Evaluating the Impact of Interactive Elements in MOOCs on Student Engagement and Learning Outcomes in Palestinian Higher Education with an AI Focus

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***Abstract*—Implementing Massive Open Online Courses (MOOCs) in Palestinian higher education institutions has brought closeness to solving the challenges of the scarcity of resources and political instabilities within the facilities. Therefore, this paper examines the impact of interactivities such as quizzes, discussion forums, and real-time feedback in managing MOOCs on improving learners' engagement and learning profile. Furthermore, it analyzes how Artificial Intelligence (AI) can enhance these approaches and other interactive attributes such as personalized content presentation, intelligent learning systems, and adaptive learning interfaces. A qualitative data analysis method has been used. The current study, therefore, examines the participants' views regarding how AI-enhanced interactions impact the learning engagement and the performance of the learners who attended a MOOC. Data were collected through interviews with MOOC participants, and thematic analysis was used to identify key themes and patterns in their responses. A call into the thematic meaning of the data reveals some advantages of using AI in learning, such as personalization, feedback, and adaptability, all of which promote efficacy in education. The studies indicate that incorporating AI features into MOOCs can help solve problems that Palestine education faces today—at a larger scale and more flexibly. The study concludes with recommendations for using AI technologies, the training of educators who will use AI in their teaching, and the support of students reachable through MOOCs with AI technologies to enhance the quality of higher education in Palestine with AI-assisted MOOCs. The findings presented in this paper are relevant for teachers and authorities who work to improve learning results in the region's higher education system.**

***Keywords*—Massive Open Online Courses (MOOCs), Artificial Intelligence (AI)-enhanced learning, interactive learning, student engagement, personalized content, intelligent learning systems, adaptive learning interfaces**

I. Introduction

Massive Open Online Courses (MOOCs) are the most significant educational achievements, especially considering the possibility of freely joining courses from any corner of the Earth [1]. Regarding Palestinian higher education, the possibility of using MOOCs to expand the horizon of possibilities in education and improve the quality of learning in scarce resource contexts becomes one of profound importance [2]. This research aims to identify and analyze the effectiveness of the various interactive features used in MOOCs to establish the possibility of using Artificial Intelligence (AI) to build a better MOOC platform.

To support the recommendation of integrating MOOC into traditional coursework, we can find the positive effects of such features as quizzes, discussion forums and real-time feedback to ensure students are attentive to the material being presented and increase their chances of success [3]. Other intelligent technologies, including adaptive learning systems and intelligent tutors, can build on these interactive features in presenting real-time and self-directed content to learners' characteristics [4]. Therefore, with the help of AI, the further development of MOOCs will lead to customized learning experiences to meet learners' needs, hence integrating effective delivery of knowledge.

This study is most relevant to Palestinian tertiary education because it revealed that the traditional effective structures have been threatened by challenges like political transition and poor funds, among others [5]. If rich-media installations are implemented into MOOCs in AI/ICT tools, these difficulties would likely not be experienced since practical and various approaches to learning could be utilized. The use of MOOCs in Palestinian higher education has had its challenges, such as a resource deficit, lack of access, and the requirement for a wide variety of content. Moreover, structures in traditional education systems in Palestine also need help, including political instabilities and limited funds, hamper education provision and quality [6]. Based on these issues, it is clear that MOOCs may present a viable means for reaching learners who need access to learning. Such elements as quizzes, discussion forums, and even real-time interaction are necessary to retain interested students and enhance student learning in MOOCs [7]. These elements enhance learners 'involvement, creating a learning environment that enhances engagement. For example, quizzes enable students to check whether or not they have grasped the subject comprehensively, while discussion forums enable students to share knowledge with others. Another benefit of face-to-face real-time feedback is that it is given instantly, and the students' mistakes can be corrected immediately [8].

Previous research has established that features within a MOOC, including quizzes, discussion forums, and feedback in real-time, have been shown to improve learner engagement and performance [9–11]. For instance, Hew *et al*. [9] posited that learners retain more information by being engaged throughout the course via quizzes. Such discussion forums [12, 13], help in peer learning as well as prepare the community of learners, thus enhancing completion rates. feedback in real-time informs learners immediately on how best to correct perceived misconceptions more effectively [14] like other gaming-related elements, such as badges and leader boards, impact student interest and motivation in MOOCs [15]. Nonetheless, Lei *et al*. [16] pointed out that the improvements made have yet to be examined to the extent possible within the current literature store to explore the

extent of interactivity propelled by AI support.

AI offers possibilities of making these features more interactive by offering individualized content, intelligent content delivery, and intelligent assistants such as intelligent tutoring systems [17]. Adaptive learning systems incorporating AI can help deliver a personalized learning experience that suits every student's learning ability and pace. One of the approaches in intelligent tutoring systems is the possibility of offering specific contingency advice to learners, thus overcoming the specified learning difficulties. Moreover, through the use of AI, patterns of student data can be generated and used to predict student learning outcomes. Hence, the solution can guide teachers in making appropriate decisions regarding the teaching methods to adopt or the type of action for a student [5].

The integration of AI into MOOCs holds significant potential to address the educational challenges in Palestinian higher education. By enhancing student engagement and achievement, AI can improve the quality of education in Palestine [18]. Therefore, exploring the impact of AI in interactive pedagogies in MOOCs on student engagement and achievements in the region's higher learning institutions is crucial.

While prior literature offers extensive research about the positive impact of these interactivity features, more research needs to be done on how AI can amplify these aspects. However, there are still open issues regarding the use of adaptive learning systems and intelligent tutors to make the MOOC learning experience more personalized, which are still being investigated and are the purpose of this research.

This study aims to answer the research question: How does the use of AI in interactive pedagogies in MOOCs influence students' engagement and achievements in the region's higher learning institutions for the improvement of education?

1) What is the current use of interactive elements in MOOCs within Palestinian higher education?
2) How do interactive elements in MOOCs impact student engagement and learning outcomes in Palestinian higher education?
3) What role does AI play in enhancing the effectiveness of interactive elements in MOOCs?
4) What recommendations can be made for integrating AI-driven interactive elements to improve MOOCs in Palestinian higher education?

II. Literature Review

In the last few years, MOOCs have grown in Palestinian universities mainly because of a desire to offer high-quality education despite scarce resources. This change was taken to the next level when the pandemic forced institutions to close their campuses and go entirely online. As of the year of [19], more than 60% of Palestinian higher education students have enrolled in at least one MOOC, and a significant percentage of them have a positive attitude toward the openness and the modality of engagement brought by these platforms. However, issues like learner engagement, motivation, and retention are still key enhancing areas, especially in low-connected internet connection and inadequate technical platforms [20].

From the above discussion, tools enabling interactivity in MOOCs play a crucial role in acquiring and retaining student interest. Some established features, such as quizzes, peer-to-peer discussions, and feedback mechanisms, affect the motivation and learning ability of the learners [21]. Interactive elements are particularly essential in the context of Palestinian HE due to the variability of learning contexts and the dearth of resources available to learners. To this degree, creative response skills are employed in quizzes, and AI-automated feedback is given to the student; the student is actively involved in the course and gets immediate feedback on performance. From similar and recent research done by Shehzad and Charles [22], the writer notes that the above constitutes enhanced student retention and understanding of a course by as much as 20 % compared to the courses not characterized by interactive elements. Specific to Palestinian students, interactive quizzes significantly improve MOOC completion rates, mainly in STEM courses where immediate feedback benefits learners [23].

One of the approaches MOOCs use is discussion forums so that students can discuss issues, ask questions, and create knowledge communities. This is especially important because peer interaction contributes to concept clarification and critical thinking. Avidove-Ungar and Busharian [24] also pointed out that engaging with the forum positively impacted the students' performance in the Palestinian MOOCs regarding their assignment scores and project quality. Gamification has been highlighted as a best practice that improves engagement in online learning platforms. Other components that correlate to improving the learning experience include artificial intelligence features such as student learning paths and adaptive content [25]. Another study conducted at Birzeit University (2023) proposed that using AI to support recommendations and provide gamified tasks was linked to the increased involvement of students and enhanced participation and completion rates that were described to contribute up to a 30% improved listener satisfaction in general [26].

As discussed, the incorporation of AI within MOOCs has created learning paradigms based on distinctive learning needs. Machine learning automated solutions, intelligent learning environments, and virtual teaching assistants are the most influential in delivering better learning outcomes to students. Intelligent tutoring systems depend on the use of artificial intelligence techniques that reveal student performances and help in the personalization of material. Liao *et al*. [27] assessed the adaptive learning system in Palestinian MOOCs. They reported the effectiveness of the adaptive learning system on overall student performance, especially for learners who face problems following the pace of MOOC content. The authors found that students interacting with AI-based systems had only 25% higher learning outcomes on more sophisticated tasks than basic non-adaptive MOOCs.

A Teaching Assistant is practical learning companion software designed to support virtual teaching activities and training by mimicking an AI Chatbot agent. On-demand support from teaching assistants, in the form of virtual teaching assistants and AI chatbots, is being embedded into MOOCs. All of these can answer queries posed by students in real time and provide explanations, tips and further resources. A study by Elsayed [28] on the subject found that students

utilizing the AI chatbots in Palestinian HE gained 18% on quizzes and enhanced their engagement levels.

However, several critical issues are posed by implementing AI integration in MOOCs in the Palestinian higher institutional environment. Namely, internet connection remains a sore point, especially when it is not guaranteed in certain regions, which jeopardizes the student learning process and hinders them from benefiting from other teaching aids that are based on AI [29]. Furthermore, most students and faculties need higher levels of digital skills knowledge, which makes MOOC interactive a challenge to implement [30]. However, there are huge possibilities. In MOOCs, AI is believed to solve the problem of lacking qualified tutors of specific disciplines by offering learners individual lessons and immediate feedback; this would offer students a much higher level of education than they can receive under regular circumstances [31]. Moreover, the recent push for integrating digital literacy in education policy in Palestine means there is potential to expand the use of AI-driven MOOCs further [32].

Iwadi, Ali, & Jabari [33] examined how CERAM Ghazouat engineers and employees see AI systems' effects on product quality and competitiveness. A statistically significant association existed between AI systems and competitive advantage. AI did not significantly increase product quality. Demartini, Sciascia, Bosso, & Manuri, (2024) [34] examined the administrative effectiveness of secondary school principals in Hafar Al-Batin Governorate in light of AI. The study explored how specialization, qualifications, school type, and experience affected principals' replies. It also examined how AI may improve principal performance. Al-Muraikhi suggested creating a flexible incentive system for AI superstars, equipping schools with AI infrastructure, and involving AI experts. The researchers suggested expanding the findings with more research.

Vinichenko, Melnichuk, & Karácsony [35] discussed how AI applications might improve higher education strategy and the strategic benefits for institutions that deploy AI. The study found that AI empowers educators, improves student outcomes, and streamlines learning. The report also underlined the need for stakeholder knowledge of AI's usefulness in education and addressed any barriers to its deployment. However, it is evaluated how AI-powered administrative tools affect corporate competitiveness in Mansoura, Egypt, targeting commercial banks. The study found that AI boosts competitive advantage in multiple ways [36].

Ain Shams University's theoretical and applied colleges were studied by Karakose [37] to see how AI affects university performance. This descriptive-analytical study demonstrated a strong positive correlation between AI and university performance. It also showed how the institution uses AI to link departments for efficient data sharing and collaboration. Halagatti *et al*. [38] examined AI's essentials and how its models improve schooling. The study linked AI to educational institution competitiveness, highlighting AI's importance in boosting education. It showed how AI applications like intelligent content, innovative learning systems, and virtual and augmented reality increase educational institutions' competitiveness. However, it stressed combining technology advances with strict control to protect educational institutions.

III. Materials and Methods

A. Research Design

This study's research method uses interviews to examine how the AI clever interactions in MOclever AIt the learners' engagement and their performance in the Palestinian HEIs. A quantitative research design was selected because it enables a detailed understanding of educators' experiences and attitudes toward using artificial intelligence in MOOCs. Semi-structured interviews used in the study provide enough freedom while keeping the study relevant to the proposed research questions. This method allows participants to post comprehensive personal accounts of their teaching activities and observations on the effects of AI and interactive tools on students. Since AI in education is still emerging, a quantitative approach is most suitable for capturing the details of the educator's experience.

B. Research Population

The research population consists of educators from three Palestinian HEIs: PTU Kadoorie; An Najah National University; Al Quds Open University. Only those institutions that are already participating in MOOCs or are planning to engage in this kind of learning have been chosen, primarily because these institutions are already embracing change and are open to experimenting in terms of adopting different technologies in educating students. Participants are selected purposively, especially teachers with prior experience in AI and MOOC. This sampling ensures the identification of participants who will be in a position to offer valuable information to the study. The criteria used in the selection include educators who fully engage in the use of learning content, including practices such as quizzes, forums, and AI tools within the MOOCs. A pool of about 20 educators is invited to attend, and hence, brings various experiences and views from various institutions.

C. Participants

The participants are selected directly from the administration of the universities selected in the study. Data gathering involves writing letters of invitation to participants informing them of the study's aim and objective, that participation is voluntary, and the inclusion criterion to be applied in selecting participants. The personal outcome is made clear to the participants; they are told that participation is optional and that they can discontinue at any time. Also, the participants are informed through writing about the study before it proceeds. This consent form outlines why the research is needed, what it means to participate in the study as an interview that may take about 10-15 minutes, and how their data will be secured and kept private. To the participants connected remotely, an electronic signature is only accepted to avoid delays.

D. Data Collection

Cued and guided interviews are used to handle the data collection in this study. These interviews are the best structured and flexible because they allow detailed responses to research questions. However, at the same time, the researcher ensures that all the topic areas are covered.

Individual interviews take about 10 to 15 minutes, including questions on participants' interactions with MOOCs and using interactive and artificial intelligence tools. In order to answer this purpose, questions are aimed at understanding how these instruments affect students' interest and performance in the course. Interviews may be conducted in a direct interview where the participants meet the researcher, or the interviews can be conducted through a video link. Every interview is conducted with the consent of the participants, and all interviews are taped to enable accurate data capture.

E. Data Analysis

Quantitative or quasi-experimental research is not suitable for this study since it will give sufficient information on the educators' experience and perception regarding AI-driven interaction in MOOCs among Palestinian HEIs. While a quasi-experimental design might be equipped to measure levels of engagement and performance, it could not allow the teachers to speak. It could not address the qualitative nature of the use of those technologies. Given the limited resources and politically sensitive context of the study in Palestine, this approach is comprehensive and flexible in addressing the AI phenomena. In this way, the researcher identifies how educators perceive this aspect in changing the dynamics of their teaching, integrating the student's interaction and learning accomplishments given…intermittent internet and lower levels of technology literacy. Due to the subjectivity and the emergent nature of the two qualitative approaches provide a lens to capture the different ways technology and learning interrelate, the study's findings will help formulate future policies and practices in AI MOOCs.

The analysis of the collected data is thematic; thus, the interviews given by the participants are studied to determine such patterns as themes. Thematic analysis, a robust method, involves multiple stages: first, the interviews are taken word for word in order to avoid any discrepancies. Subsequently, initial codes are created with the purpose of capturing concepts regarding AI, interactivity, and activity. These codes are then combined into broader categories that address the study's research questions. The last process is the process of analyzing these themes in order to determine the cornerstone of AI aided interactions on student modalities and performance. Validity and reliability of the analysis is sought to enhance by triangulation, that is, cross checking data obtained from different sources. In addition, a member check is done where respondents are allowed to go through the interview tapes and check the accuracy of the collected data.

F. Inclusion and Exclusion Criteria

A purposive sampling technique is employed in this study to make sure that the participants are knowledgeable in MOOCs and implementation of Artificial Intelligence in Palestinian Higher Education Institutions (HEIs). The following criteria are established for the inclusion and exclusion of participants:

1) Inclusion criteria

Educators from Palestinian HEIs: Employees must be working in one of the three targets Palestinian HEIs only: Palestine Technical University, Kadoorie, An Najah National University and Al Quds Open University as educators.

Experience with MOOCs: Masters enrolled learners must have been engaged in designing, delivering, or managing at least one MOOC within the last two years.

Use of AI Tools: Participants were required to implement AI interactive tools, such as quizzes, discussion forums, adaptive learning systems, intelligent tutoring systems, or feedback AI systems, in MOOCs.

Willingness to Participate: Informed consent is mandatory, and the participants must agree to participate in the study and give their experiences regarding MOOCs and the usage of Artificial Intelligence.

Fluency in English or Arabic: Interviewees must answer questions in English or Arabic, depending on the participants' preference.

2) Exclusion Criteria:

No Experience with MOOCs: Teacher participants who have never designed, taught, or administered any MOOC are ineligible.

No Use of AI Tools: The research excludes educators who have yet to adopt AI-based tools in their MOOCs.

Unwillingness to Participate: The Wards of this study are those who did not give informed consent or who were unwilling to be interviewed.

Administrative and Non-Academic Staff: The study does not include people working as administrators who do not teach or engage with MOOCs.

Educators from Non-Selected HEIs: Researchers from other universities besides the three selected HEIs (Palestine Technical University, Kadoorie; An Najah National University; Al Quds Open University) are also excluded from the study to follow the institutions concerned with AI technologies in MOOCs.

These criteria ensure that only participants who are directly related to the research objectives may contribute their knowledge concerning the use of AI and Interactive elements in MOOCs in the Palestinian higher educational context.

G. Validity and Reliability Tests

To ensure the validity and reliability of the study, triangulation is used by cross-verifying data from multiple sources, including different educators and institutions. Member checking is also conducted, where participants review and confirm the accuracy of their interview transcripts. A consistent interview protocol is followed for all participants, and an inter-coder reliability test is conducted by having multiple researchers code a subset of the data and compare results to ensure consistency in coding.

H. Ethical Considerations

Ethical considerations include obtaining informed consent from each participant, ensuring confidentiality, and seeking ethical approval from the institutional review board of each participating HEI. Participants are informed about the study's purpose, their rights, and how their data will be used and protected.

IV. Analysis and Results

A. Hierarchical Analysis

The hierarchical chart highlights the interaction data and

AI priorities based on educators' responses regarding the integration of interactive elements and AI in MOOCs; the areas of interest include the ability of AI to facilitate personalized learning, immediate feedback, and the flexibility to adapt the content according to the learners' performance, as illustrated in Fig. 1. This generally favourable position demonstrates how incorporating AI-enhanced elements benefits students and their learning process; at the same time, the noted drawbacks include updating content with AI, being fair toward students, and making such tools available to every student. The diagram also shows how MOOCs and AI can revolutionize education in Palestine through cost-effective, accessible and efficient education delivery models for a larger group of students.

The hierarchical chart also presents why MOOCs are integrated within the context of lifelong learning and educators' suggestions for continuous improvement in using AI tools. It also outlines the methods of developing and organizing MOOCs and provides information on the kinds of AI applications and the particular approaches they are employed in. In conclusion, the diagram provides a logical flow of how AI and interactivity in MOOCs can improve learning outcomes and educational Opportunities in Palestinian higher learning institutions.

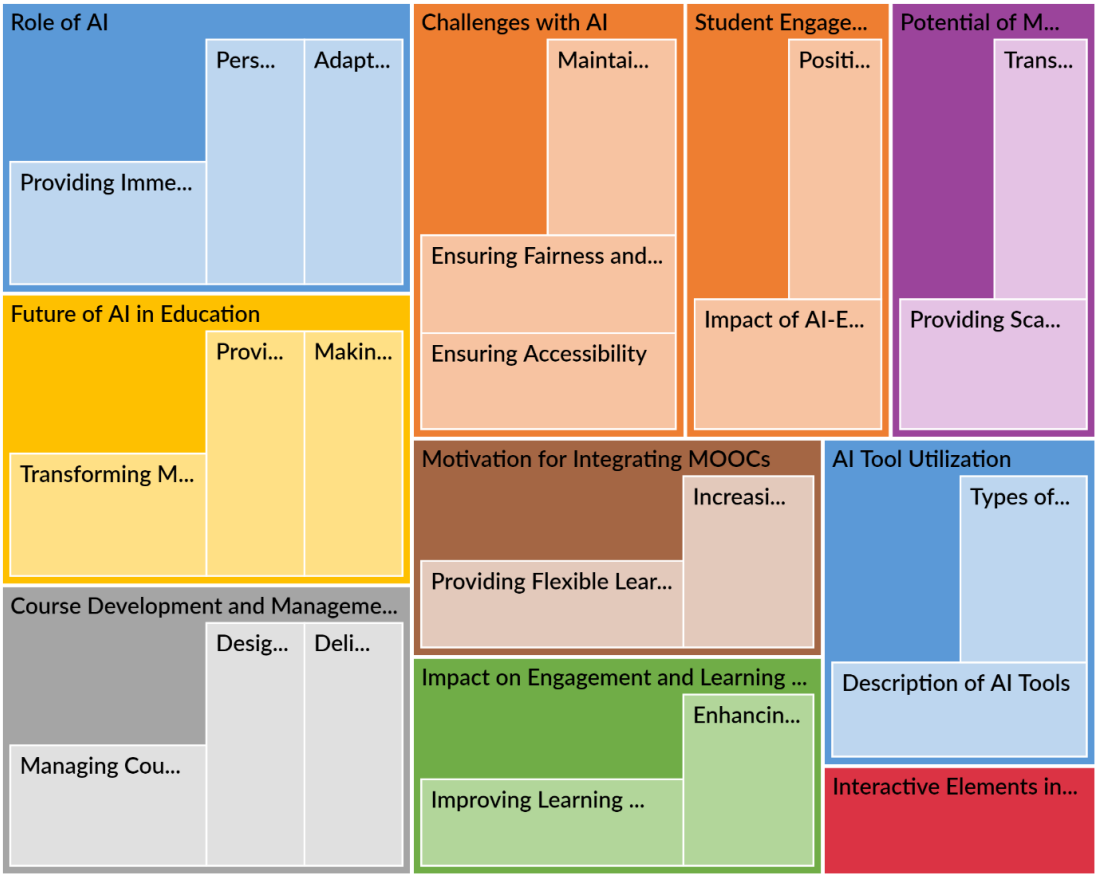

Fig. 1. Hierarchical chart.

Table 1. Thematic analysis

Theme	Sub-theme	Description
Role of AI	Providing Immediate Feedback	AI tools offer real-time feedback to students, aiding in timely correction and learning.
	Personalization	AI enables customization of learning experiences based on individual needs and preferences.
	Adaptability	AI tools adapt learning content and pace according to the student's performance and understanding.
Challenges with AI	Maintaining Fairness and Equity	Ensuring AI applications do not introduce or perpetuate biases, providing equitable opportunities.
	Ensuring Accessibility	Making AI tools accessible to all students, including those with disabilities or underprivileged backgrounds.
Student Engagement	Positive Impact of AI-Enhanced Learning	AI increases student engagement through interactive and adaptive learning experiences.
	Impact of AI-Enhanced Interactivities	Features like quizzes, forums, and real-time feedback, enhanced by AI, positively affect participation.
Potential of MOOCs	Transforming Education	MOOCs have the potential to provide scalable and flexible learning solutions.
	Providing Scalable Solutions	MOOCs offer educational opportunities to a large number of students simultaneously.
Future of AI in Education	Providing Continuous Improvement	AI continuously enhances education quality by adapting to new needs and advancements.
	Making Learning More Accessible	AI bridges gaps in education access, offering opportunities to a broader audience.
Course Development and Management	Managing Course Content	AI assists in organizing and managing course content for enhanced learning efficiency.

	Designing Courses	AI helps in designing interactive and engaging courses.
	Delivering Courses	AI tools effectively deliver course content to students.
Motivation for Integrating MOOCs	Increasing Access and Flexibility	Motivations include providing flexible learning opportunities and increasing education access.
	Providing Flexible Learning Paths	MOOCs cater to diverse learning paths and schedules, making education more adaptable.
AI Tool Utilization	Types of AI Tools	Various AI tools such as adaptive learning platforms and intelligent tutoring systems are used in MOOCs.
	Description of AI Tools	Detailed descriptions of AI tools and their specific applications in MOOCs.
Impact on Engagement and Learning Outcomes	Improving Learning Efficiency	AI improves the efficiency of learning processes and outcomes.
	Enhancing Student Performance	AI-enhanced interactive elements lead to better student performance and achievement.
Interactive Elements in MOOCs	-	This theme encapsulates all interactive elements discussed, highlighting their importance in engagement and learning.

Table 1 presents a clear and systematic breakdown of all the themes and sub-themes insofar as the use of AI in MOOCs in Palestinian higher learning institutions is concerned. It underscores the importance of AI in optimizing the immediacy of feedback, individualization, and flexibility of learning activities, thus engaging learners and improving their performance. The issues arising from AI are also highlighted, including issues of fairness, equity and accessibility, so as to show the need to approach it cautiously. The applicability of MOOCs for revolutionizing education through the solutions they deliver is emphasized, as well as the requirement for constant advancement and openness of learning. It also presents the rationales for using MOOCs, including expanding access and flexibility and the possibility of personalization. An overview of different AI tools, their definitions, and how they influence learning effectiveness and students' performance is provided. Last but not least, interactive content as a component of MOOCs is stressed to be highly significant for students' participation and better results. The findings of this study are helpful for educators and policymakers who seek to improve the quality of higher education using AI-based MOOCs.

B. Cluster Analysis

The clusters analysis combines items denoted by a similar number of words. It illustrates relationships between the corresponding themes regarding the influence of AI and interactive components in MOOCs on learners' engagement and performance, as in Fig. 2. Thus, the hierarchical clustering points to the fact that such elements as the influence on activity and learning results, can be associated with interactive aspects of MOOCs and the purpose of introducing MOOCs, which underlines that effective interactive initiatives and proper motivation play a decisive role in improving the experience and outcomes of students. The connection between the possibility of MOOCs and the role of AI is evident through the part focusing on AI, specifically, AI's ability to revolutionize practices and impact education.

Also, AI integration positively affects cognitive learning and participation levels, proving AI benefits students' performance and interest. Considering the benefits of using AI tools for content creation and updating, the problem of Fairness and Accessibility is one of the major concerns when implementing AI in education. The discussion on course development and management is linked to the future of AI in education. Hence, it implies that further AI enhancements will redefine MOOCs' delivery. In summary, the above diagram shows the complex interconnection of these themes. It shows how the AI and the interactive components are challenging and essential in enhancing MOOCs for improved learning results.

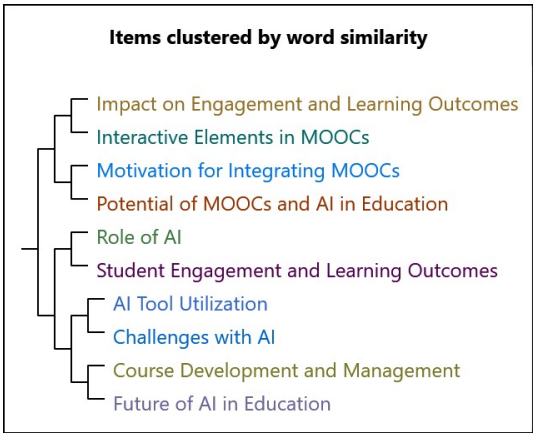

Fig. 2. Cluster analysis.

Fig. 3. Word cloud.

The word cloud, in Fig. 3, illustrates the terms that educators have discussed most when giving their opinions on the effectiveness of the selected interactive elements and AI in MOOCs about engagement and performance. Specific keywords like 'interactive', 'learning', 'MOOCs', 'student', 'elements', and 'students' demonstrate that these are some of the focal topics users discuss. Terms like 'feedback', 'improved', 'smart', 'personalized', and 'interactivity' denote the characteristics and advantages of AI integrated into MOOCs. Also, terms such as 'experience', 'education', 'technology', and 'providing' show ways technology can improve experiences in education. The appearance of such title words as recommendation, improvement, need, and continuous also points to ongoing improvement and meeting student requirements. In sum, the word cloud reaffirms the centrality of using the concept of interactivity with the help of

AI in MOOCs to enhance students' learning experiences in higher education.

V. Findings of the Study

This study's findings, which aimed to investigate the effectiveness of integrating interactive sections in MOOCs within Palestinian higher education in connection to AI specialization, are underscored by a rigorous analysis using hierarchical chart analysis, cluster analysis, and word map. These analytical tools have been instrumental in drawing out several crucial observations.

This hierarchical chart analysis results show that the topics connected to AI and MOOCs have a clear hierarchy. This indicates that AI plays a significant role in shoring up more interaction, providing feedback on involvement, and, more particularly, providing tailored cognition about MOOCs. The discussion presents how some software and technologies used in AI aid in adjusting the curriculum to learners' performance, greatly enhancing their performance. Moreover, the chart highlights areas requiring AI integration, including updating content frequently, equal assignment distribution, and ensuring all students incorporate advanced technology in class. All these are important to advance the AI-MOOCs plan and improve education outcomes.

To compare themes and identify connections between them, the related words are identified and grouped into clusters using the K-Means algorithm, which shows the interdependence of various factors for MOOCs. It proves that the kind of activities – including quizzes, polls, and discussion forums – implemented is highly connected with engagement and achievement. The utilization of MOOCs is more motivated by AI advantages, such as increased access and flexibility. The review points out the major role of AI, which indicates its applicability to enhance educational practice and the brightness of MOOCs. Several issues, for example, in the context of AI, including questions of accessibility to it or the possibility of having unbiased feedback, are also raised, which shows potential episodes that should be addressed more for proper realization.

The word cloud visualization is another summary of key terms with the frequency of occurrence derived from the study method that supports the information in the hierarchical and cluster analysis. Mentioned keywords, such as 'interactive,' 'learning' 'MOOCs', 'student', and 'elements', reflect the major topics under consideration. Terms like "feedback," "improved" "flexible," "customized," and "interactivity" represent the key characteristics and advantages of using AI in engaging and tweaking features. Concerning terms such as "recommendations," "improved," "needs," and "continuous" found in the entire visualization, the map likewise underlines the centrality of ongoing engagement and the active identification of students' requirements.

The hierarchical chart analysis, the cluster analysis, and the word cloud analysis all together indicate that integrating AI in the MOOCs by developing interactive elements enhances student engagement and the quality of student achievement in Palestinian universities. The following areas point out how AI helps to increase student engagement and the learning outcome: AI offers individualized and adjustable tools and comments on the coursework, thereby contributing to students' motivation and diligence. Nevertheless, the successful application of these technologies entails certain challenges regarding the accessibility of these technologies, the fairness of the processes based on these technologies, and the availability of updated content for continuous updating of the technology. The features of the MOOCs and AI in utilization of the educational output in Palestine are apparent: MOOCs can educate a vast number of people, AI as an element of the MOOCs—can educate each learner individually, and both approaches can influence education in Palestine as much needed scalable, flexible, and for as many people as needed solution.

VI. Discussion

The findings of this study reveal that interactive tools, including quizzes, discussion forums, peer assessment, and real-time feedback, are commonly used in MOOCs in Palestinian HEIs. From these interactive components, they were naive that they assist a lot in teaching, compelling learner's attention and hence enhancing learning accomplishments. Interactive elements have been highlighted as necessary in the previous literature, and this finding aligns with prior research. According to Jaiswal and Arun [39] quizzes and discussion forums are essential in supporting students and helping them improve their results. Similarly, Martin [40] stated that elements in the content material, such as feedback that AI generates as a result, have a clear correlation between retention rates and improvement in student performance, as evidenced by this research.

Furthermore, some faculties of Palestinian higher education showed relatively better results when these interactive options were included. The above hierarchal chart and cluster analysis from this study support and concretize these tools, inferring that with appropriate application, these tools are critical features of MOOC [41]. This concurs with the gamification which indicated higher engagement levels and improved performance due to the gamified and interactive learning environment we note here. Interestingly, terms such as 'engagement,' 'feedback,' and 'learning' were highlighted frequently through cloud visualization in line with the study's propositions [42].

As a result of the study, we have seen that students taking the MOOCs with interaction elements are more attentive and achieved better results than the control group participants. This concurs with the findings by Salas-Pilco *et al*. [43] who found that students in adaptive learning environments embedded in MOOCs had a higher learning accomplishment. The hierarchical chart analysis conducted for the current study also provides evidence of this fact, pointing towards a positive correlation with the interactive features that contributed to better student performance and retention rates. Zawacki-Richter, Marín, Bond, & Gouverneur [44] also fully supported the present findings and noted that increased communication with classmates in the discussion forum facilitates improved understanding and scholars' performance.

When applied to MOOC functionalities, AI integration was observed to impact learners positively. Adaptive learning, intelligent tutoring systems, and AI-based content delivery systems have evolved into new teaching methodologies that deliver new course content based on the

learner's capability. As mentioned in our cluster analysis, the differentiated instruction strategy proposed herein was also found to maintain student engagement and enhance performance for the duration of learning [45]. Techniques such as these are responsive and enable scenarios to be constantly changing, improving the learning process. Lucci, Musa, & Kopec [46] also made similar observations about the benefits of AI in MOOCs. They pointed out positive externalities to personalizing content and the kinds of motivation that come with presents.

However, our study also reveals some impossibilities, specifically how these technologies and intelligent learning systems can or will be implemented, made available, and fairly distributed for HEs in Palestine. AI-enhanced tools demonstrate unprecedented potential to improve a range of educational practices; however, if not implemented or made accessible to all, AI may widen existing achievement gaps. This concern has resonated with the statements made by Mushtaque, Awais-E-Yazdan, & Waqas [47] who pointed out that the reduced availability of technological infrastructure in some areas can constrain the advantage of AI in learning. Therefore, the appropriate technologies must be easily accessible by all to augment the benefits of the same on the learning and participation of the students.

Therefore, this research provides evidence of the importance of the pedagogical elements and the AI tools in enhancing MOOC students' engagement and performance in the Palestinian context. To make the most of these technologies, it is still important to discuss the remaining issues of access and equity. New investigations should be conducted to determine the accessibility and equitable distribution of Artificial Intelligence-supported learning instruments across various education environments.

A. Limitations

The primary limitations of this study include the lack of generalizability of the findings due to the purposive sampling method and the potential for bias in participants' responses, as those with positive experiences may be more inclined to participate.

VII. Conclusion and Recommendations

For this research, the impact of the active components of MOOCs on increasing the students' involvement and course outcomes concerning AI in Palestinian higher learning institutions has been studied. The study also revealed the utility of quizzes, forums, peer assessments, and real-time feedback and their positive link with students' participation and improved performance in MOOCs. Further to these advantages, AI tools and elements such as incorporated lessons and feedback tailored to reflect the learning profile of the students are offered. The research objectives were met by analyzing the present state in the field of MOOCs, the efficiency of using the interactivity parts, and the potentialities of using the application in designing the MOOCs. These practical implications concern pointing out that the constant professional training of educators is necessary to enable them to interact with the identified technologies correctly and remain satisfied with the available resources and content to ensure the fairness of technologies and update the content to achieve the maximum results with the use of AI-supported MOOCs.

In conclusion, the use of AI-involved interactive elements for MOOCs shows the right direction path that can lead to success in improving the quality of higher education in Palestine. It shows that educational organizations need recolonizations that cannot design a more effective, inclusive, and stimulating way to move the outlined challenges and employ the suggested initiatives. It would also help improve the student's knowledge retention while at the same time indirectly serving the noble aim of making education universally available to aspiring students across the globe.

Adopt AI Technologies: Promote the use of AI in the form of interactive features to be included within the MOOCs as it helps to add a personal touch to the process. Adaptive learning platforms, intelligent tutoring systems, and self-managed learning systems can offer customized content, individualized assessments, and feedback so that students can progress at the precise learning curve that is perfect for them while keeping the learning process interesting and stimulating.

Training for Educators: Develop detailed training on how educators can employ artificial intelligence applications and analyze data to provide the best lessons. For this reason, teachers were trained in the skills of using AI technologies in their practices, analyzing the data obtained, and changing their approaches in accordance with the results achieved by the students.

Student Support: Ensure strong infrastructures are in place to assist students in the structures brought about by AI and fully utilize the technological features for learning. This entails providing tutorials, help centers, and constant support to guarantee that students from all groups with different levels of technological literacy are in a position to find the AI-supplemented MOOCs useful and usable. Furthermore, incorporating the interactive elements into their education will also benefit from having instructions on how best to interact with them.

Continuous Improvement: Share changes and improvements to AI with others and/or parts of the interactive software used when issues arise and additional information is obtained. This means collecting data regarding the students' engagement and achievement, questionnaires and feedback about the AI-assisted solutions and tutees together with students and faculty, and continually modifying and improving AI tools and interfaces. The always-evolving concept ensures that artificial intelligence-based educational applications are useful and up-to-date.

A. Implications of the Study

The study's findings have implications for the effectiveness of transformative potential of AI-driven interactive elements in MOOCs. If ever designed and proposed in the Palestinian Higher Education Institutions. AI technologies play an essential role in promoting student's interests and achievements, which improves educational quality; that is why teachers use AI tools for providing feedback and personalized learning. This highlights the requirement to make a suitable investment in AI frameworks and enhance the professional development needs of instructors to maximize the use of the technologies. For example, when implementing AI learning, policymakers are

responsible for addressing equity and access so all students benefit from advanced learning environments. Constant research gathering and data analysis are required to improve AI applications, solve ethical issues, and ensure that educational technologies are valuable and practical. Thus, these endeavours might foster more effective, purposeful, and participative learning processes, thereby enhancing educational gains in Palestinian higher learning institutions.

APPENDIX

Questionnaire for Interviewing Educators on the Impact of Interactive Elements in MOOCs on Student Engagement and Learning Outcomes

This questionnaire is designed to gather comprehensive insights from educators about their experiences and perceptions regarding the impact of interactive elements and AI in MOOCs, aiming to understand their influence on student engagement and learning outcomes in Palestinian higher education.

Section 1: Background Information

Can you please tell us about your professional background and current role in higher education?

How many years of experience do you have in teaching or managing MOOCs?

Have you used AI-driven tools or platforms in your teaching practices? If so, please describe them.

Section 2: Experience with MOOCs

Can you describe your experience with designing, delivering, and managing MOOCs?

What motivated you to integrate MOOCs into your teaching?

Section 3: Interactive Elements in MOOCs

What types of interactive elements (e.g., quizzes, discussion forums, real-time feedback) do you use in your MOOCs?

How do you think these interactive elements affect student engagement and learning outcomes?

Can you share any specific examples or success stories related to the use of these interactive elements?

Section 4: AI Integration in MOOCs

How have you integrated AI-driven tools or systems into your MOOCs?

What role does AI play in enhancing the interactive elements of your MOOCs?

Can you provide examples of AI applications that have been particularly effective in improving student engagement and learning outcomes?

What challenges have you encountered in using AI-enhanced interactive elements in your MOOCs?

Section 5: Student Engagement and Learning Outcomes

In your observation, how do AI-enhanced interactive elements impact student engagement?

How do these elements influence student learning outcomes, based on your experience?

Have you noticed any differences in engagement and outcomes between students who interact more with AI-enhanced elements and those who do not?

Section 6: Recommendations and Future Directions

What recommendations would you make for improving the integration of AI-enhanced interactive elements in MOOCs?

How can educators be better supported in implementing AI technologies in their online courses?

What do you see as the future of AI in enhancing MOOCs and online education in general?

Section 7: Additional Comments

Is there anything else you would like to add about your experiences with MOOCs, interactive elements, or AI in education?

Do you have any other insights or suggestions related to this study?

Closing:

Thank you for your time and valuable insights. Your contributions are greatly appreciated. If we have any follow-up questions, may we contact you again?

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Olfat Abujarad conceptualized the research framework, designed the methodology, and conducted the data collection and analysis. She also led the writing of the original draft of the manuscript. Helmi Norman contributed to the refinement of the research design, provided critical revisions to the manuscript, and supported the interpretation of findings within the context of higher education and AI in learning environments. Norazah Mohd Nordin offered strategic guidance throughout the study, supervised the overall research process, and reviewed and edited the final manuscript for intellectual content and coherence. All authors reviewed and approved the final version of the manuscript.

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