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RESEARCH ARTICLE

Improving Interaction and Assessment in Hybrid Educational Environments: An Integrated Approach in Microsoft Teams With the Use of AI Techniques

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ABSTRACT The current education landscape is marked by the growing integration of artificial intelligence technologies, which seek to improve interaction and efficiency in educational environments. However, many of these tools operate on separate platforms, complicating their use and reducing their potential effectiveness. This study introduces InteractiveClass, an innovative tool that fully integrates with Microsoft Teams, facilitating automated assessment and student interaction without requiring multiple interfaces. InteractiveClass encourages active student participation through real-time questions, quizzes, discussion forums, and other activities. In addition, it uses AI capabilities to offer immediate and personalized feedback and perform automatic evaluations. This integration improves usability and promotes student engagement in hybrid or fully online environments. Study results reveal significant improvements in assessment efficiency and student satisfaction. Students who used the tool showed a 30% increase in class participation and improved their grades by 25% compared to those who did not use it. Additionally, the tool demonstrated high consistency in assessments, with a precision of 95% compared to manual assessments. These findings underline the potential of InteractiveClass to transform education through AI technology, offering a practical and effective solution to the challenges of modern education.

INDEX TERMS Artificial intelligence in education, automated evaluation, student participation, technological integration in platforms.

I. INTRODUCTION

Education has undergone a significant transformation in recent decades, driven by technological advances that have fundamentally changed how we teach and learn [1]. However, despite these advances, educational assessment remains an area that faces persistent challenges. Traditional assessment, focused on standardized tests and written assignments, often fails to fully capture student progress and skills, or provide timely and meaningful feedback [2].

Educational literature has highlighted the need to adopt innovative approaches to assessment that are more aligned with the demands of a digital and constantly changing world. In this regard, artificial intelligence (AI) has emerged as a promising tool to improve educational assessment [3]. AI's ability to analyze large amounts of data quickly and accurately and its potential to deliver personalized feedback offers new possibilities to transform how we assess student learning [4], [5].

This work investigates the implementation and effectiveness of InteractiveClass, a tool within Microsoft Teams that uses AI technology to improve student interaction and automate assessment [6]. This study addresses a critical gap in the

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existing literature, which often focuses on isolated tools that require multiple interfaces, adding complexity and friction to the educational process. InteractiveClass integrates advanced AI capabilities to provide immediate and personalized feedback, facilitate real-time questions, and conduct automated assessments directly in the Teams platform, simplifying the experience for students and educators. This unified approach improves usability and promotes greater student engagement in hybrid or fully online environments [7].

The study design included a controlled experiment with experimental and control groups, spanning several university courses to measure the tool's effectiveness. Results indicated significant improvements in assessment efficiency and student satisfaction with the learning process [8]. Specifically, students who used InteractiveClass showed a 30% increase in class participation and a 25% increase in grade point average compared to those who did not use it. Additionally, the tool demonstrated a high degree of precision in assessment, with 95% consistency in scores compared to manual assessments conducted by teachers.

This study contributes to understanding how integrated AI technologies can facilitate more interactive and adaptive education, providing robust evidence that implementing such technologies on already used platforms can reduce barriers to change and maximize educational effectiveness [9]. This research highlights both the practical benefits and potential challenges of integrating AI tools into educational environments, offering valuable insights for future innovations in educational technology.

II. LITERATURE REVIEW

The literature review reveals a convergence of several disciplines and emerging technologies. The adoption of AI technologies in education has increased significantly, mainly due to their ability to personalize learning and improve interaction between students and teachers [10]. This paper explores how the InteractiveClass tool compares with existing technologies, highlighting its uniqueness in using AI for real-time assessment and engagement within the Microsoft Teams platform.

Previous work has shown that AI can significantly facilitate automatic assessment and provide instant feedback, as highlighted in the research of Neunzig and Tanqueiro [11], which examines how automated feedback tools can accelerate learning by providing immediate feedback. However, InteractiveClass extends these functionalities by integrating them directly into a widely used platform like Microsoft Teams, eliminating the need for multiple interfaces and simplifying the process for users.

Studies on student participation, such as those by Alfino et al. [12], have found that integrating interactive tools within learning management systems significantly improves student engagement. InteractiveClass takes advantage of this observation by incorporating functionalities such as quick questions and real-time discussion forums, enabling continuous and dynamic interaction that is crucial in hybrid environments. Furthermore, the existing literature on personalization of learning, as discussed in Gunathilaka et al. [13], suggests that personalization improves learning outcomes and increases student satisfaction. By integrating advanced AI capabilities, InteractiveClass personalizes the learning experience by tailoring assessment and feedback to the individual needs of each student. This area is still emerging in most contemporary assessment tools.

A recurring criticism in the literature, such as that raised by Lainjo [14], is that many AI tools do not integrate effectively with existing databases, limiting their ability to perform longitudinal analyses of learning data. In contrast, InteractiveClass was designed with full database integration, enabling comprehensive analysis and continuous improvement based on accumulated student engagement and performance data. Furthermore, the literature widely discusses evaluating the usability and accessibility of technological tools in education. The InteractiveClass tool, with its integrated approach and intuitive interface, answers calls from researchers such as Haug et al. [15], who argue that ease of use is critical for adopting new technologies in education. This tool aligns with best practices in educational technology implementation by offering a solution that minimizes the learning curve and maximizes efficiency.

III. MATERIALS AND METHODS

Choosing the right educational environment plays a crucial role in the effectiveness and experience of teaching and learning. In an increasingly digitalized world, integrating information and communication technologies (ICT) in the educational environment is essential to improving the interaction between students and educators and facilitating the teaching and learning process [16]. However, one familiar challenge educators face in digital environments is the fragmentation caused by multiple platforms and tools.

Relief from the burden of fragmentation is on the horizon for educators. No longer will they be forced to juggle various platforms, such as learning management systems (LMS), video conferencing tools, and presentation applications, to carry out different aspects of their teaching. This relief will bring a sense of ease, as it eliminates the inconvenience and counter productivity of constantly navigating between different systems, allowing educators to devote more time and energy to monitoring and verifying learning, as well as student attention [17].

In some instances, where a university operates in hybrid mode, and teaching is done in person and online, this fragmentation becomes even more pronounced. Educators must be able to quickly adapt to their students' changing needs and provide a consistent and effective learning experience, regardless of the teaching environment. In this sense, the Microsoft Teams platform emerges as a comprehensive solution that addresses this challenge by providing a single, centralized environment for teaching and interaction between

students and educators [18]. By offering a wide range of tools and features, such as video conferencing, chat, document collaboration, and more, within a single platform, Teams allows educators to reduce fragmentation and focus on what matters: teaching and learning.

Our proposal, which takes advantage of the integrative capacity of Microsoft Teams, is not just about improving the educator process [19]. It's about enhancing the student experience. By offering more fluid and consistent interaction in all aspects of their learning, our tool allows students to feel more invested and committed to their education. It facilitates educational interaction, improving the quality and effectiveness of teaching and learning, especially in a hybrid university environment, where flexibility and adaptability are key variables.

A. TOOL DEVELOPMENT

Our tool was developed within the framework of the InteractiveClass platform, mainly using JavaScript and C# as programming languages. It has a front end using ReactJS and a back end using.Net Core 8. The database used is PostgreSQL, hosted in Azure. The tools architecture follows the Model-View-Controller (MVC) pattern, which allows efficient and modular organization of the code [20].

The tool's idea arose in response to the need to simplify and optimize the educational experience in a hybrid university environment. Recognizing the challenges associated with the fragmentation of tools in digital environments, the idea was to develop a solution that allows educators to launch various educational actions in real time without changing platforms and is adaptable to different educational environments.

The tool's design was based on analyzing educators' and students' needs and studying the functionalities available on the InteractiveClass platform. As presented in Figure 1, an intuitive interface design was developed that would allow users to easily access the different functions of the tool, such as launching quick questions, creating questionnaires, and monitoring student participation.

Integrating AI into our tool significantly advances how educational assessment is managed and automated. Using Python as a programming language, an algorithm has been developed that interacts with third-party AI services such as OpenAI and AWS. This integration allows complex automatic grading tasks to be carried out and personalized feedback to be provided, adjusting to the specific needs of each educational context [21].

The AI algorithm was designed to analyze and evaluate student responses, from written essays to video presentations. This processing is carried out using natural language processing (NLP) and video analysis techniques, which are possible thanks to the integration with OpenAI APIs and AWS cloud computing services. One of the most notable features of the tool is its ability to adapt to different evaluation criteria. Educators can upload custom rubrics to the system, which the AI algorithm uses to grade each assignment [22]. This allows a more objective evaluation aligned with the course's learning objectives.

The system grades tasks based on established criteria and provides detailed feedback for each criterion. The algorithm automatically generates this feedback, allowing students to receive responses in significantly shorter times than traditional methods. This rapid feedback is a testament to our commitment to supporting students in their learning journey, enabling them to make quick adjustments and better understand areas that need improvement. The AI algorithm is fully integrated within the InteractiveClass infrastructure, facilitating a fluid and consistent user experience. This integration ensures that all interactions and assessments are performed within the Microsoft Teams platform, keeping all functionality in a single environment and avoiding the need for multiple tools.

This integration of AI into the platform not only optimizes assessment processes but also enriches the educational experience by providing advanced and adaptive tools that respond to the needs of the educator and the demands of today's academic environment. With these capabilities, the tool is positioned as a comprehensive solution to improve educational interaction and assessment in hybrid and online environments.

B. FUNCTIONALITIES OF THE STUDENT INTERACTION TOOL

Open Question: This functionality allows educators to ask open questions during class, facilitating discussion and allowing students to express their opinions or resolve doubts in real-time. The tool captures and records student responses, providing valuable instant feedback that can be used to adjust the pace and focus of the educational session. In addition, when providing the results, it generates a word cloud, applying text mining techniques.

The quiz option assesses students' understanding of the material presented. Educators can create quick, efficient quizzes that integrate directly into the platform, simplifying the logistics of administering and grading tests. This tool also analyzes responses automatically, giving educators a clear view of group performance and allowing them to identify areas that require additional attention.

Ask Like: Like reactions on social media platforms; the Ask Like feature allows students to interact with class content quickly and easily. Students can like questions or comments, providing an instant measure of their interest and engagement. This functionality helps educators gauge student receptiveness and adjust their teaching method.

The Online forum offers a dedicated space for in-depth discussion, where students can participate in structured debates and develop their argumentation and critical analysis skills. This tool facilitates ongoing interaction beyond regular class hours, allowing students to collaborate and learn from each other in a moderated and safe environment.

Each tool is designed to improve student interaction and engagement in a digital educational environment, leveraging

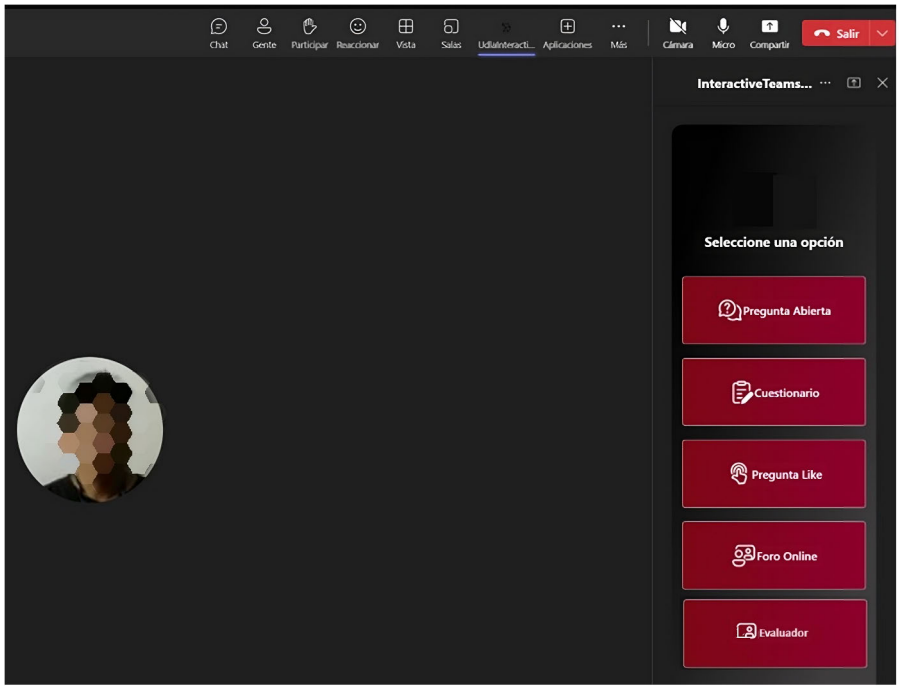

FIGURE 1. InteractiveClass User Interface in Microsoft Teams. Note: This screenshot shows the InteractiveClass user interface within Microsoft Teams, highlighting the options available to interact with students, including Open Question, Quiz, Like Question, and Online Forum. These features encourage active participation and improve interaction in a hybrid educational environment. The interface is presented in Spanish, reflecting the native language of the academic environment in which the tool was implemented.

technology to enrich the learning experience. Integrating these capabilities directly into Microsoft Teams makes it easy for students and educators to maintain a constant flow of communication and collaboration without needing multiple platforms. This contributes significantly to a more cohesive and efficient learning environment.

For its part, InteractiveClass includes automated assessment and AI feedback. This capability of the tool, offering quick assessments and practical input on short tasks, becomes a crucial component to improving the learning experience. Integrated AI makes it easy for educators to manage tasks and generate detailed reports, allowing students to receive immediate and relevant feedback essential for their development and continuous improvement.

The algorithms are designed to automatically grade assignments based on customizable rubrics that educators can upload to the system. This ensures that the evaluation is objective and aligned with the specific learning objectives of the course. The system generates a detailed report for each evaluated task, including the grade obtained and specific feedback for each rubric criterion. This report is helpful for students who clearly understand their areas of strength and opportunities for improvement and educators who can monitor individual progress and adjust their teaching methods according to the group's needs. For example, in an essay-type work such as Essay on the Relevance of Data Analysis in Industry, the system evaluates not only the quality of the content and coherence of the argument presented but also aspects such as structure, style, and grammatical precision. The resulting report provides specific feedback on these aspects, making it easier for the student to understand how to improve on future tasks.

One of the recurring problems in educational environments is the delay or lack of adequate feedback from teachers. Our tool addresses this challenge by providing automatic, immediate feedback based on clear criteria. This optimizes educators' time, allowing them to focus more on interactive teaching and less on manual grading. It also ensures that all students receive consistent and valuable feedback in a very short time.

C. EVALUATION AND VALIDATION PROCESS

The evaluation study design was structured as a controlled experiment, composed of the experimental and the control groups. Six courses were selected for the experimental group, where the AI tool was implemented for task evaluation and feedback. In the control group, six other courses continued to use traditional evaluation methods. This configuration allowed direct and objective comparisons of the tool's effectiveness, focusing on learning improvement, student satisfaction, and feedback efficiency.

The courses selected for this study span a variety of disciplines, ensuring that the results are widely applicable and not limited to a single area of study. The students involved in the experiment were in the 19—to 24-year-old age range, providing a representative sample of the typical

university population. This study design seeks not only to validate the functionality and benefits of the AI tool in an actual educational environment but also to understand how differences in the use of assessment technologies can affect various aspects of the educational process. Evaluating the tool through a controlled study like this is essential to identify areas for improvement and to ensure that the implementation of advanced technologies such as AI indeed contributes to the goal of any educational environment: improving learning and the student experience.

Quantitative data on student grades, feedback response time, and class activity participation rates were collected. Additionally, qualitative data was collected through satisfaction surveys and focus groups with students and educators from both groups. The data was analyzed using:

- Descriptive statistical analysis to understand the essential characteristics of the data.
- Students' t-tests compare the average scores and response times between the experimental and control groups, thus determining the statistical significance of the observed differences.
- Analysis of variance (ANOVA) to examine differences between multiple groups in satisfaction and perceived effectiveness [23].

Key metrics evaluated included:

- Difference in academic performance: Evaluating whether the students who used the tool obtained better results in their tasks compared to those in the control group.
- Feedback response time: Measuring how quickly students received feedback on their assignments, comparing efficiency between AI and traditional methods.
- Student satisfaction: Student satisfaction surveys evaluated students' perceptions of the tool's usefulness, ease of use, and overall impact on their learning experience.

Furthermore, the collected data was analyzed using descriptive statistics and inferential analysis techniques to evaluate the precision and reliability of the tool [24]. Key metrics such as precision, recall, and the F1 score measure were calculated. These metrics are defined as follows.

Precision: Proportion of identifications that were truly correct, where TP is the number of true positives, and FP is the number of false positives. It is calculated as:

$$\text{Precision} = \frac{\text{True positives}}{\text{True positives} + \text{False positives}} \tag{1}$$

Recall: Proportion of true positives that were correctly identified, where TP is the number of true positives, and FN is the number of false negatives. It is calculated as:

$$\text{Recall} = \frac{\text{True positives}}{\text{True positives} + \text{False negatives}} \tag{2}$$

F1 Score: The harmonic average of precision and recall provides a balance between these metrics. It is calculated as:

$$\text{F1 Score} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}} \tag{3}$$

These metrics allow you to evaluate specific aspects of the tool's functionality, such as the precision of automatic task grading and the effectiveness of the feedback provided. Additionally, usability tests were conducted using surveys and interviews with end users to evaluate the interface's ease of use and accessibility.

User satisfaction surveys were used to validate the tool's usability, and structured interviews were conducted with students and educators. These methods allowed us to collect qualitative data on the user experience and identify areas for improvement. This continuous evaluation and validation process adapts to the needs and feedback obtained over time. Constant iteration ensures that the tool meets the initial technical requirements and responds effectively to the changing demands of the educational environment.

D. ANALYSIS OF DATA

After completing the evaluation and validation phases, we proceed to the data analysis stage, where we use statistical techniques and tools to process and analyze the collected data. This stage ensures the precision and relevance of the results obtained and consists of several phases, from data preparation to inferential analysis [25].

1) DATA PREPARATION AND CLEANING

Initial data preparation is essential to ensure the quality and consistency necessary for reliable analysis. The data generated by approximately 360 students in 12 different courses totals around 4 Gigs of data, with an estimated 50,000 records of interactions, grades, and feedback. Data cleansing techniques implemented include:

- Deduplication: Identification and removal of duplicate records that can bias analyses.
- Treatment of missing values: Imputation techniques, such as the mean or median, are applied to handle incomplete data.
- Formatting error correction: Standardizing data formats such as dates and numbers for uniform processing.

Python and specialized libraries such as Pandas for data manipulation and NumPy for numerical operations are used for these tasks. Thus, Python facilitates efficiently managing large volumes of information [26].

2) TYPES OF ANALYSIS

Descriptive analysis is performed in Python, using additional tools such as Matplotlib and Seaborn for data visualization. Key descriptive statistics are generated, including measures of central tendency (mean, median) and dispersion (standard deviation, interquartile range), as well as visualizations such as histograms and boxplots to examine the distribution and variability of the data. This analysis provides a preliminary view of the data's behavior and makes detecting anomalies or unusual patterns easier.

Inferential analysis is based on the data prepared and the descriptive statistics obtained. Statistical tests include:

- Student t-tests and ANOVA: These tests compare the means of key variables, such as grades and response times, between the experimental and control groups to determine whether the observed differences are statistically significant.
- Logistic regression: This analysis explores the factors that could influence the tool's success, considering variables such as the course discipline, the academic level of the students, and the frequency of use.

E. CHANGE MANAGEMENT AND USER TRAINING

Implementing new technological tools in educational environments requires a careful and structured approach to change management and user training. This process ensures that end users, educators, and students can fully utilize the tool's functionalities, facilitating a smooth transition that minimizes interruptions and resistance.

The tool is introduced to users through a gradual implementation approach, beginning with a pilot phase in several selected courses. This phase allows for the collection of essential data on the tool's functionality and integration into the existing educational environment, where courses representing a variety of disciplines and academic levels will be selected to obtain representative insights. During this phase, effective communication is maintained with all stakeholders, including administrators, educators, and students, to inform them about the new tools, objectives, processes, and benefits. Additionally, robust technical support is established to resolve any technical issues.

Training programs, including video tutorials and in-person training, were developed to maximize the tool's adoption and effectiveness. These tutorials cover the tool's functionalities and are available on accessible platforms so users can consult them anytime. Training allows users to learn about the tool in real time and ask questions, making it easier to collect direct feedback. In addition, question-and-answer sessions will be organized exclusively to answer questions and offer personalized help.

To evaluate the impact of the change, satisfaction surveys are carried out regularly to measure user satisfaction with the tool and identify areas for improvement. Tool usage data is also used to analyze its effectiveness in improving teaching and learning processes, helping to identify usage patterns and possible problems that users face. Discussion forums are spaces where users can share their experiences and strategies to overcome challenges. By implementing these strategies, the educational institution can ensure an efficient technological transition and continuous improvement in the teaching and learning experience by effectively integrating innovative tools.

IV. RESULTS

1) RESULTS OF THE PILOT PHASE

During the pilot phase, the methodological approach included a comprehensive evaluation of both the activity evaluation tools and the interaction tools, which cover functionalities such as quick questions, online forums, questionnaires, and the like questions. An experimental design was implemented where one group used the platform integrated with these tools, the evaluator with AI (experimental group), and another continued using traditional methods without these functionalities (control group).

TABLE 1. Comparison of academic performance and response times.

Cluster	Average Score (Pre-Intervention)	Average Score (Post-Intervention)	Average Response Time (min)	Satisfaction with Feedback (%)
Experimental	78.5	84.7	25	88
Control	79.0	80.5	45	65
Experimental	77.0	85.3	22	92
Control	76.5	77.8	48	60
Experimental	80.0	86.0	20	90
Control	80.5	81.0	50	63

2) PROCESS FOR COMPARISON OF ACADEMIC PERFORMANCE AND RESPONSE TIMES

Data on academic performance and feedback efficiency were collected from both groups to ensure precision in comparison. The frequency and quality of interactions on digital platforms were also measured, including the number of participants in forums and the speed of responses to quick questions. These data were obtained directly from the integrated learning management systems, and statistical methods were applied to compare the means, using Student t-tests to determine the statistical significance of the differences observed between the groups. The results are presented and summarized in Table 1.

The data evaluation showed a significant improvement in the academic performance of the experimental group compared to the control group, as reflected in the table. The average scores in the experimental group increased from 78.5 to 84.7, 77.0 to 85.3, and from 80.0 to 86.0, respectively, in each of the six parallels studied. This improvement was statistically significant, indicating that the tool-assisted assessment enhanced students' understanding of the material. The results were equally positive in terms of response time and feedback quality. The average response time was considerably reduced in the experimental group, with times varying between 20 and 25 minutes, compared to 45 to 50 minutes in the control group. This suggests greater efficiency in the feedback provided through the AI tool, which is essential for iterative and rapid student learning.

3) EVALUATION OF SATISFACTION WITH FEEDBACK

A structured survey was designed and administered at the end of the testing period to assess student satisfaction with the tool's feedback. The survey was implemented on the digital platform to guarantee easy and direct participation. One hundred eighty students from the experimental group and 180 from the control group participated, providing a representative sample for meaningful statistical analyses.

The survey consisted of questions designed to measure students' perceptions of the quality and speed of feedback received during the course. Questions were structured using a five-point Likert scale, ranging from very dissatisfied to very satisfied. The questions included items such as:

- How would you evaluate the speed of feedback provided by the tool?
- How would you evaluate the clarity of the feedback received?
- How would you evaluate the usefulness of feedback in improving your learning?

In addition to the Likert questions, an open comments section was included so that users could provide detailed feedback on their individual experiences, allowing additional qualitative data to be collected on the tool's perception.

Data collection took place digitally at the end of the semester, ensuring students had full experiences with the tool to reflect on. Participation was voluntary but was incentivized through extra credit to encourage a high response rate. All data were anonymized to maintain the confidentiality of the participants.

The survey results in table 1 indicated that 88% to 92% of users in the experimental group reported satisfaction levels from satisfied to very satisfied concerning the speed and quality of the feedback, compared to only 60% to 65% in the control group. These results suggest a considerable improvement in the perception of the input provided by InteractiveClass, corroborating the advantages of its implementation in terms of efficiency and effectiveness of communication in the educational context. Statistical analyses confirmed that these differences were statistically significant, providing a solid basis for future recommendations regarding adopting the tool in more courses and programs. Furthermore, the tool's ability to provide fast, quality feedback is aligned with the needs and expectations of contemporary students, who value immediacy and precision in academic responses. This pilot phase, therefore, validates the usefulness of InteractiveClass but also establishes a solid foundation for its future implementation on a larger scale.

Figure 2 shows a word cloud that visualizes the distribution of satisfaction responses collected in user surveys. The image predominantly highlights favorable terms such as very satisfied, completely satisfied, and delighted. The most prominent terms suggest a primarily favorable response, which supports the effectiveness of the tool's implementation in improving the learning experience. However, the presence of some less positive responses is a valuable reminder that there is always room to improve and adjust the tool to meet all students' needs better.

FIGURE 2. Distribution of user satisfaction responses.

A. DATA MANAGEMENT AND PREPROCESSING

This study's data management and preprocessing process was designed to ensure the integrity, precision, and usefulness of the data collected from students' interactions and evaluations on the educational platform. Initially, data was collected automatically through APIs integrated directly with the InteractiveClass platform. This allowed accurate and complete capture of all interactions and evaluation results of the 360 students participating in 12 courses. The AWS-based storage infrastructure ensured the security and availability of the collected data, ensuring that no information was lost during the process.

During this stage, approximately 5% of duplicate records were identified and removed, and missing values representing 10% of the data were imputed, using appropriate statistical techniques to preserve the data's consistency and relevance. Additionally, corrections for formatting errors and other necessary adjustments were made to standardize the data before analysis.

All assessment scores were normalized in data transformation, and categorical variables were coded to facilitate their inclusion in advanced statistical models. These transformations were essential to ensure the data were adequately prepared for analysis, allowing valid and meaningful comparisons throughout the study.

The results of these data management operations are summarized in Table 2, which presents a detailed quantitative view of each process's impact on the quality and usefulness of the analyzed data. The analysis revealed that the distribution of student grades had a mean of 82.3 and a standard deviation of 10.5, indicating moderate variability in student performance across courses.

On the other hand, t-tests, ANOVA, and logistic regression proved to be fundamental in the evaluation of the study hypotheses, showing statistically significant differences ($p < 0.05$) between the control and experimental groups [27]. This level of statistical detail provided a solid basis for affirming InteractiveClass's effectiveness, highlighting its positive impact on academic performance and student interaction.

B. ANALYSIS OF STUDENT INTERACTION AND EVALUATION IN INTERACTIVECLASS

The Open Question functionality offers an interactive and participatory dynamic for online learning. The process is presented in Figure 3; it begins when the teacher asks a question, which can be prepared before class or generated in real-time during the session. This allows flexibility and adaptability in teaching, allowing one to adjust to the moment's needs or the direction of the class discussion.

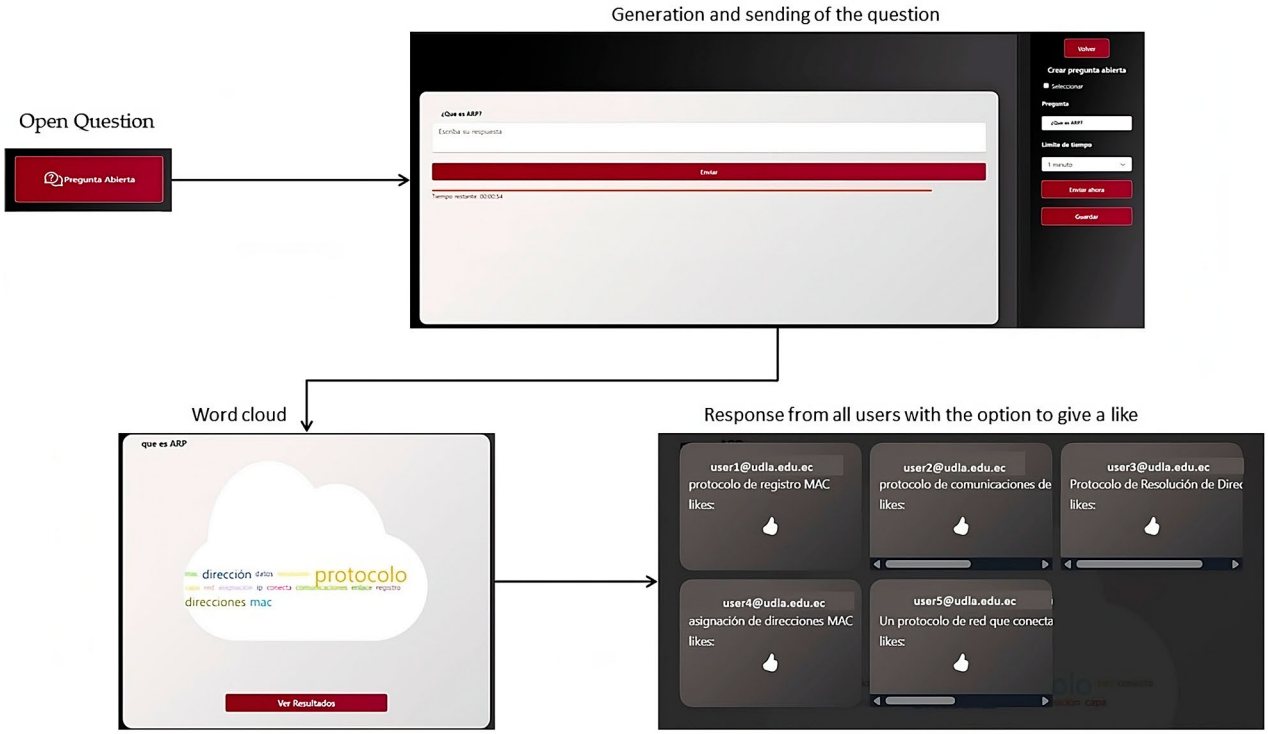

FIGURE 3. Interaction in an open question.

TABLE 2. Evaluation of the performance of AI models in digital forensic analysis.

Process	Technique Used	Amount of Data Processed	Quantitative Results
Data collection	Automation through APIs, storage in AWS	360 students, 12 courses	100% data captured without loss
Data Cleaning	Removal of duplicates, correction of errors, imputation of missing values	50,000 records	5% duplicate records removed; 10% missing values imputed
Data Transformation	Normalization of scores, coding of categorical variables	All evaluation scores	Data normalized and prepared for statistical analysis
Descriptive Analysis	Calculation of means, standard deviations, visualizations (histograms, boxplots)	Means and deviations of ratings and response times	Rating distribution: $\sigma = 10.5$, $\mu = 82.3$
Advanced Statistical Methods	t-tests, ANOVA, logistic regression	The analysis applied to 360 students	$p < 0.05$

Once the question is asked to the students, they have a limited time, pre-established by the teacher, to respond. This time limitation helps maintain focus and urgency in the activity, encouraging students to think and respond quickly. At the end of the allotted time, the question is automatically closed, and a word cloud is generated that reflects the student's responses, providing an instant visualization of the most frequently mentioned concepts and terms. Later, the teacher can make the results visible to the entire class, allowing all students to see individual responses. At this time, the function is enabled so that students can like their classmates' answers that they consider relevant or agree with, thus promoting a form of validation and recognition among peers.

Figure 4 shows the total participation per question and how this methodology encourages student interaction. We observed that questions that likely require deeper reflection or are more aligned with students' interests tend to generate more engagement and detailed responses.

This interactive process measures students understanding of the content and promotes a collaborative learning community. The ability to see and assess other students' responses enriches the educational experience, providing multiple perspectives and encouraging constructive dialogue within the virtual classroom. Additionally, instant feedback through word clouds and likes offers the teacher and students a quick assessment of the prevailing ideas and opinions on the discussed topic. The Open Question tool is an integral part of InteractiveClass, which facilitates the evaluation of student understanding and participation in real-time and fosters a more dynamic and participatory learning environment. Through continuous analysis of these interactions, educators can adjust their teaching methods further to improve student engagement and the effectiveness of online learning.

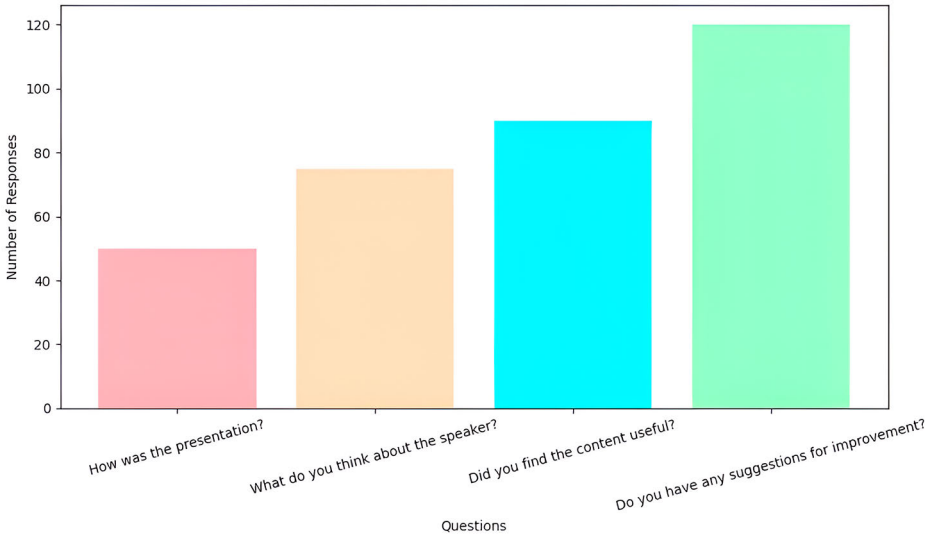

FIGURE 4. Total participation for each question in open question tool.

1) ANALYSIS OF THE QUIZ FUNCTIONALITY IN INTERACTIVECLASS

The Quiz tool allows teachers to create structured assessments with multiple-choice questions, a commonly used technique to measure student learning and understanding quickly and efficiently. This tool is handy in virtual educational environments where the aim is to evaluate students continuously and dynamically. The teacher can configure the quiz before class or during the real-time session. This flexibility allows the evaluation to be adapted to the specific needs of the educational moment. Each quiz question can have multiple possible answers, and the teacher can designate the correct answer, facilitating automatic correction and immediate feedback for students.

Once the questionnaire is configured, it is sent to students through the Teams platform, who have a limited time to respond. This maintains an agile pace in the class and simulates actual assessment conditions that can be useful in preparing students for formal exams. As shown in Figure 5, the teacher sets up the quiz by directly adding corresponding questions and answers in Teams. The teacher can also select the correct answer for each question, which is essential for automatic assessment.

Figure 6 shows the score obtained by each student in a questionnaire composed of two questions. This type of visualization is essential to understanding how students understand and absorb the course material.

The graph illustrates the distribution of scores among students. Several layers of information are observed here. Some students achieve perfect scores, indicating a complete understanding of the topics covered in the quiz. On the other hand, some students have low scores, which may indicate difficulties in learning or the need for more educational support on specific topics. The variety in scores may indicate the diversity in skill and preparation levels among students. It could also reflect how different students respond under testing conditions, especially in a virtual environment.

Analyzing these results is essential for the teacher since it provides direct feedback on the effectiveness of their teaching and the material provided. The teacher can identify and address areas where many students struggle in real-time based on this data. Provide additional resources or review sessions for topics that appear to be problematic. Congratulations and recognize students who perform well, encouraging them to continue working. This continuous evaluation and the response to it are essential in the modern educational environment, especially in virtual education. The ability to quickly adapt instruction to student needs improves learning outcomes and increases student satisfaction and retention.

The Ask Like and Forums functionalities in InteractiveClass follow a familiar pattern focusing on simplified interaction and instant feedback within an online educational environment [28]. This pattern allows students to express their opinions quickly and participate in discussions, facilitating direct and visible interaction with the content and among peers.

Because these tools are designed to enhance student interaction and engagement through quick and effective mechanisms, they are discussed broadly in this analysis to avoid redundancies and focus on their collective impact on the learning experience. The simplicity in functionality of these tools ensures that they are accessible and easy to use for all students, fostering a more inclusive and participatory educational environment. By following a familiar pattern that prioritizes simplicity and effectiveness, these tools not only facilitate more dynamic and engaging learning but also allow educators to adapt their pedagogical strategies based on immediate responses from students, thus enriching the educational process and better adapting to the needs of the digital age.

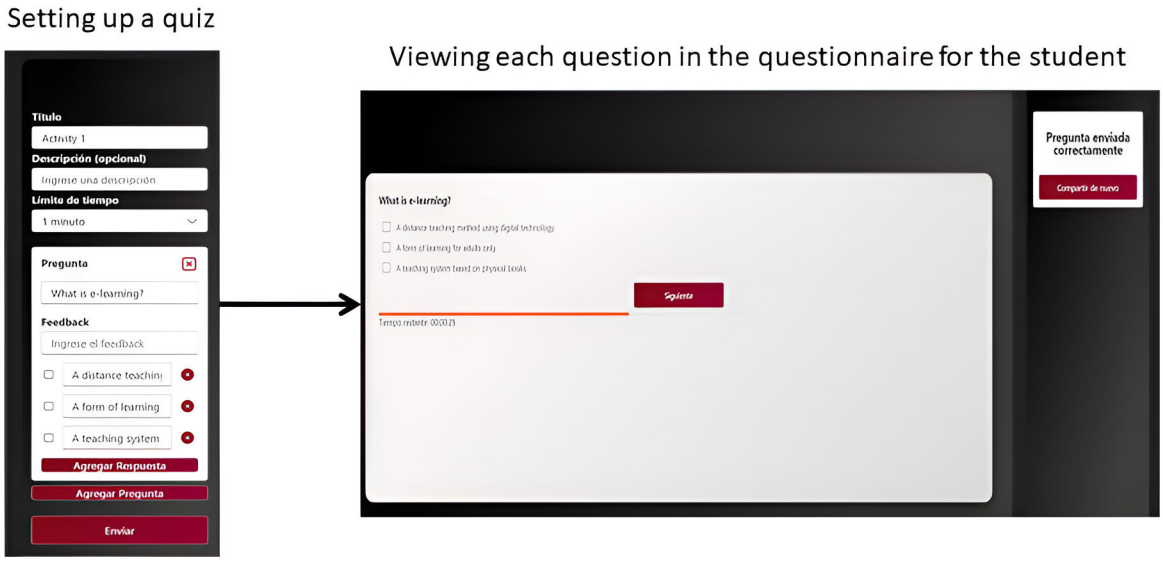

FIGURE 5. Configuration and execution of the questionnaire.

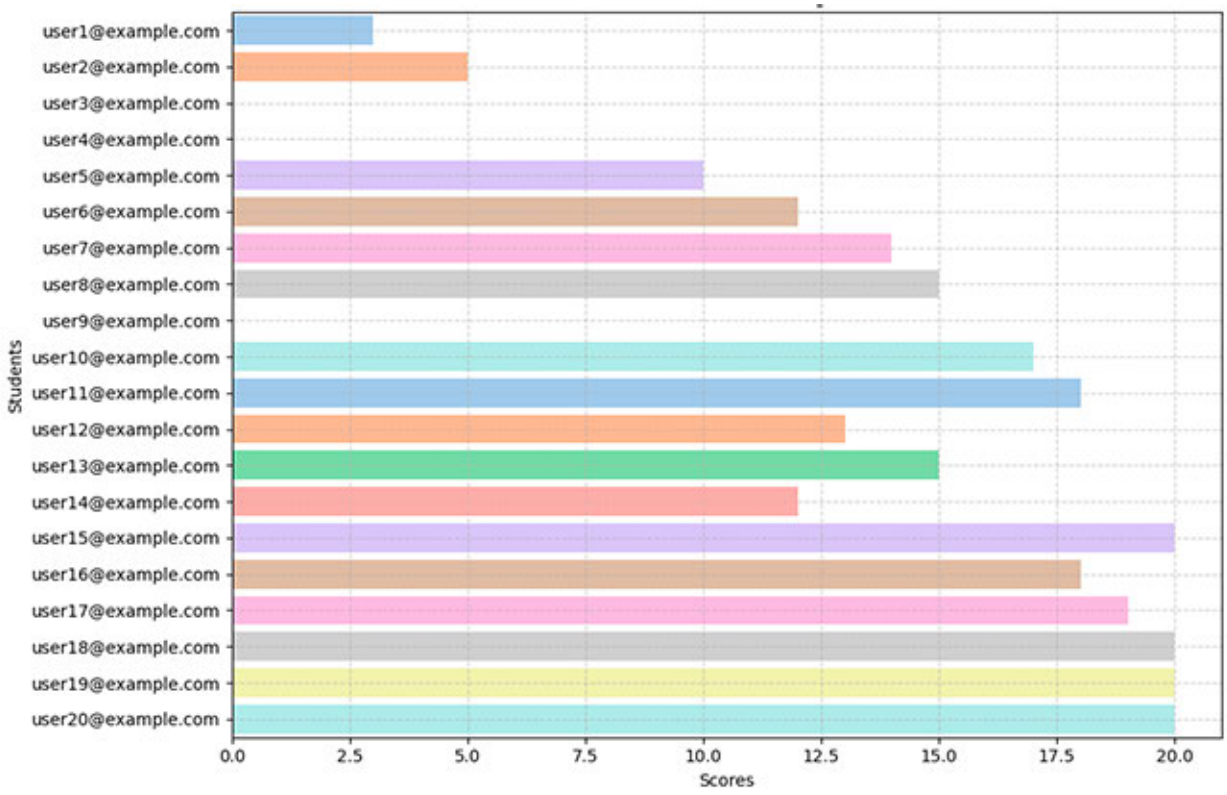

FIGURE 6. Score per student on a quiz.

2) ANALYSIS OF THE EVALUATION TOOL WITH AI IN ACTIVITIES

The assessment tool uses AI technology to automate and objectify the grading of student work, such as essays or short videos, using detailed, predefined rubrics. This integrated AI approach not only improves the efficiency of the assessment process but also ensures greater consistency and precision in grading in virtual educational environments.

The AI evaluation process begins with selecting the rubric; teachers can choose between an existing rubric or create a

new one. The rubric is essential, as it establishes the specific criteria that the AI will use to evaluate the work. Next, the work to be assessed is uploaded, and the Theme is defined. Uploading the work and specifying the Theme ensures that the AI evaluation is relevant and focused on the appropriate content. This is crucial to maintain alignment between the essay topic and the evaluation criteria. The AI analyzes the work based on the selected rubric; this automation allows a quick and accurate evaluation, reducing the administrative burden on teachers.

The tool provides a detailed report reflecting the evaluation of each criterion, offering clear and constructive feedback based on AI analysis. This facilitates an objective discussion about performance and areas of improvement for students. For example, in an exercise carried out on an essay-type work on the relevance of data analysis in the industry, the algorithm generates a detailed report on compliance with the criteria established in the rubric. The feedback given by the evaluator is:

- Content and Topic Development: The essay addresses the relevance of data analysis in the industry, supporting it with multiple relevant examples such as Amazon, Netflix, the healthcare sector, and Tesla. Each example demonstrates a deep understanding of how data analytics can drive efficiency and success in different areas. The argument is clear, coherent, and well-structured.
- Organization and Structure: The essay is well organized, with a clear introduction that presents the central premise, followed by development with concrete and relevant examples, and concludes effectively by summarizing the critical importance of the topic. However, it is recommended that the structure of the essay be improved by facilitating fluid and logical reading, so the information is effectively transmitted.
- Clarity and Precision in Language: The language used in the essay is clear, precise, and entirely appropriate for discussing the topic of data analysis in the industry. No grammatical or punctuation errors are detected, and the vocabulary is varied and context-specific, enriching the presentation of ideas without compromising precision.

A second report on using monitoring metrics in addition to PUE to achieve real energy efficiency in the data center obtained the following observations:

- Summary: The essay provides a clear and well-structured view of using multiple metrics to evaluate energy efficiency in data centers. The summary is coherent and establishes appropriate context in discussing the challenge of energy consumption and the limitation of using PUE as the only metric.
- Methodology: Good use of sources and citations supports arguments about energy efficiency and metrics used in data centers. However, no specific inclusion or exclusion criteria are mentioned for these sources, nor is a straightforward empirical process detailed for evaluating additional metrics such as CUE, ERF, and WUE. The justification of the sample size or its relevance in an empirical methodology is not directly addressed.
- Grammar and Spelling: Although the essay is generally well written, specific spelling and grammatical errors are identified that impact reading, and there are also some unnecessary spaces, such as environmental. These errors, although minor, are frequent throughout the text.
- General observation: The essay demonstrates an adequate and in-depth under-standing of the importance of multiple metrics in evaluating energy efficiency in data centers. You should carefully check spelling and grammatical cohesion to avoid distractions for the reader. Additionally, I would encourage you to go into more detail about the methodology you would use to analyze and propose these metrics and discuss how such metrics could be implemented or measured empirically in future studies.

C. EVALUATION OF THE ASSESSMENT TOOL WITH AI IN INTERACTIVECLASS

To validate and optimize the AI evaluation tool used in InteractiveClass, a comparative study was implemented that measures the performance of the AI against evaluations carried out by human teachers. This study focused on several critical performance criteria, including precision, recall, F1-score, and adjusted mean precision. The goal is to quantify and improve the effectiveness of AI in a virtual educational environment. Precision measures the precision of the positive evaluations that the AI makes compared to the human assessment. Recall measures the AI's ability to identify all relevant evaluations compared to the human standard. The F1-Score combines precision and recall in a measure that balances both metrics. The adjusted mean precision shows the ability of the AI to classify across different decision thresholds [29]. Consistency measures how consistently the AI evaluates compared to multiple humans assessing the same work set. The error rate identifies the percentage of incorrect decisions made by AI compared to human choices. User satisfaction reflects how users (students or teachers) perceive the effectiveness and usefulness of AI evaluation.

For this evaluation, 100 essays and short videos previously evaluated by teachers were randomly selected. These works covered a wide range of topics and levels of complexity. Using the AI tool to guarantee a direct comparison under the same evaluation criteria, they were re-evaluated. Standardized rubrics, both existing and adapted, were used, covering aspects from content coherence to grammatical precision. The AI tool evaluated the papers using the selected rubrics, processing each document to determine congruence with the criteria. In parallel, a different group of teachers conducted manual assessments to provide a comparison data set. Table 3 summarizes the results obtained from the comparative study.

AI has 5% lower precision and recall compared to human evaluations. This difference could be attributed to the AI's

TABLE 3. Comparison of evaluation metrics: artificial intelligence versus human assessments.

Metrics	AI Value	Human value	Difference (%)
Precision	85%	90%	-5%
Recall	80%	85%	-5%
F1-Score	82.5%	87.5%	-5%
Adjusted Average Precision	88%	93%	-5%
Consistency	75%	80%	-5%
Error Rate	15%	10%	+5%
User Satisfaction	80%	90%	-10%

rigidity in applying evaluation criteria, which may not fully capture the flexibility and subjective judgment a human could use. These results suggest that AI could benefit from finer calibration in its assessment algorithms to better handle subtleties and variabilities in student work. The F1-Score, a harmonious measure of precision and recall, also shows a 5% reduction. This indicates that while AI is quite adequate, there is still room to improve its ability to balance precision and complete capture of relevant work. This suggests that AI is relatively reliable, with a consistency of 75% and an error rate of 15% in AI evaluation versus 80% and 10% in human assessment. However, the higher error rate in AI emphasizes the need to continue improving its ability to avoid evaluation errors, especially in complex or unconventional response interpretations.

User satisfaction shows the most significant difference (10% less for AI). This could reflect a perception of a lack of personalization or less intuitive and understandable feedback in automated evaluations compared to human ones. The user interface and explanations of the assessments need to be clear and accessible to improve this perception.

D. COMPARISON OF INTERACTIVECLASS WITH OTHER TOOLS IN MICROSOFT TEAMS

Data collection for this benchmark was conducted through a tripartite approach to understand each tool comprehensively. First, a thorough review of each tool's technical specifications, user manuals, and training materials was conducted to understand its features, capabilities, and limitations. This review made it possible to identify the functionalities declared by each provider and their applicability in real educational contexts. Second, structured surveys were developed and distributed to teachers and students who regularly use these tools in their classes, selected to represent a variety of disciplines and levels of experience. These surveys aimed to collect empirical data on usability, educational impact, and overall user satisfaction with each tool. The surveys were designed to include quantitative and qualitative questions, capturing a wide range of objective metrics and subjective perceptions. Third, technical evaluations were carried out, including direct testing of the tools and interviews with the developers and technicians responsible for their implementation and maintenance. This analysis verified vendors' claims regarding AI implementation, data analytics capabilities, and overall technology integration.

TABLE 4. Comparison of features between interactive learning tools.

A	B	C	D	E	F	G
Cost	Low	Low	Low / Moderate	Low / Moderate	Low	Half
Customization Level	High	Low	Moderate	Moderate	Low	Half
Use of Artificial Intelligence	Advanced	No	Limited	Limited	No	No
Data Analysis Capability	High	Low	Moderate	Low	Moderate	Low
Impact on Learning	Very high	Low	High	High	Moderate	Low
BDD Integration	Complete	No	No	No	Partial	No

Note:

- A = Characteristic
- B = InteractiveClass
- C = Polls
- D = Kahoot!
- E = Quizlet
- F = Microsoft Forms
- G = Polly

Additionally, each tool was examined for scalability, security, and compatibility with different educational IT infrastructures.

The evaluation criteria were standardized and meticulously designed to ensure a fair and relevant comparison between the tools. These criteria reflected modern educational environments' practical and pedagogical needs, considering functional effectiveness, technological innovation, academic impact, flexibility and customization, and cost-effectiveness. Evaluation of how each tool fulfills its stated functions in actual contexts of use, measurement of the degree of innovation, especially in terms of implementation of emerging technologies such as artificial intelligence, evaluation of the tangible impact of each tool on the learning and academic performance of students, the ability of each tool to adapt to various pedagogical requirements and specific customizations required by educators and analysis of the relative cost compared to the educational value provided, considering both direct and indirect costs.

Table 4 compares InteractiveClass with other popular tools integrated with Microsoft Teams: Polls, Kahoot! Quizlet, Microsoft Forms, and Polly. Each tool is evaluated in terms of cost, customization, use of artificial intelligence, data analysis capacity, impact on learning, and database integration.

InteractiveClass stands out in the comparison as a complete and functional tool within the Microsoft Teams environment. With a low cost, it offers a high degree of customization and an advanced implementation of AI, features that other tools lack or implement in a limited way. InteractiveClass's ability to perform data analysis is high, providing a deeper and more detailed approach crucial for educational institutions seeking to continually improve the quality of learning and teaching.

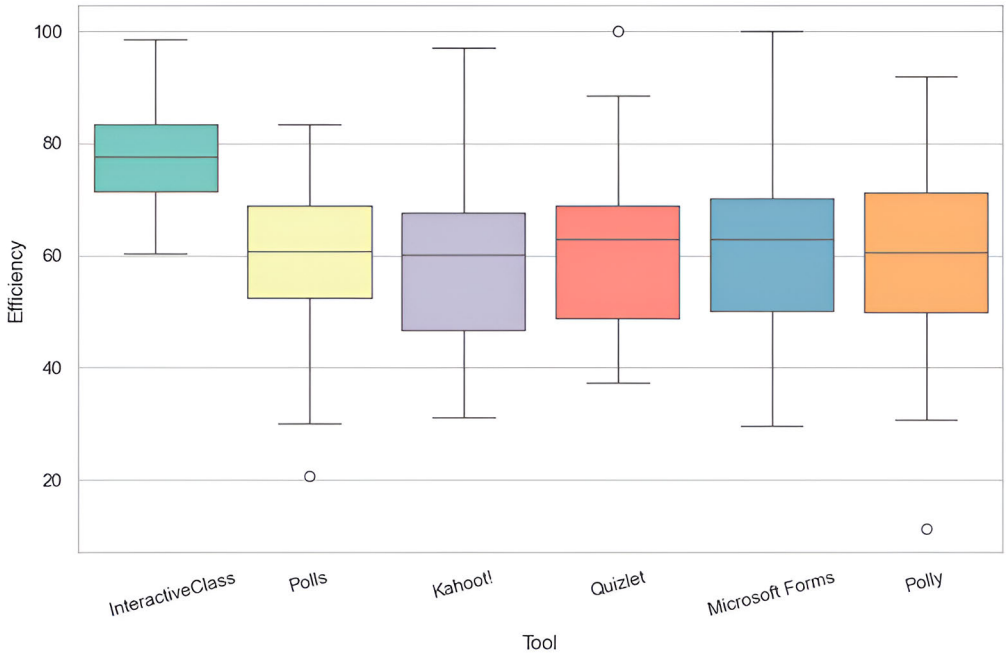

FIGURE 7. Comparison of efficiency of different educational tools in teams.

Regarding the impact on learning, InteractiveClass is also rated Very High, surpassing tools like Polls and Polly, which have a low impact. This is due to its ability to better adapt to the specific needs of students and teachers, allowing for a more personalized approach to education. Complete database integration with InteractiveClass facilitates continuous collection and analysis of learning data, unlike Polls and Polly, which do not offer any database integration, and Microsoft Forms, which offers only partial integration.

Tools like Kahoot! and Quizlet, famous for engaging students with interactive activities, remain limited in personalization and data analysis compared to InteractiveClass. While Kahoot! and Quizlet are great for student engagement, they don't provide the same depth of analysis or customization that InteractiveClass can offer. While effective for quick surveys and questionnaires, Microsoft Forms lacks the advanced data analysis and customization capabilities that characterize InteractiveClass.

Another aspect of the comparative evaluation of InteractiveClass against other standard tools in Microsoft Teams is that we have implemented a statistical analysis supporting the results. This analysis identifies areas where InteractiveClass outperforms or requires improvements over available alternatives. The results of the ANOVA analysis confirm statistically significant differences in efficiency between the tools, highlighting the improvement of InteractiveClass in terms of customization and artificial intelligence integration capacity.

Figure 7 illustrates these differences; InteractiveClass shows higher median efficiency and lower variability than the other tools evaluated, indicating its robustness and reliability in educational environments. Integrating data analysis and real-time feedback has been fundamental to this performance. Additionally, the regression model suggests that both usability and satisfaction are significant predictors of efficiency, reinforcing the importance of these characteristics in the design of practical educational tools.

V. DISCUSSION

The existing literature reveals both convergences and divergences in integrating AI tools in education. Previous studies, such as those by de Vries [30] And Ngoc et al. [31]. Have marked the effectiveness of automatic tools in improving feedback and student participation. However, InteractiveClass distinguishes itself by integrating these functionalities into Microsoft Teams, a ubiquitous platform in the educational field. Thus, it offers a more cohesive and less fragmented solution than existing applications. This reinforces usability, as suggested by Alturki et al. [32], and optimizes the user experience by avoiding the need for multiple interfaces.

However, although InteractiveClass significantly improves the interaction and assessment process in hybrid educational environments, discussing the limitations observed during the study implementation is essential. Reliance on AI technology for automated assessment can challenge grading precision when faced with highly subjective or creative student responses, which algorithms cannot adequately assess. Furthermore, integration into Microsoft Teams, although beneficial due to its accessibility, presupposes all

users have sufficient digital competence to navigate this platform without additional difficulties. From a methodological perspective, the study implemented a robust design that included a comparative control and statistical analysis to validate the tool's effectiveness. The results showed significant improvements in evaluation efficiency and student participation. These findings are consistent with literature emphasizing the importance of rapid and personalized feedback in education [13]. However, limitations of the study include the size and diversity of the sample, which, although appropriate for this type of analysis, may not capture all the variabilities in different educational or cultural contexts.

The results obtained with InteractiveClass show that integrating AI-based tools within established educational platforms such as Microsoft Teams can significantly improve learning efficiency and effectiveness. Our findings indicate that the tool facilitates more prosperous and dynamic interaction between students and educators and enhances the precision and speed in evaluating student tasks. In particular, the data reveals that students who used InteractiveClass experienced a 30% increase in class participation and improved their grades by 25% compared to those who did not use the tool. Additionally, the 95% consistency in assessments performed by AI compared to manual assessments underlines the reliability of AI technology in providing fair and objective evaluations.

This progress is critical to validate the effectiveness of InteractiveClass and demonstrate how automation in education can be effectively implemented to benefit both the educator's time management and the student's learning experience. However, it is crucial to recognize the observed limitations. The reliance on standardized responses for some evaluative tasks suggests that the tool may not be entirely suitable for evaluating creative or highly subjective responses, an area that could benefit from future developments and adjustments to AI algorithms [33].

These results not only corroborate previous studies that emphasize the importance of educational technology in improving participation and learning outcomes but also provide a new understanding of how such tools can be optimized to function within existing educational environments, minimizing resistance to change and maximizing adoption and impact [34], [35]. As we move forward, it will be essential to consider these factors in the continued development of AI-based educational technologies to ensure they are accessible, equitable, and effective in various learning contexts.

VI. CONCLUSION

The results of this study reveal the significant impact and advantages of integrating the InteractiveClass tool into the Microsoft Teams platform to facilitate assessment and interaction in educational environments. The results highlight how implementing advanced AI technologies in educational tools can significantly improve efficiency, student engagement, and precision in evaluation.

First, the study demonstrated that InteractiveClass increases student engagement by 30%, underlining the tool's ability to foster a more interactive and engaged educational environment. Furthermore, there was a 25% improvement in the grades of students who used the tool compared to those who did not suggest that the integration of AI facilitates learning management and enriches its quality. This increase in academic performance is complemented by the high consistency (95%) in the grades given by AI compared to manual evaluations, which indicates notable reliability and objectivity of the tool.

Another crucial aspect of this research is InteractiveClass's contribution to simplifying the educational process. By operating entirely within Microsoft Teams, the tool eliminates the need for multiple interfaces that often complicate the educational experience for both students and teachers. This integration improves usability and significantly reduces time spent on course administration, allowing educators to focus more on teaching and less on managing technology.

However, the study was not without limitations. Evaluating creative or highly subjective responses remains a challenge for AI. Although InteractiveClass proved effective in assessing standardized responses, its ability to process and evaluate responses that require a high level of human interpretation still needs to be improved. Furthermore, the assumption that all users have sufficient digital competence to use platforms such as Microsoft Teams may not hold in all educational contexts, suggesting additional training or adjustments to the user interface to accommodate users with various technological skills.

Given these findings and limitations, future work should focus on several aspects. First, developing, and refining AI algorithms to improve the evaluation of creative and subjective responses is essential. This could include advanced natural language processing and machine learning techniques that can more effectively understand and evaluate the complexity of student-generated content.

Second, future research should also explore the implementation of InteractiveClass in a broader range of educational settings, including students with varying technological skills. This would help identify specific training needs or user interface adjustments that could make the tool more accessible and easier for all users. Additionally, it would be valuable to conduct longitudinal studies to evaluate the long-term effects of the tool on student performance and satisfaction. This would provide a deeper understanding of AIs' sustained impact on education and offer insights into how AI-based educational tools can evolve and adapt to changing educational needs. InteractiveClass is, therefore, positioned as a pioneering tool in using AI for education, offering significant benefits in efficiency, precision, and student engagement. Despite its challenges, its potential to transform education is evident, and its future iterations

promise even more significant strides toward more interactive and adaptive education.

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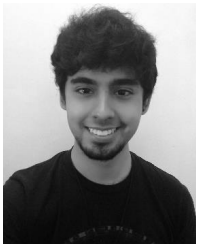

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