
Lexicon-Based Approach for Sentiment Analysis of Technology Students in the City of Tegal toward AI Adoption in Learning

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Abstract

This study aims to analyze the sentiment of technology students in Tegal City toward the adoption of Artificial Intelligence (AI) in learning. The explicit novelty of this research lies in its empirical focus on a localized tech-cluster student cohort within a regional urban area (Tegal City) who display uniquely high frequencies of digital-tool interaction, coupled with a specialized lexicon-based computational framework optimized for Indonesian academic linguistics. The research employs a descriptive quantitative approach combined with text mining techniques. Data were collected through an online survey involving 158 respondents using a questionnaire consisting of closed and open-ended questions. Sentiment analysis was conducted using a lexicon-based method to classify opinions into positive, neutral, and negative categories. The results indicate that students' experiences with AI are dominated by positive sentiment (56.96%), reflecting its benefits in improving efficiency and understanding of learning materials. However, in terms of future expectations, there is an increase in neutral (44.94%) and negative (8.86%) sentiments, indicating a more critical perspective. The main concerns include overdependence on AI and the accuracy of AI-generated information. This study concludes that AI has significant potential to support learning, but its use should be balanced with the development of critical thinking skills and the improvement of reliable and accurate AI systems.

1. Introduction

The development of Artificial Intelligence (AI) technology has brought significant changes across various aspects of life, including the education sector. The presence of AI offers numerous conveniences, such as process automation and personalized learning, which ultimately contribute to improving the effectiveness and efficiency of the learning process [1]. In addition, AI has now been widely applied in various sectors, such as healthcare, marketing, and education, including in the development of AI-based learning media. Sentiment analysis has emerged as a powerful tool to capture public attitudes toward technology in real time, leveraging data from digital platforms and online content[2].

One of the rapidly advancing forms of AI today is Generative Artificial Intelligence (Gen-AI), which introduces various innovations in content creation and learning support. This technology enables the automatic, interactive, and adaptive generation of teaching materials tailored to students' needs, thereby having the potential to enhance the quality of the learning process more optimally [3].

In the context of education in Indonesia, AI technology holds great potential to support adaptive learning that is customized to the individual needs of students, thereby improving both understanding and learning motivation [4]. Furthermore, the use of AI allows students to access information more quickly and easily, supporting a more flexible and independent learning process[5].

The implementation of AI in education has demonstrated a significant impact on improving the quality of learning [6]. On the other hand, the utilization of AI also contributes to increasing efficiency and productivity within the educational environment [7].

However, the application of this technology also raises various dilemmas, particularly related to ethics[8] and bias, technological dependency, and the readiness of educational stakeholders. Therefore, collaboration among various parties is necessary to ensure that the use of AI, especially generative AI, can be optimized wisely in supporting the learning process[9].

Although numerous studies have examined the use of Artificial Intelligence in education, most have focused on the implementation and benefits of the technology. While common text mining approaches rely on complex machine learning (e.g., Naïve Bayes, SVM) or deep transformer architectures (e.g., BERT) which command intensive training data and immense hardware processing, this study deliberately leverages a lexicon-based method. This choice guarantees structural rule transparency, eliminates computational bottlenecks related to model training, and yields highly interpretable classification boundaries for small-to-medium specialized survey texts in a regional academic environment. Consequently, studies that specifically analyze students' sentiment toward the adoption of AI in learning remain limited, particularly in local contexts such as the City of Tegal.

Previous research has explored sentiment analysis regarding the use of Artificial Intelligence in education by utilizing data from social media. For example, a study conducted by [10] analyzed public opinion on the X platform using the Naïve Bayes method. The results showed that the majority of public sentiment tends to be positive toward the use of AI in education. However, the study focused on general public opinion and did not specifically examine students' perceptions as direct users of AI technology in the learning context, particularly within a local scope such as the City of Tegal.

2. Research Method

The rapid advancement of digitalization in education, marked by the emergence of Artificial Intelligence (AI) applications based on big data and Natural Language Processing (NLP), has fundamentally transformed learning dynamics at the global level [11]. This transformation not only affects how learning materials are delivered but also opens new opportunities for developing more adaptive and data-driven learning methods.

Along with the increasing use of AI in education, various data analysis approaches have also evolved significantly. One of these is computational text analysis, which enables the systematic processing of large volumes of qualitative data. The growing volume of digital text data, combined with advancements in algorithms for understanding semantic structures, has encouraged a closer integration between qualitative and quantitative approaches [12]. In this context, text mining has become an effective method for extracting meaningful information from unstructured text data [13]

On the other hand, quantitative research remains a primary approach for measuring phenomena objectively and systematically. Descriptive quantitative methods, for example, are used to describe the characteristics of a population based on collected data [14]. In general, quantitative research designs include various types, such as descriptive, correlational, comparative, survey-based, pre-experimental, experimental, and quasi-experimental approaches [15]. In practice, data collection is often conducted through survey methods using questionnaires as the main instrument, which require validity and reliability to ensure accurate and accountable results[16].

Based on these developments, this study adopts a descriptive quantitative approach combined with text mining techniques to analyze students' perceptions of AI usage in learning. This approach is chosen to provide a comprehensive perspective, encompassing both quantitative and qualitative aspects, thereby enabling a deeper understanding of the phenomenon under investigation. All data processing and analysis in this study were conducted using the Python programming language with the support of the Google Colab platform.

2.1 Population and Sample

The research data were collected through an online survey involving 158 student respondents from various study programs within the technology field in the City of Tegal. In terms of granular distribution across academic majors, the sample is strictly stratified into Information Technology at 33.6% (53 respondents), Information Systems at 26.2% (41 respondents), Accounting Information Systems at 18.9% (30 respondents), and auxiliary technical disciplines at 21.3% (34 respondents).

2.2 Research Instrument

The research instrument used was a questionnaire consisting of two main parts:

- a. Quantitative Section, which employed a five-point Likert scale: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. This section was designed to measure students' perceptions of several aspects, such as productivity, learning independence, and concerns regarding the impact of AI usage. Within educational survey frameworks, the Likert scale operates as a fundamental psychometric tool engineered to transform qualitative human subjectivity, attitudes, and distinct behavioral attributes into an objective, quantifiable reality through structured and validated metric choices [17]

Table 1. Construction of the Quantitative Instrument Using a Likert Scale

No	Variable/Aspect	Instrument Statement
1	Productivity & efficiency	AI helps me understand learning material more quickly AI improves my learning productivity
2	Learning independence	AI make me more independent in learning I will continue to use AI in the learning process
3	Psychological aspect	I feel comfortable using AI in learning
4	Concerns & impact	AI makes me less critical in thinking I am concerned about the negative impact of AI AI may replace the role of lecturers in the future

- b. Qualitative Section, consisting of open-ended (essay) questions aimed at exploring respondents' subjective experiences in greater depth. This section captures students' experiences, perceived benefits, concerns, and expectations regarding the use of AI in the learning process.

Table 2. Open-Ended Questionnaire Instrument

No	Open-ended Question	Information Objective
1	Describe your experience using AI in learning	To explore actual usage and the context of students interaction with AI tools
2	What is the greatest benefit of AI in your learning process?	To identify the specific benefits perceived by students
3	What concerns or limitations of AI in learning do you perceive?	To examine potential challenges, ethical risks, and technical limitations from the users perspective
4	What are your expectations for the future use of AI in education?	To capture students projections regarding technological development and regulatory support

2.3 Data Analysis Technique

The qualitative data obtained from open-ended responses were analyzed using the Lexicon-Based Sentiment Analysis method. The lexicon dictionary used was a base Indonesian sentiment corpus that was manually customized for the higher education domain by injecting specialized semantic polar weights; academic enablement tokens like 'membantu' (helpful) and 'mudah' (easy) were encoded with a positive weight (+1), whereas academic-risk markers such as 'ketergantungan' (dependency) and 'halusinasi' (hallucination) were explicitly mapped with a negative weight (-1). This method was employed to classify respondents' opinions into positive, negative, and neutral sentiment categories based on a relevant lexicon dictionary [18]. To ensure classification integrity, a rigorous validation procedure was executed on a randomly selected subset of 79 data samples, representing exactly 50% of the total dataset, for manual validation. The manual labeling process was performed independently by two domain experts: a lecturer in Indonesian Language Linguistics and a lecturer in Information Technology. The degree of alignment between the automated lexicon outputs and the expert annotators was measured using the Percentage Agreement metric, calculated via the following equation:

$$P_A = \left(\frac{Ac}{Ac+Dc} \right) \times 100\%$$

$$= \left(\frac{69}{69+10} \right) \times 100\%$$

Where PA is the percentage agreement, Ac represents the total number of concordant or agreed-upon cases between the automated system and the experts, and Dc denotes the total number of discordant cases. This evaluation yielded a final manual verification accuracy and inter-rater agreement score of 87.3%.

The data analysis process was carried out through several stages as follows:

a. Preprocessing

The preprocessing stage aims to clean and prepare text data for further analysis. This process includes removing special characters and numbers, as well as converting all text into lowercase (case folding). Within computational text linguistics, text preprocessing operates as a critical pipeline that structures raw conversational artifacts into formalized semantic tokens through sequential steps of case folding, tokenizing, filtering (stopword removal), and morphological root stemming to reduce data dimensionality and maximize classification thresholds[19].

Table 3. Preprocessing Results

Ceritakan pengalaman Anda menggunakan AI dalam pembelajaran	Clean_Pengalaman	Bagaimana harapan Anda terhadap penggunaan AI di dunia pendidikan ke depan?	Clean_Harapan
Bikin cepat mengerjakan tugas	bikin cepat mengerjakan tugas	Membantu manusia dalam pekerjaan	membantu manusia pekerjaan
Ai sangatlah membantu untuk mengerjakan tugas	ai sangatlah membantu mengerjakan tugas	Lebih luas lagi untuk mencari informasi	lebih luas lagi mencari informasi
lebih memudahkan mengelola/mencari data	lebih memudahkan mengelola mencari data	harapan saya agar bisa lebih kritis lagi penggunaan ai agar tidak di salah gunakan	harapan agar lebih kritis lagi penggunaan ai agar salah gunakan
pengalaman saya saat tidak menegerti atau jelas yang di jelasin dosen/guru lalu saya mencoba mencari pengertian dari ai	pengalaman menegerti jelas jelasin dosen guru lalu mencoba mencari	pembelajaran yang lebih efisien	pembelajaran lebih efisien

Ceritakan pengalaman Anda menggunakan AI dalam pembelajaran	Clean_Pengalaman	Bagaimana harapan Anda terhadap penggunaan AI di dunia pendidikan ke depan?	Clean_Harapan
paling ai cuma buat bantu memahami materi aja si pake bahasa yang lebih saya pahami	pengertian dari ai paling ai cuma buat bantu memahami materi aja si pake bahasa lebih pahami	lebih di kembangkan tapi jangan di kembangkan banget krna nnti mahasiswa ga berpikir kritis gitu apalagi sampe ketergantungan beuh ga jadi Indonesia emas 2045	lebih kembangkan tapi jangan kembangkan banget krna nnti mahasiswa ga berpikir kritis gitu apalagi sampe ketergantungan beuh ga jadi Indonesia emas

b. Tokenization and Filtering

At this stage, the text is divided into individual word units (tokenization). This is followed by a filtering process, also known as stopword removal, which eliminates words that do not carry significant meaning, leaving only the important words relevant to the analysis.

c. Sentiment Scoring

Each text data is then analyzed to determine its sentiment category, namely positive, negative, or neutral. This process is carried out using a lexicon-based approach, which utilizes a dictionary containing a list of words along with their associated weights or polarity values. Each word in the text is matched with the dictionary, and the frequency of word occurrence is used as the basis for determining the overall sentiment tendency within the academic context [20].

Table 4. Lexicon-Based sentiment labeling

Clean_Pengalaman	Sentimen_Pengalaman	Clean_Harapan	Sentimen_Harapan
bikin cepat mengerjakan tugas	Positif	membantu manusia pekerjaan	Positif
ai sangatlah membantu mengerjakan tugas	Positif	lebih luas lagi mencari informasi	Netral
lebih memudahkan mengelola mencari data	Positif	harapan agar lebih kritis lagi penggunaan ai agar salah gunakan	Negatif
pengalaman mengerti jelas	Netral	pembelajaran lebih efisien	Positif
jelasin dosen guru lalu mencoba mencari pengertian dari ai			
paling ai cuma buat bantu memahami materi aja si pake bahasa lebih pahami	Netral	lebih kembangkan tapi jangan kembangkan banget krna nnti mahasiswa ga berpikir kritis gitu apalagi sampe ketergantungan beuh ga jadi Indonesia emas	Negatif
cukup membantu sedang mager mengetik	Positif	berkolaborasi	Netral
perfect tergantung pengguna nya menggunakan ai	Netral	bagus jangan salah gunakan	Netral

Clean_Pengalaman	Sentimen_Pengalaman	Clean_Harapan	Sentimen_Harapan
menggunakan ai kebutuhan coding seperti membenarkan mana error	Netral	lebih perhatikan lagi agar salah penggunaan	Negatif
tentunya sangat membantu pekerjaan sehingga dapat ringan luar biasa	Positif	kurang kurangi langsung copy paste jawaban kalian harus mengerikan konsepnya dulu	Negatif
	Netral	lebih user pengguna lebih bijak lagi menggunakan ai jangan tergantungan	Netral

d. Data Visualization

The results of the analysis were then visualized using a WordCloud to identify dominant words that reflect students' perceptions of the use of AI in learning. Text visualization can be presented in various forms, such as graphs, word trees, or text clouds, which enhance the audience's ability to understand information more effectively [21].



Figure 1. Visualization of Data from the Analysis of Students' Expectations

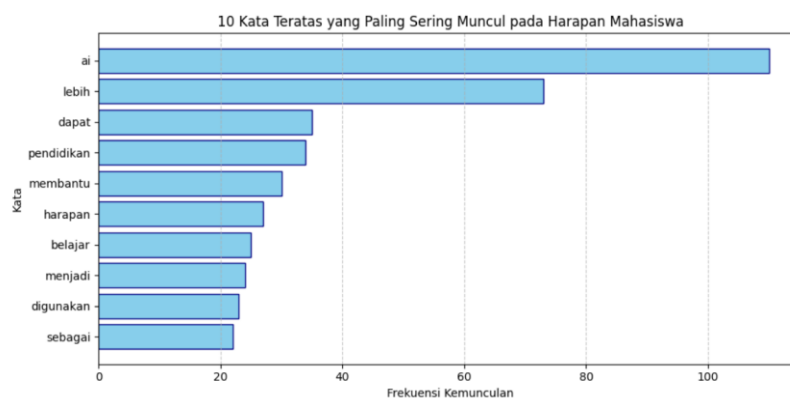


Figure 2. visualization of the top 10 words on student expectations

Figure 2 presents the empirical visualization of the top 10 most frequently occurring words in students' future expectations, providing an interpretative narrative that explains the underlying factors behind the sentiment distribution shown in Table 6. The absolute dominance of the terms "ai" (110 occurrences), and "lebih" (73 occurrences), underscores a collective recognition of the technology's core operational capabilities. However, the high frequencies of the keywords "pendidikan" (34), "membantu" (30), and "harapan" (27) demonstrate that students strongly expect AI to remain an adaptive, supportive mechanism rather than an autonomous replacement for human instruction. Crucially, the occurrence of terms such as "dapat" (35), "menjadi" (24), and

"digunakan" (23) directly mirrors the substantial rise in neutral sentiment (44.94%) and negative expectations (8.86%) identified in Table 6. These specific terms are heavily embedded within complex context structures where students condition their future acceptance on regulatory frameworks, stressing that AI "must be used" with high ethical boundaries. This structural distribution reveals that tech-cluster cohorts in the City of Tegal maintain a highly reflective perspective; their positive expectations are bounded by strict prerequisites for technological balance, data accuracy, and the preservation of academic integrity.

2.4 Validation Procedure

To ensure sentiment accuracy, manual checking (manual labeling) was conducted on a portion of the data samples to verify whether the automatic classification performed by the system was consistent with the context of the sentences provided by the students, as explained in section 2.3.

3. Result and Discussions

3.1 Respondent Characteristics

This study involved 158 respondents, the majority of whom were from technology-related study programs in the City of Tegal. Based on the demographic data obtained, all respondents were active students with direct engagement in the use of technology within the learning process.

The results indicate that all respondents (100%) have used Artificial Intelligence (AI) technology in their learning activities. This suggests that the level of AI adoption among technology students is very high. The most commonly used AI tool is ChatGPT, with a percentage of 89.2%, followed by Google Gemini at 77.8%. These findings indicate that Generative AI-based platforms are the primary choice for students in supporting their academic activities.

The dominance of ChatGPT and Google Gemini usage reflects students' tendency to utilize AI technologies that are interactive and capable of providing rapid responses to information needs. This also shows that students are becoming increasingly accustomed to using AI as a supporting tool for understanding learning materials, completing assignments, and seeking academic references.

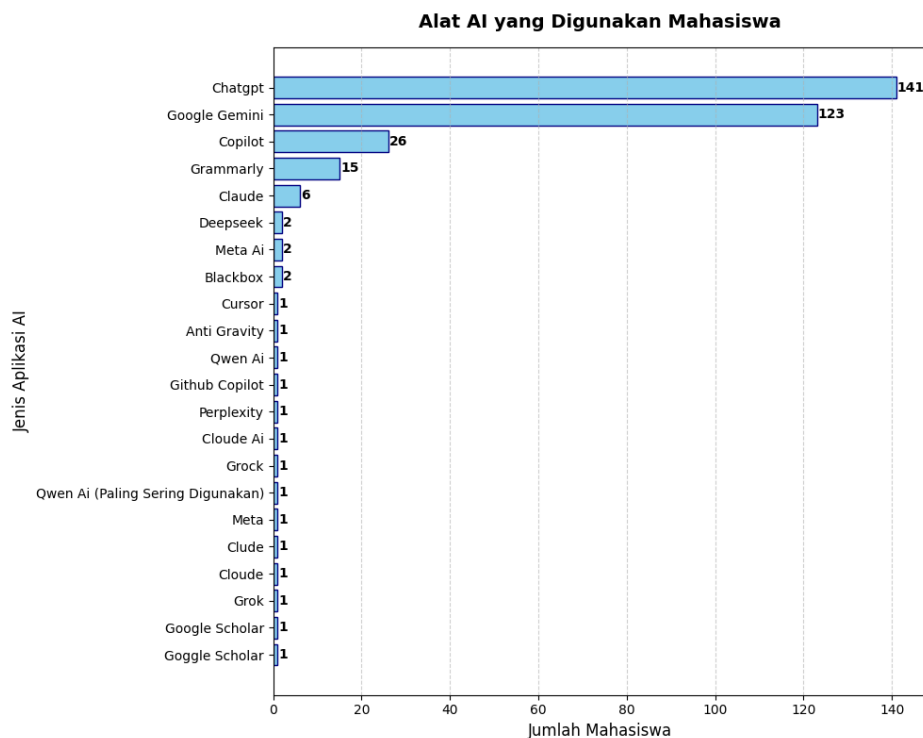


Figure 3. Trend of AI usage among students

3.2 Sentiment Analysis of AI Usage Experience

Based on the results of data processing using the lexicon-based sentiment analysis technique on students' experiences in using Artificial Intelligence (AI), a sentiment distribution was obtained as presented in Table 5.

Table 5. Sentiment Distribution of Students' Experiences

Sentimen	Responden	Persentase (%)
Positif	90	56.96 %
Netral	61	38.61 %
Negatif	7	4.43 %
Total	158	100 %

Based on Table 5, the analysis results indicate that positive sentiment dominates, accounting for 56.96% or a total of 90 respondents. This suggests that the majority of students have a favorable perception of the use of AI in learning. This dense positivity exposes a prominent behavioral tendency among tech-cluster students who act as utilitarian early adopters, aggressively utilizing AI for rapid cognitive offloading to minimize assignment turnaround times. However, using generative platforms to bypass technical and programming hurdles introduces severe academic ethics challenges. Over-reliance on automated code generation or essay synthesizers risks promoting unearned performance metrics, fostering hidden plagiarism, and weakening fundamental computational logic, as automated outputs substitute for deep human cognitive engagement.

In addition, neutral sentiment accounts for 38.61%, indicating that a number of students view the use of AI in an objective and contextual manner. This group tends to use AI as a supplementary tool without showing a strong inclination toward either positive or negative attitudes.

Meanwhile, negative sentiment is only 4.43%, indicating that only a small proportion of students have concerns regarding the use of AI. These negative sentiments are generally related to the potential for technological dependency, a decrease in critical thinking skills, and doubts about the accuracy of information generated by AI.

Overall, these findings suggest that the use of AI in learning has been well accepted by students, although there are still some concerns that need to be addressed in the implementation of this technology within educational environments.



Figure 4. Data visualization from the analysis of students experiences

The data presented in Table 5 indicate that the majority of students have positive experiences in using Artificial Intelligence (AI) in the learning process. This finding is supported by the WordCloud visualization, which shows the dominance of keywords such as “learning,” “assignments,” “materials,” and “understanding.” These words reflect that students’ use of AI is primarily focused on productive academic activities.

Students mainly utilize AI to accelerate the completion of academic tasks, particularly those of a technical nature, as well as to obtain additional explanations for materials that are difficult to understand during classroom learning. This indicates that AI functions not only as an information retrieval tool but also as a support system for enhancing conceptual understanding independently.

These findings suggest that the integration of AI in learning has contributed positively to the effectiveness of students' learning. However, intensive use of AI should be balanced with the development of critical thinking skills to prevent students from becoming overly dependent on technology in solving academic problems.

3.3 Sentiment Analysis of Expectations toward AI in the Future

In contrast to the sentiment analysis results regarding experiences of AI usage, the sentiment related to students' expectations of Artificial Intelligence (AI) in the future shows a shift in sentiment distribution, as presented in Table 6.

Table 6. Sentiment Distribution of Students' Expectations toward AI

Sentimen	Responden	Persentase (%)
Positif	73	46,20%
Netral	71	44,94%
Negatif	14	8,86%
Total	158	100%

Based on Table 6, positive sentiment still dominates at 46.20%, although it has decreased compared to the sentiment related to previous AI usage experiences. On the other hand, neutral sentiment shows a significant increase to 44.94%, indicating that students hold more cautious and balanced perspectives when considering the future development of AI.

In addition, negative sentiment has increased to 8.86%, suggesting greater concern compared to current AI usage experiences. These concerns are generally related to potential long-term impacts, such as technological dependency, a decline in critical thinking skills, and the risk of AI misuse in academic contexts.

The shift from a dominance of positive sentiment toward a more balanced distribution between positive and neutral sentiments, along with the rise in negative sentiment, indicates that although students currently perceive the benefits of AI, they are also becoming increasingly aware of the potential challenges and risks that may arise in the future. This reflects a more critical and reflective attitude among students toward the development of AI technology in education.

3.4 Discussion

The dominance of positive sentiment in students' experiences indicates that Artificial Intelligence (AI) has provided significant added value in improving academic efficiency. Students tend to utilize AI as a "personal tutor" capable of simplifying complex concepts into more understandable forms. This finding is consistent with the Technology Acceptance Model (TAM), which states that perceived ease of use and perceived usefulness are the main factors driving the widespread adoption of technology.

However, the analysis of students' expectations for the future reveals a more complex dynamic. There is an increase in neutral sentiment (44.94%) and negative sentiment (8.86%), indicating a shift from previously dominant positive attitudes toward more cautious and reflective perspectives. This suggests that students are not merely passive users of AI but are beginning to consider the long-term implications of its use.

Based on keyword extraction results, an ambivalence phenomenon is identified in students' perceptions of AI. On one hand, students expect the development of more advanced technologies that can optimally support the learning process. On the other hand, several concerns have emerged, including:

3.4.1. Excessive Dependency

Students are concerned that the continuous use of AI may reduce their critical and analytical thinking abilities. This concern is consistent with research findings indicating that the increasing adoption of AI in education creates the potential for excessive dependence on technology, which may hinder the development of students' critical thinking skills and independent learning abilities [22]. Furthermore, the rapid advancement of Artificial

Intelligence (AI), which increasingly facilitates the completion of academic tasks, is also considered to heighten the risk of dependency that may negatively affect students' critical thinking capabilities [23].

Dependence on the instant answers provided by AI has the potential to limit exploration, reasoning processes, and deep understanding of learning materials. This finding is supported by research [24], which demonstrates that while the use of AI in education offers convenience and efficiency, excessive reliance on it can weaken students' critical and creative thinking abilities. In this context, students tend to depend on outputs generated by AI systems without engaging in independent verification, analysis, or reflection.

The concerns expressed by users are directly correlated with modern variations of the Technology Acceptance Model (TAM) that incorporate the concept of AI Skepticism as one of the primary operational barriers to technology acceptance. As dependence on AI continues to increase, the habit of obtaining instant answers from AI systems may contribute to a decline in independent analytical thinking skills. Such conditions have the potential to create a learning environment that is less conducive to intellectual exploration, making students less accustomed to dealing with conceptual ambiguity and complex problems that require in-depth reasoning processes. Consequently, critical evaluation, cognitive reflection, and analytical decision-making abilities may deteriorate, despite the significant benefits that AI technology provides in supporting the learning process..

3.4.2. Information Accuracy

Another concern relates to the accuracy of information generated by AI. Some students reported experiences of receiving inaccurate or “hallucinatory” responses, leading to doubts about the reliability of the technology.

Findings related to concerns about the phenomenon of AI hallucination represent an important contribution of this study. The notable increase in neutral sentiment (44.94%) and negative expectations implies that as students move past initial technical experimentation, they develop an evaluative neutrality rooted in systemic uncertainty regarding the consistency of generative knowledge. They highlight the need for developing more controlled AI systems grounded in reliable sources. In alignment with current literature on trustworthy AI, a recommended architectural intervention is Retrieval-Augmented Generation (RAG). By systematically binding generative language engines to closed, peer-reviewed educational reference corpuses, RAG effectively suppresses stochastic hallucination, transforming volatile software into highly accountable educational systems.

Overall, the results of this study indicate that although AI has been widely accepted and provides tangible benefits in learning, there is a need to manage its use wisely. A balanced approach between leveraging technology and strengthening critical thinking skills is essential to optimizing the role of AI in education.

4. Conclusions and Future Works

Based on the results of this study on lexicon-based sentiment analysis of technology students in the City of Tegal regarding the adoption of AI in learning, it can be concluded that the use of AI has been widely accepted and has had a positive impact in supporting students' academic activities. This is indicated by the dominance of positive sentiment in AI usage experiences at 56.96%, reflecting that students perceive tangible benefits, such as increased efficiency in completing tasks and improved understanding of learning materials.

However, the analysis of students' expectations for the future reveals a more complex shift in perception patterns. Although positive sentiment still dominates, there is an increase in neutral and negative sentiments, indicating that students are becoming more critical in their views on AI usage. The main concerns include the potential for technological dependency and issues related to the accuracy of AI-generated information, including the phenomenon of AI hallucination.

These findings suggest that students view AI not only as a beneficial tool but also as a technology that must be used wisely and in a controlled manner. Therefore, efforts are needed to balance the use of AI with the strengthening of students' critical thinking skills. In addition, the development of more accurate AI systems based on reliable sources is essential to enhance user trust in the context of learning.

Overall, this study demonstrates that the adoption of AI in education has significant potential to improve the quality of learning, but it also requires proper management to minimize potential negative impacts. To

establish responsible AI integration, higher education institutions must deploy clear honor codes defining the ethical and legal boundaries of machine-generated text in grading. Concurrently, lecturers must redesign evaluations away from easily automated home tasks toward Project-Based Learning (PBL) formats defended through direct, mandatory oral examinations, thereby guaranteeing true intellectual accountability in an AI-saturated ecosystem.

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