

Analysis of Final Exam Essay Answer Accuracy: The Role of Artificial Intelligence in Automatic Assessment

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Abstract—The issues investigated in this research include the accuracy of artificial intelligence (AI) scoring of essay answers, the challenges of validity and fairness in automated scoring, as well as potential biases in the algorithms used, and how these affect academic assessment results compared to human scoring. The method used in this study consists of several systematic steps. First, data was collected by asking relevant questions to an artificial intelligence (AI) platform. After that, the questions are inputted into AI platforms such as Copilot, Gemini, and Blackbox AI. Next, the resulting answers are analyzed using machine learning algorithms and natural language processing (NLP) to ensure the quality and depth of analysis. The answer results are then tested to evaluate their accuracy and relevance to the context of the question asked. The analysis results are visualized in the form of graphs or tables. This research shows that artificial intelligence (AI) has great potential in the automated assessment of essay answers. The results showed that Copilot got the highest score of 63.4%, Gemini 50.5% and Blackbox.AI 56.9%. However, the answer accuracy results between each AI Platform are still below 70%, meaning that the answers from the AI platform are still far from expectations. The next research recommendation is to retest the AI Platform using other methods to get accurate and consistent results.

Keywords : Artificial intelligence (AI), Natural Language Processing (NLP), Scoring Accuracy, Algorithm Transparency, Automated Scoring

I. INTRODUCTION

Information and communication technology has changed many aspects in the world of education, including assessment methods [1]. One of the promising innovations is the use of artificial intelligence (AI) to conduct an automated assessment of the answers to the final exam essays [2]. Essay assessment is a great challenge, both for teachers and students, because it involves evaluating students understanding, analysis, and critical thinking skills[3].

Artificial intelligence (AI) has become an important subject in the field of education due to its popularity among students around the world. Applications such as text generation, data processing, and curriculum development, among others, prove that artificial intelligence (AI) is one of the most advanced chatbots available [4].

Artificial intelligence, particularly in the form of natural language processing (NLP) [5], has shown significant potential in analyzing and evaluating text [6] [7]. With these technological advancements, AI systems can be trained to understand the context, structure, and arguments in essay answers, and provide constructive feedback [8]. The use of AI in automated assessment can help reduce faculty workload, improve assessment consistency, and provide faster feedback to students[9].

Students should have an ethical point of view about whether they want to use AI to complement their learning process and how much influence this technology has on their academic work [10]. They can then learn to use it more effectively and avoid the misuse of AI, in order to take advantage of the benefits that this AI technology may have in higher education [11].

It's incredible how AI is able to reproduce human-like behavior and a writing style so convincing that it becomes difficult to distinguish between machine-produced and human-generated content [12].

However, although many studies have shown the accuracy of AI in scoring, there are still challenges that need to be addressed [13]. Questions of validity, fairness, and transparency in automated judgments are of primary concern. Will AI be able to understand the nuances and complexities of human arguments? What if there is bias in the algorithm used? Therefore, it is important to analyze the accuracy of the essay answers assessed by AI and compare them with human assessments [14].

This study aims to explore the role of artificial intelligence in the automated assessment of final exam essay answers [15]. By analyzing the accuracy of assessments provided by AI and evaluating the factors that influence those outcomes, it is hoped that this

study can provide valuable insights for the development of more effective and fair assessment methods in higher education. In addition, the results of this study can serve as a basis for further discussion regarding the implementation of technology in the academic evaluation process.

II. LITERATURE REVIEW

Artificial intelligence (AI) has revolutionized various sectors, including education. The integration of AI in educational settings has demonstrated significant potential in enhancing teaching and learning processes [16]. Research by Lijia Chen et al (2020) highlights the emergence of the metaverse as a new frontier for learning, emphasizing AI's role in creating immersive educational experiences. Additionally, Paek, Seungsu (2021) discuss how AI can assist in understanding and creating art, suggesting its versatility across disciplines [17].

Natural Language Processing (NLP) represents a critical aspect of AI applications in education, particularly in automated assessment. Botelho (2023) outlines the fundamentals of NLP, emphasizing its capability to analyze and evaluate text efficiently [18]. AI systems utilizing NLP can assess students' written responses, providing valuable insights into their understanding and critical thinking skills (Chen et al., 2024). This potential has led to an increasing interest in implementing AI-driven assessment tools in academic environments [19]. The similarity measure is a technique to find how much two sentences are similar in the sense of semantic, syntactic and structure. Similarity measure will enable us to decide the scoring marks for answer script [20].

Comparative examination of AI tools in use today and assessing their effectiveness in Natural Language Processing accuracy, customization, engagement, and learning of foreign languages. The AI Platform possesses the features and functionalities of different AI tools that assist students and instructors in making informed choices when selecting these resources for educational and training objectives [21].

Advances in AI technology have led to significant developments in areas such as healthcare, customer interaction, and inter-industry operations [22]. Research into the use of AI in the education sector has also grown rapidly in recent decades [23] and seeks to explore how AI can be applied in an academic context. Zuboff (2020) conceptually outlines four main functions of AI in the education and teaching process, namely profiling and prediction, intelligent automated learning systems, assessment and measurement, and adaptive and personalized systems [24].

III. RESEARCH METHODS

The process flow starts with the collection of questions to be posed to the AI platform [25]. These questions are then fed into the platform, which includes technologies such as Copilot, Gemini and Blackbox AI. Upon receiving the input, the AI platform processes the question and generates relevant answers with in-depth analysis using machine learning algorithms and natural language processing [26]. Next, the generated answers are tested for accuracy to ensure that the information provided is reliable and appropriate to the context of the question [27]. The results of these tests are then visualized, allowing stakeholders to understand the results of the analysis more easily [28]. Finally, the process ends with a conclusion that includes an overall evaluation of the accuracy of the answers and the insights gained from the data visualization [29]. This approach helps generate accurate and reliable information for better decision-making.

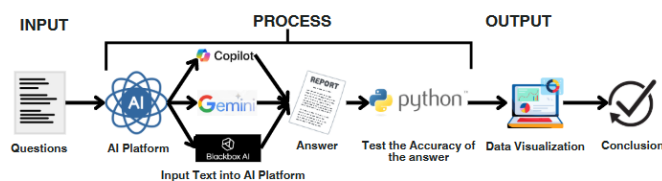


Figure 1. Stages of Research

Overall, this flow describes a systematic process from question collection, processing and analysis using AI, accuracy testing, data visualization, to conclusion drawing. This approach helps in generating more accurate and reliable information for decision making [30].

Data visualization plays a crucial role in analyzing data, enabling us to present information in a clearer and more engaging manner [31]. Processing data manually one by one is a tough job. However, with computers and artificial intelligence, difficult work such as data processing can be made easy. Data processing is very important so that existing data is easy to read [32]. Data processing can be visualized in the form of tables and diagrams/graphs [33].

Presentation of data in the form of tables and graphs can make it easier for readers to read and understand data. In natural language processing, the data to be extracted includes unstructured or "arbitrary" data. In standard language processing, the details that need to be gathered consist of disorganized or "self-assertive" content. For upcoming applications like assumption testing or topic modeling, this type of content must be transformed into structured data [34].

Engaging visual displays can allow, among various other features, to present information with varying degrees of detail, examine data through interconnected views, and adapt charts in real-time to concentrate on what users find appealing [35]. This processing is generally carried out in data analysis and visualization activities using common free software such as GrADS, Ferret, NCL, R, Python, and others . In today's technological era, data processing and presentation can be done easily through a programming language known as Python [36].

Python is an object-oriented high-level programming language created by Guido van Rossum. It is multi-functional and runs with maximum interpretation, offering many uses. This object-based programming language is commonly used to simplify large amounts of complex data. One of the reasons Python is so popular with scientists and data analysts is because it is so flexible [37]. Thanks to this flexibility, the language can be used to build data models, organize data sets, design algorithms powered by Machine Learning (ML), provide web services, and apply data mining techniques to efficiently accomplish various tasks in a short period of time.

```
import difflib

def hitung_akurasi(jawaban_diberikan, jawaban_benar):
    """
    Menghitung akurasi ketepatan kata antara dua teks menggunakan difflib.SequenceMatcher.

    Args:
        jawaban_diberikan: Teks jawaban yang diberikan.
        jawaban_benar: Teks jawaban yang benar.

    Returns:
        Akurasi ketepatan kata dalam bentuk persentase (0-100).
    """
    matcher = difflib.SequenceMatcher(None, jawaban_diberikan, jawaban_benar)
    return matcher.ratio() * 100

jawaban_diberikan = "Inputan Jawaban AI"
jawaban_benar = "Inputan Jawaban Benar"

akurasi = hitung_akurasi(jawaban_diberikan, jawaban_benar)
print(f"Akurasi ketepatan Jawaban: {akurasi:.2f}%")
```

Figure 2. Code Analysis Using Python

The above code defines a function that evaluates the accuracy of word agreement between two pieces of text utilizing the difflib library, which is available in Python. Initially, the difflib library is imported to facilitate the comparison of texts. The function, named calculate_accuracy, takes in two parameters: answer_given, which represents the response produced by artificial intelligence (AI), and answer_true, referring to the correct answer. Inside the function, a SequenceMatcher object is instantiated to analyze the two texts [38]. The function then computes the ratio of word agreement, which is converted to a percentage by multiplying by 100. An example is included to illustrate the function's application, with answer_given set to "AI Answer Input" and answer_true to "Correct Answer Input." Ultimately, the calculated accuracy is presented in a percentage format, rounded to two decimal points.

IV. RESULT AND ANALYSIS

The following table presents essay questions related to introduction to information systems, accompanied by detailed answers. This table aims to provide a clearer understanding of the various aspects of information systems, including their definition, role in decision making, analysis, design, implementation, as well as the importance of verification and validation. Thus, this table becomes a comprehensive source of information to understand the basics of Information Systems and their application in the organizational context.

Table 1. Essay questions about an introduction to information systems

| No | Questions | Answer |
|----|---|---|
| P1 | Explain what is meant by information systems | Information systems are a combination of technologies, people, and processes used to collect, process, store, and distribute information |
| P2 | Explain what a management information system is | A system that provides the necessary information for managers in the day-to-day decision-making process |
| P3 | Explain Si's role in decision support | a vital tool in business decision-making, providing a solid foundation for making informed, efficient, and strategic decisions |
| P4 | Explain what data analysis means in information systems | a systematic process to collect, process, and evaluate data to produce information that is useful for decision-making |
| P5 | Explain what an analyst system means | A professional responsible for designing and implementing information systems that meet the needs of the organization |
| P6 | Explain what is meant by system design | The process of designing the architecture, components, and interfaces of an information system to meet user needs and business goals that have been set |
| P7 | Explain what system testing is | process evaluation and verification of information systems to ensure that they function in accordance with specifications and meet user needs |
| P8 | Explain what is called data analysis and visualization | The process of representing data in the form of graphs or images to facilitate the understanding and analysis of information |

In this analysis, we present a comparison table of the results from three entities, namely Copilot, Gemini, And Blackbox.AI, related to understanding various aspects of information systems. This table presents percentage data that reflects the performance of each entity in answering the questions that have been set.

Table 2. Comparison Table of Question Results

| | COPILOT | GEMINI | BLACKBOX.AI |
|----|---------|--------|-------------|
| P1 | 32,90% | 60,34% | 60,34% |
| P2 | 50,40% | 55,40% | 48,18% |
| P3 | 38,75% | 35,62% | 49,51% |
| P4 | 63,57% | 44,26% | 76,01% |
| P5 | 86,76% | 69,35% | 58,12% |
| P6 | 58,30% | 43,76% | 40,31% |
| P7 | 72,78% | 62,25% | 70,52% |
| P8 | 42,92% | 32,80% | 41,18% |

The comparative table of the results of the above questions shows the percentage data obtained from three entities: Copilot, Gemini, and Blackbox.AI, related to various aspects (P1 to P8) of Information Systems.

From the results listed, it appears that:

1. Gemini performed best on most questions, particularly on P1 (60.34%) and P6 (69.33%), demonstrating a strong understanding of basic concepts and Information Systems Design.
2. Blackbox.AI also showed competitive results, especially in P4 (76.01%), which reflects good analytical skills in Information Systems.
3. The Copilot recorded the lowest results on most of the questions, especially on P8 (42.92%), which indicates the need to improve understanding of System Verification and validation.

Results Score Each Questions

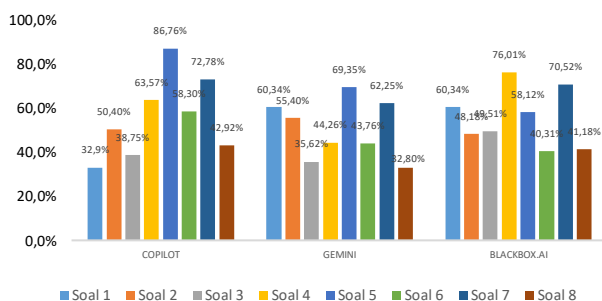


Figure 3. Results Score

From the second figure, it can be seen that Copilot recorded the highest scores in most questions, with a peak score of 86.76%, showing strong performance and a good understanding of the topics tested. Blackbox.AI also showed good results, especially on certain questions, while Gemini had the lowest score on most questions, with a low score of 32.8%.

Accuracy AI

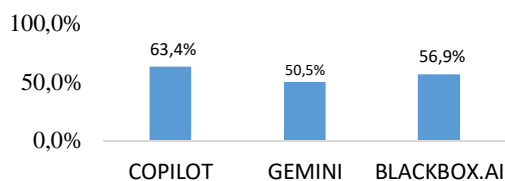


Figure 4. Results Accuracy AI

In the third figure, the overall accuracy shows that Copilot has 63.3% accuracy, Blackbox.AI 56.9%, and Gemini 50.5%. These results show that although Copilot has the highest score on individual questions, Copilot shows more consistent accuracy.

VI. CONCLUSION

In this study, we found that the application of artificial intelligence in automated assessment shows great potential, but is also faced with significant challenges. AI can improve the consistency of assessments and provide faster feedback, but issues such as validity and potential bias in algorithms need to be addressed. A comparative analysis between AI and human judgments shows that while AI can achieve high accuracy in some aspects, there is still a need to improve AI's understanding of the nuances of human arguments. This research provides a basis for further discussion regarding the application of technology in the academic evaluation process, as well as emphasizing the importance of developing an ethical framework to guide the use of AI in education.

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