Penggunaan LMS	:	3.6
H. Penilaian/Asesmen	:	3.6
Rerata	:	**3.5**

Distribusi Nilai Mutu

Angka	Penilaian
1.00 - 2.33	Kurang
2.34 - 2.79	Cukup
2.80 - 3.33	Baik
3.34 - 4.00	Sangat Baik

Kesimpulan dan Rekomendasi Hasil Survei

Berdasarkan hasil survei dari mahasiswa, kelas ini masuk kategori **SANGAT BAIK**. Selamat atas kinerja yang luar biasa. Pertahankan hal yang sudah **SANGAT BAIK** ini.

Figure 7. Average score of learning evaluation in SIA

Source: researcher’s primary data

b. Students demonstrated significant improvements in critical thinking, collaboration, and digital literacy skills. Their ability to analyze data and interpret statistical results also improved. This was demonstrated by the satisfactory results of their data analysis project.

Figure 8. Working on practice questions in class

Source: researcher's primary data

c. Students do not memorize formulas, but understand the practical application of statistical concepts in business and management research. This is evident in the quality of their final projects, which demonstrate adequate data analysis.

3. Supporting Evidence

a. Summary of Learning Evaluation Assessment in SIA:

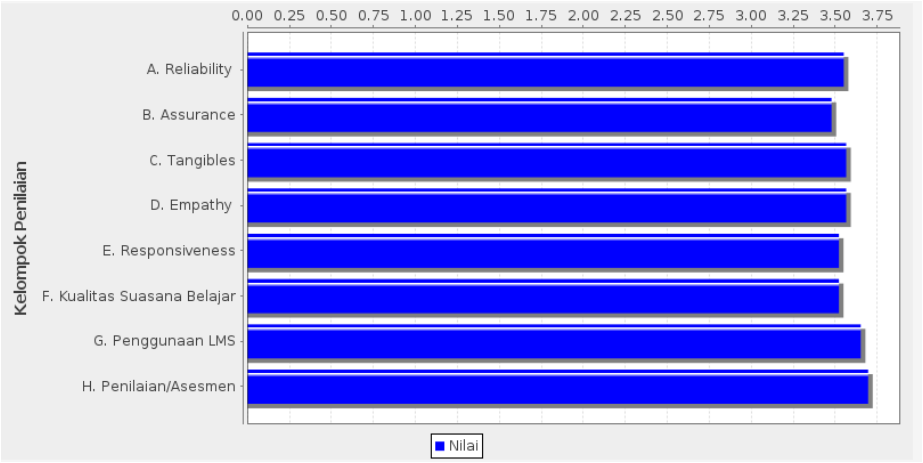


Figure 9. Summary of learning evaluation assessment in SIA

Source: researcher's primary data

b. Screenshot of online quiz results shows high participation rate.

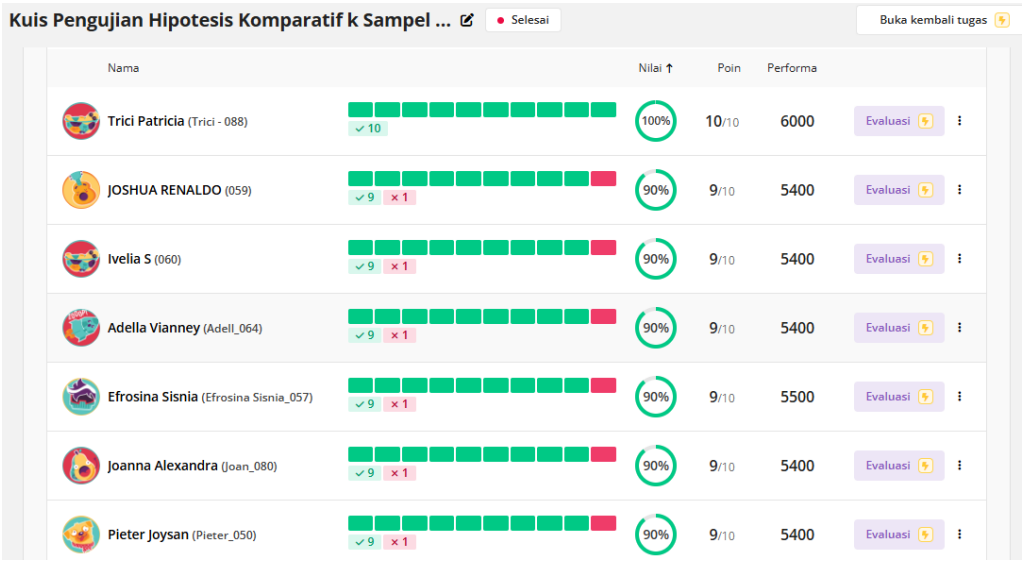


Figure 10. Screenshot of online quiz results

Source: researcher's primary data

c. Screenshot of the lecturer's material creation prompt.

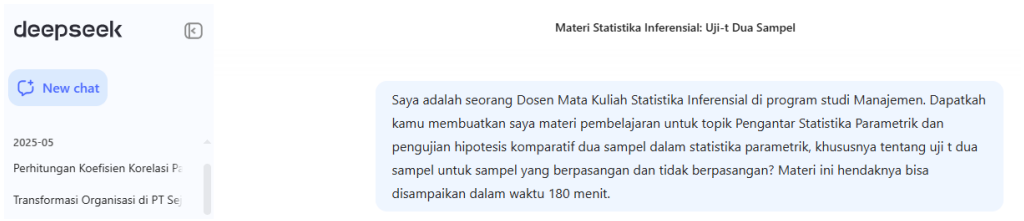


Figure 11. Example prompt in DeepSeek to help create materials

Source: researcher's primary data

d. Screenshot of the lecturer's quiz creation prompt.

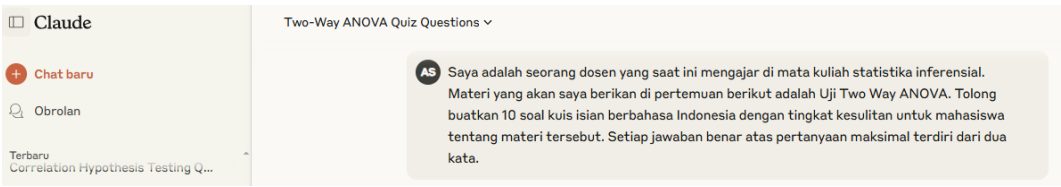


Figure 12. Example prompt in Claude.ai to help create a quiz

Source: researcher's primary data

e. Screenshot of the completeness of learning materials in the LMS from pre-class to post-class.

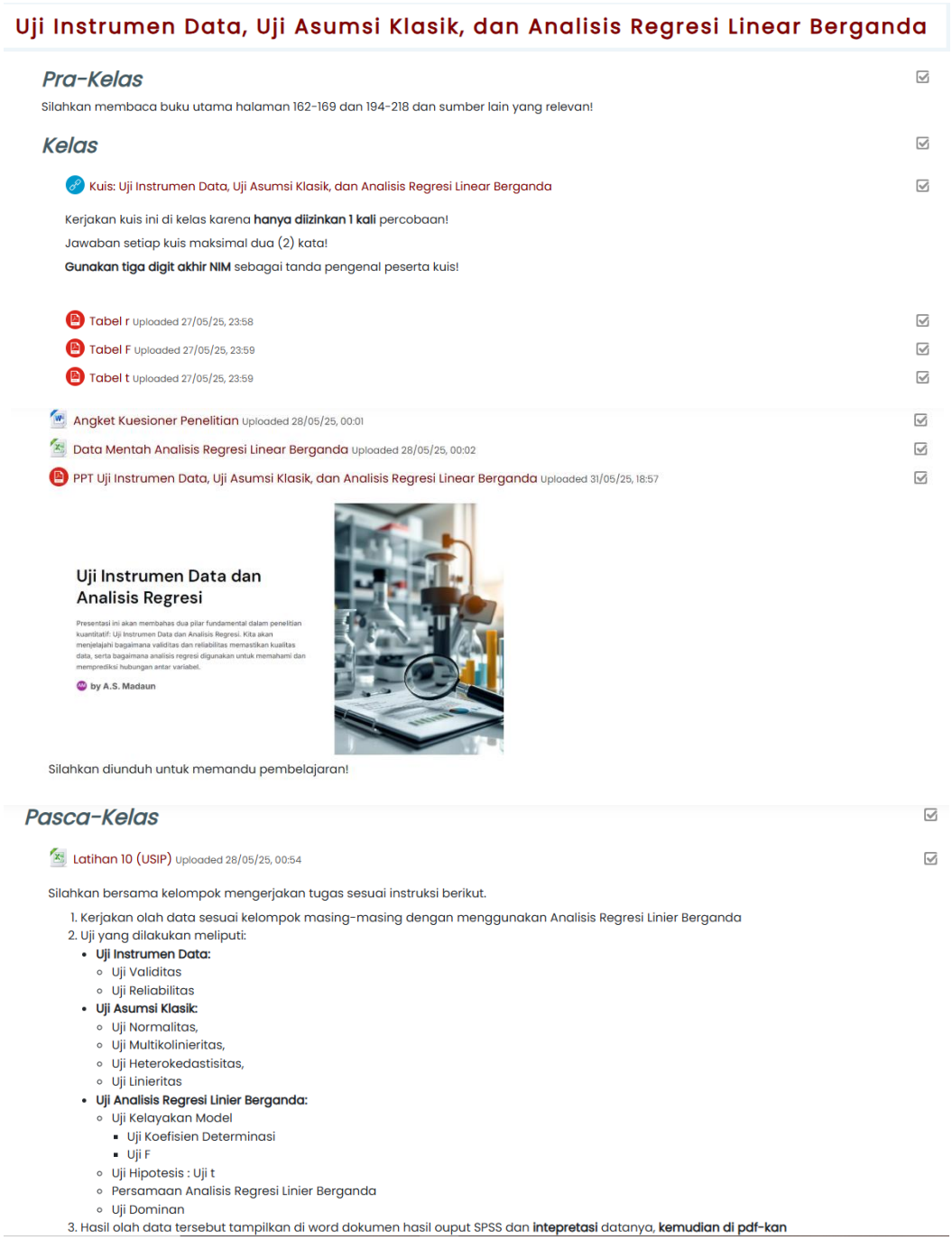


Figure 13. Screenshot of teaching materials in LMS

Source: researcher's primary data

5. CONCLUSION

The implementation of the integration of flipped learning methods and generative AI tools in the Inferential Statistics course has proven to be successful in significantly improving the quality of learning. The average exam score increased from 63.73 (mid-term exam) to 80.05 (final exam). The percentage of students receiving A, A-, B+, B, and B- increased from 21.60% (mid-term exam) to 100% (final exam). The attendance rate reached 84.32% and the student satisfaction level reached 3.5/4.0 demonstrating the effectiveness of this innovation. Students not only mastered theoretical concepts but were also able to apply them in practical contexts through the use of SPSS and real-world data analysis. The learning flexibility provided through the support of AI tools allows each student to learn according to their own abilities and pace.

The successful implementation of this learning innovation opens new horizons for more comprehensive development. The next step involves deeper integration through the development of a custom AI assistant specifically for the Inferential Statistics course. This is made possible with Custom ChatGPT Pro, where verified materials are entered into a database and will help users find answers to questions about Inferential Statistics. More varied gamification will also be added to increase student engagement in the learning process. Expansion to other quantitative courses is the next priority, involving collaboration between lecturers to develop best practices and provide mutual input on learning materials and their dynamics. This innovation demonstrates that the integration of AI technology with the right approach can have a transformative impact on the quality of education in higher education.

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