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Utilization Of Moocs For Professional Development Among Mathematics Faculty In Saudi Arabian Universities

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Abstract
MOOCs have great impact in education for the different stakeholders as they offer an opportunity to learners to enhance their higher education and the faculty to hone their competence and professional development. Although there exist vast literature relating to the benefits of using MOOCs among the learners and the faculty in mathematics, there is paucity of information focusing on the Middle East. The purpose of this qualitative descriptive study was exploration of the use of MOOCs for the professional development and training of mathematics faculty at higher education institutions in Saudi Arabia. Data was collected from 20 participants with open and close-ended questions. For the qualitative data, the researcher conducted a six-step thematic analysis to identify the themes that provided the response to the research question. After the analysis, five themes were identified on how the sampled participants used MOOCs for their professional development and training of mathematics faculty in higher education. The themes were: educators use MOOCs to keep themselves updated, eeducators' use MOOCs as a collaborative tool, MOOCs were preferred by educators as they were offered Flexible and interactive learning, MOOCs was used by educators to improve their teaching skills and strategies, and educators faced challenges when using MOOCs in professional development.
Keywords: *MOOCs, Mathematics Faculty, Technology, Self-efficacy, STEM*

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I. INTRODUCTION

Technology has transformed mathematics instruction, leading to increased applications of technologies in higher education (Al-Adwan, 2020; Engelbrecht et al., 2020; Hoyles et al., 2020; Oh et al., 2020; Zaremohzzabieh et al., 2022). Massive open online courses (MOOCs) support mathematics instructors by improving access to continued education (Altalhi, 2021; Gonda et al., 2020). MOOCs provide a platform for personalized and adaptive learning environments for students in higher education and professional development (Kuo et al., 2021; Oh et al., 2019; Zaremohzzabieh et al., 2022). Scholars have highlighted the increased adoption and application of MOOCs across higher education (Al-Adwan, 2020; Engelbrecht et al., 2020; Hoyles et al., 2020; Oh et al., 2020; Zaremohzzabieh et al., 2022). Due to the increased prevalence of MOOCs in higher education, the number of publications over the last decade has also increased to understand their use (Irwanto et al., 2023). However, due to the recent adoption of MOOCs in higher education, there still needs to be more literature for further exploration, particularly regarding the use of MOOCs for the professional development of higher education instructors.

Further exploration of MOOCs surrounding the use and quality of MOOCs in higher education is an area in which further research is needed due to a lack of comprehensive findings (Alyoussef, 2021; Irwanto et al., 2023; Oh et al., 2019). Similarly, there remains a need for additional research on how MOOCs are used by mathematics instructors, particularly in the context of higher education (Taranto et al., 2020). Research on this topic is essential to identify policy and practice implications for improving the success of MOOCs for the professional development of mathematics instructors in higher education. Policies and practices that increase professional development opportunities foster a more encouraging environment and acknowledge and reward contributions. This study enhances the success and professional development of mathematics instructors in higher education.

The purpose of this study is to explore the use of MOOCs for professional development of mathematics instructors at higher education institutions in Saudi Arabia. To explore this phenomenon, the research question explored in this study is: How are MOOCs used for the professional development and training of mathematics faculty at higher education institutions in Saudi Arabia? Self-efficacy, introduced in the following section, will be utilized as the theoretical framing in this study.

II. THEORETICAL FRAMEWORK

The success of MOOCs within higher education depends on several factors, including learner self-efficacy. Bandura's social cognitive theory, developed from social learning theory, will be used in the present study to focus on self-efficacy (Bandura, 1986). Self-efficacy is essential for learning as it impacts an individual's perceived ability to complete a task (Al-Adwan, 2020; Bandura, 1986). Self-efficacy was found to be critical to behavioral and emotional engagement in MOOCs (Al-Adwan, 2020; Kuo et al., 2021). This result indicates that Self-efficacy affect the acceptance of MOOCs among students within the higher education setting. For this reason, self-efficacy was selected as the theoretical framing in the present study to understand how MOOCs are used for the professional development and professional development of mathematics faculty at higher education institutions in Saudi Arabia as a means of improving their self-efficacy in mathematics education.

III. REVIEW OF LITERATURE

This section reviews literature on the acceptance of MOOCs in the Saudi Arabian context, using the unified theory of acceptance and use of technology (UTAUT) as a framework to examine the factors influencing their adoption among students.

MOOCs in Higher Education

MOOCs provide learners access to continuous education beyond traditional online formats (Altalhi, 2021; Alyoussef, 2021; Gonda et al., 2020). Due to their accessibility, there has been an increase in the number of courses, institutions, and students enrolled in MOOCs (Alyoussef, 2021). In 2018, for instance, more than 81 million students were enrolled in more than 9400 MOOCs produced across 800 higher education institutions globally (Alyoussef, 2021). MOOCs are particularly relevant in higher education as students pursuing bachelor's degrees and higher degrees were the largest adopters of MOOCs (Al-Adwan & Khdour, 2020). However, these studies failed to address factors surrounding MOOCs' long-term applications and implications for higher education, particularly given the barriers to their success.

Scholars have also documented some notable challenges that are associated with MOOCs. Aldowah et al. (2020) documents that despite high enrollment rates, most of the users drop out at certain stages, even without attaining the intended learning outcome, which leads to low completion. Some of the reasons for the high dropout rates include lack of self-regulation, and greater independence and autonomy offered by these online platforms. While also indicating that low completion rate is associated with greater autonomy and independence, Kuo et al. (2021) indicated that engagement and self-efficacy contributes to success in usage of MOOCs for learning.

MOOCs in STEM and Mathematics Higher Education

MOOCs have been immensely used in furthering Science, technology, engineering, and mathematics (STEM) higher education as they provide support to student's education and professional development among the faculty members. Taranto et al. (2020) documented that MOOCs were effective in promoting better and professional teaching of mathematics. In a different study, Taranto et al. (2021) noted that MOOCs were beneficial to mathematics instructors and STEM faculty by providing professional development. Taranto et al. (2021) further demonstrated that MOOCS have structured academic format, which improves the competence of the educators on their pedagogy. The usefulness of MOOCs on promoting STEM education is widely studied.

The use of MOOCs in furthering higher education has been explored by several scholars. For instance, using MOOCs, it becomes possible to teach engineers in mathematical domains, due to their favorable simulation, comprehensive high-quality content, pedagogical, and technological perspective (Vagaeva et al., 2021). In another study, Taranto et al. (2020) also noted that MOOCs provided effective support to instructors teaching mathematics in higher education. The two studies are just an indication on the extent to which MOOCs have been used by faculty in STEM to promote learning in higher education.

Scholars have also documented the benefits that are associated with the use of MOOCs in mathematic learning. MOOCs have been found instrumental in increasing access to students in mathematics learning, right from the Bachelors to Masters' education (Gonda et al., 2020). Gonda et al. (2020) noted that with proper evaluation of the MOOCs to use, by the faculty and other users, students might benefit immensely and enhance their comprehension of mathematics in higher education. Barriers to success for learners using MOOCs for mathematics include "lack of spare time, the lack of skills of working in such format, and the lack of regulation for introducing the results of studying at MOOC into the formal educational process" (Vagaeva et al., 2021, p. 1). Due to the lack of understanding of the challenges surrounding using MOOCs in mathematics, further research is needed to identify implications for other contexts.

MOOCs in the Middle East

Despite evidence of the benefits of MOOCs in the context of mathematics higher education, there needs to be more literature on this topic in the Middle East. Among the limited research, scholars have explored the

factors surrounding the use of MOOCs in higher education in the Middle East. For instance, Al-Adwan (2020) explored the factors pertaining to the adoption and use of MOOCs by students in higher education. Highlighting the need for further research on this topic, Al-Adwan (2020) found that more guidelines were needed to support students in using MOOCs for their learning. Learners with more self-efficacy and perceived convenience were found to have increased behavioral intention to use MOOCs (Al-Adwan, 2020). Their finding indicates that, self-efficacy and perceived convenience are related to students' perceived usefulness and perceived ease of use of MOOCs. While the findings may not be generalizable to the Saudi Arabian context, the work of Al-Adwan (2020) demonstrates the importance of self-efficacy for student success in the use of MOOCs for higher education. Due to the increase of MOOCs in Saudi Arabia, despite limited research, the present study is significant in helping to contribute to existing evidence.

What is known is that MOOCs may have increased in the context of Higher Education in the Kingdom of Saudi Arabia. The increase in MOOCs has also proliferated with the support of the open science community by providing MOOCs available in Arabic (https://github.com/Open-Science-Community-Saudi-Arabia/MOOCs). However, as described by other scholars more research is needed to understand MOOCs across higher education context, and Saudi Arabia and the Middle East broadly is no exception (Al-Adwan, 2020; Engelbrecht et al., 2020; Hoyles et al., 2020; Oh et al., 2020; Zaremohzzabieh et al., 2022). Further research is essential to assess the sustainability, implications, challenges, and best practices for MOOCs in higher education. The present study aims to contribute to the limited literature on MOOCs in the higher education context in Saudi Arabia.

Among available research, a challenge pertaining to MOOCs, specifically in Saudi Arabia, is the acceptance of MOOCs in higher education. For instance, Altalhi (2021) utilized the unified theory of acceptance and use of technology (UTAUT) to explore the factors relating to the acceptance and use of MOOCs among students at Taif University. Altalhi (2021) found that behavioral intention to use MOOCs was impacted by attitude. Actual use of MOOCs was influenced by behavioral intention, attitude, and facilitating conditions. Attitudes toward the use of MOOCs among students were affected by performance expectancy, social influence, and computer self-efficacy (Altalhi, 2021). The present study aims to contribute further to the work of recent research on MOOCs by exploring the use of MOOCs in Saudi Arabia to identify challenges and best practices. In the section to follow, the methods and procedures used will be described.

IV. METHODS

The purpose of this qualitative descriptive study is to explore the use of MOOCs for the professional development and training of mathematics faculty at higher education institutions in Saudi Arabia. The present study aims to contribute to the limited literature on MOOCs in the higher education context in Saudi Arabia. To achieve this aim, qualitative methodology and a descriptive research design was used to answer the following question:

Research Question: How are MOOCs used for the professional development and training of mathematics faculty at higher education institutions in Saudi Arabia?

Qualitative methodology was selected, as the most appropriate for this study to explore as the focus on understanding the phenomenon in-depth rather than on the numeric relationship between variables (Creswell & Creswell, 2018). The need to explore this phenomenon in-depth was expressed by scholars (Al-Adwan, 2020; Engelbrecht et al., 2020; Hoyles et al., 2020; Oh et al., 2020; Zaremohzzabieh et al., 2022) due to the lack of understanding of MOOCs and their implications in the higher education context. This study is particularly significant due to this research void in the evolving realm of MOOCs as an emerging technology. The implications for both research and practice, derived from the data collected, will be elaborated upon in the findings section.

Qualitative data was collected using two sources of data. Utilization of multiple sources of data was essential in triangulating the findings. Triangulation involves comparing data across sources to ensure trustworthiness and add credibility to qualitative findings (Creswell & Creswell, 2018). The two sources of data were semi-structured interviews with mathematics instructors from higher education institutions across Saudi Arabia. An interview protocol will be developed to conduct the semi-structured interviews. Interview and survey protocols were developed prior to data collection and are included in the appendices.

Participant Recruitment

Participants were invited to participate in the study via a purposeful sampling of mathematics instructors across higher education institutions in Saudi Arabia. Purposeful sampling is the selection of participants based on criteria established by the researcher (Creswell & Creswell, 2018). The criteria for participants were as follows:

- Higher education instructor at a Saudi Arabian institution.
- Experience with MOOCs in mathematics education.
- Informed consent provided to a recorded interview (or interview notes recorded by the researcher).

Data Analysis

Six-step thematic analysis by Braun and Clarke (2012) was utilized to analyze the qualitative data obtained from the semi-structured interviews. Thematic analysis was used to identify the critical patterns in how MOOCs are used by mathematics higher education faculty. The data was coded and analyzed with the support of NVivo software. Iterative coding was conducted through line-by-line coding and code grouping. Code groups were then revised based on a review for appropriateness to the data. Braun and Clarke's (2012) six steps for thematic analysis include the following steps, which were used to organize the codes and identify emergent themes:

- Step 1: Review and become familiar with the data
- Step 2: Develop initial codes (open coding based on identified patterns)
- Step 3: Search for themes based on initial codes
- Step 4: Review the identified themes for accuracy and appropriateness of the data
- Step 5: Define and refine themes, including the development of theme descriptions
- Step 6: Write up/report the findings of the study (to be presented in the discussion of the results).

V. FINDINGS

The purpose of this qualitative descriptive study is to explore the use of MOOCs for the professional development and training of mathematics faculty at higher education institutions in Saudi Arabia. The present study aims to contribute to the limited literature on MOOCs in the higher education context in Saudi Arabia.

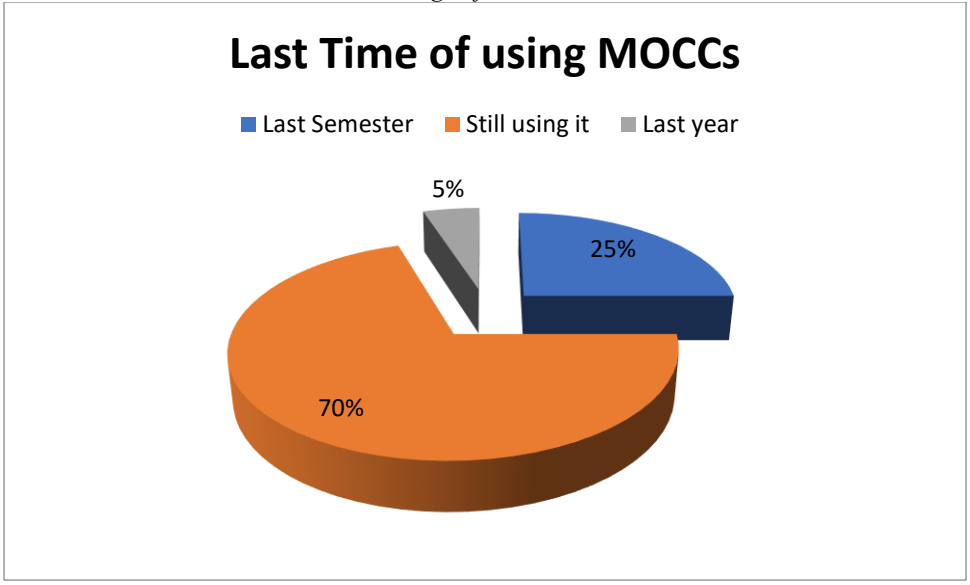
VI. Results

Use of MOOCSs descriptive data

From the analysis, it is evident that the majority of the participants are still using MOOCs for their professional development. This is evidenced by the findings that 70% of the sampled participants were still using it even now, while 25% used it last semester. In addition, 5% of the participants used it last year. The findings that all the participants have experience in using MOOCs validate the results since the sample encompasses people who may provide relevant information relating to the research question. Figure 1 represents a diagrammatic representation of the usage of MOOCs for professional development among mathematics educators.

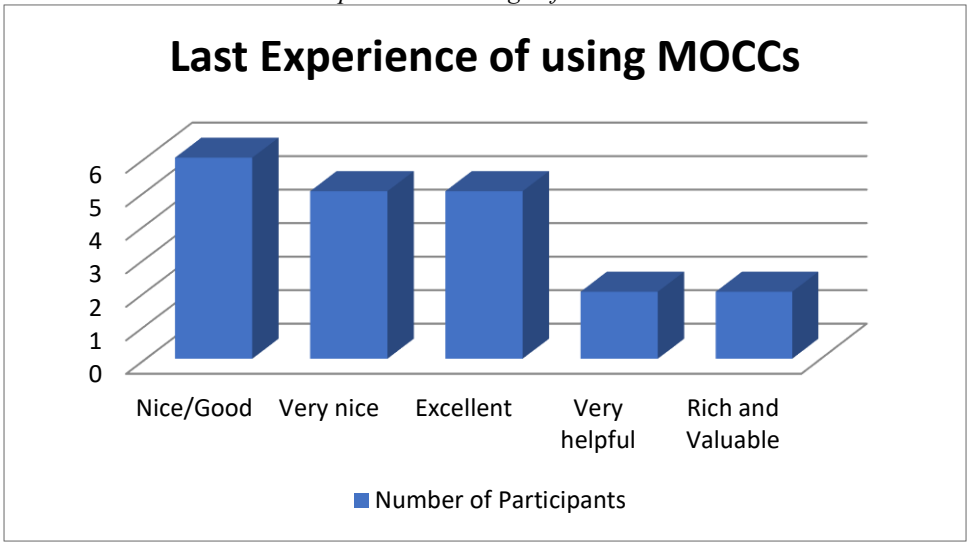
Figure 1

Usage of MOOCS



The analysis reveals that the majority of the participants had a positive experience when using MOOCs in their professional development. Six participants indicated that the experience was nice, while five of them noted it was very nice. In addition, five of the participants indicated an excellent experience from using MOOCs. Two participants indicated that MOOCs were very helpful to them. Two participants indicated that MOOCs are rich and valuable. Figure 2representsthe experiences of the participants in using MOOCs for professional development.

Figure 2
Experience in Usage of MOOCS



Findings from Thematic Analysis

From the analysis, six themes emerged that responded to the research question. The themes were formed after the aggregation of the common themes that showed a certain pattern. Only codes that reached data saturation were considered for this study. This means that codes that five or more participants evidenced were considered for the aggregation and forming of themes. Table 1 represents.

Table 1
Themes and Codes

Code	References	Themes
Being up to date	17	Educators use MOOCs to keep themselves updated
Being updated on trends	8	
Latest technologies knowledge	5	
Up to date on research development	6	
Challenges of using MOOCS	11	Educators faced challenges when using MOOCs
Limited interaction	5	
Quality and Relevance of materials	8	
Collaboration	15	Educators use MOOCs as a tool to enhance their collaboration with others and students.
Connecting and interacting with educators	10	
Learning from peers	6	
Interactive and engaging lessons	5	Educators used MOOCs in professional development as they offered interactive, flexible, and engaging lessons.
Flexible learning	5	
Teaching methods and strategies	29	Educators used MOOCs to improve their teaching Skills and strategies.
Assessment strategies	5	
confidence on instructors	3	
Hands-on strategies	3	
improved teaching skills	10	
New teaching strategies	2	
Valuable resources	38	MOOCs were valuable resources for educators.
Courses from top universities	5	
Quality and Cost-effective Resources	12	
Wide range of resources	21	

Educators use MOOCs to keep themselves updated

From the analysis, 14 participants indicated that they used MOOCS to keep themselves updated. This theme emerged from three codes participants indicated that MOOCS kept them updated on the trends, technologies, and research and development. For instance, Participant 7 said, "Instructors can use MOOCS to learn about the latest trends and issues in mathematics education, helping them stay informed and engaged with the field." Equally, Participant 12 noted, "Instructors can use MOOCS to learn about the latest developments in mathematics curriculum design, allowing them to better align their instruction with national and state standards."

Participants 4, 7, 12, 16, 15, 10 all agreed that they use MOOCs as tools to help them in understanding the trends in mathematics pedagogy. This assertion can be demonstrated by Participant 10, who noted, "I think MOCCs is a valuable tool for mathematics instructors who are looking to stay up-to-date with the latest trends and developments in the field. It offers a platform for collaboration and sharing of best practices that can help instructors improves their teaching and assessment practices." The statement by participant 10 resonates with what participant 15 stated, "Instructors can use MOCCs to learn about the latest trends in mathematics pedagogy, including flipped classrooms, blended learning, and other innovative approaches." The two illustrations demonstrate the use of the MOOCs as tools for enhancing the ability of the teachers to get the modern teaching approaches, and stay up-to-date with development in mathematics field.

The theme that educators use MOOCs to keep themselves updated represented the statements from 14 participants. The description of the theme was that MOOCs are used by teachers and students to remain updated with the latest in the mathematics field. Instructors could conduct research and use modern teaching methods after benchmarking from the MOOCs. On the other hand, students could benefit from the immense knowledge they derive from the information available from the MOOCs.

Educators use MOOCs as a collaborative tool

The researcher identified the theme that educators use MOOCs to enhance collaboration with students and other stakeholders. A total of 10 participants demonstrated that they were able to collaborate with the students and other educators thanks to the MOOCs. Concerning this, there was an agreement among participants 4, 5, 6, 8, 10, 11, 12, 16, and 17 all who pointed out at that MOOCs helps in promoting collaboration. For instance, Participant 4 said, "MOCCS provides a platform for instructors to connect with other mathematics educators from around the world, allowing them to share best practices and collaborate on new teaching strategies." Similarly, Participant 10 noted that it brought together people in the mathematics field. Participant 10 stated, "MOCCS provides instructors with access to a global community of mathematics educators, allowing them to share ideas and collaborate on new teaching strategies." Participant 6 recommended MOOCs due to the ability to connect teachers globally saying, "MOCCS is a great way for mathematics instructors to connect with other educators from around the world and share ideas and best practices. I would definitely recommend it."

This theme was identified from 10 participants, making it a strong theme. Participants noted that MOOCs are used to enhance collaboration between students and educators. In addition, students were able to engage with their fellow mathematics learners through peer learning.

MOOCs were preferred by educators as they were offered flexible and interactive learning

This theme represented the statement that MOOCs enabled the educators to offer flexible and interactive learning. This theme was developed after aggregation of three codes: flexible learning, engaging, and interactive. This means that educators who participated in this study noted that in Saudi Arabia, MOOCs helps them to provide better education to their students. Participant 3, 5, 10, 15, and 19 all agreed on the interaction and engagement offered by the MOOCs. To demonstrate this, Participant 15 said, "MOCCS offers courses on the use of games and simulations in mathematics education, which can help instructors create more engaging and interactive learning experiences for their students." This also resonated with the statement by participant 3 who stated, "Instructors can use MOCCS to learn about the latest technologies, software tools that can help them create more engaging, and interactive lesson plans." On the other hand, Participant 3, 10, and 16 noted that MOOCs allow flexible learning. This can be demonstrated by quote from Participant 3 who said, "I appreciated the flexibility that MOCCS offered. I was able to fit my learning around my work schedule and other commitments."

This theme can be described as the educators' opinion that they preferred MOOCs since they allow for interactive, engaging, and flexible learning. This theme was identified from 8 participants, making it a key finding for this study. The theme represented the use of MOOCs for training in mathematics among the Saudi Arabia educators, hence providing response to the research question.

MOOCs was used by educators to improve their teaching skills and strategies

Eleven participants noted that educators in Saudi Arabia used MOOCs as a way to improve their competence and teaching methods. Some participants indicated to using MOOCs to assess their teaching strategies. This was evidenced from Participant 13 who stated, "Instructors can use MOCCS to learn about

different assessment methods and strategies, allowing them to better evaluate student learning and progress." On the same theme, MOOCs enabled the educators to engage in a more hands training strategy as indicated by Participant 19 who responded by saying, "MOCCS offers courses on the use of project-based learning in mathematics education, which can help instructors, create more hands-on and applied learning experiences for their students." Participant 10 noted that using MOOCs, he was able to develop a more student-centered strategy to teaching mathematics. On the same note, MOOCs helped Participant 5 to learn new teaching strategies and techniques.

This theme meant that educators in mathematics used MOOCs as they noted its usefulness in allowing use of better teaching strategies. From 11 participants, who responded to the open-ended questions, a pattern was identified on the impact of MOOCs regarding the impact on teaching strategy. By demonstrating how the MOOCs was instrumental in enhancing professional development in mathematics through appropriate strategies, this theme provided response to the research question.

MOOCs are an important resource for educators

From the analysis, 17 participants indicated that MOOCs provided useful resources to the educators to enhance their teaching. This theme was developed after the researcher aggregated the following codes: quality and cost-effective resources, supplemental and support materials, and a wide range of resources. In regard to the quality and cost-effective resources, 10participants (1, 2, 3, 4, 5, 9, 7, 10, 20, 14), agreed that the materials provided by MOOCs were of high quality and offered value for money. This can be demonstrated by Participant 2 who said, "MOCCS provided me with access to high-quality courses that I wouldn't have been able to afford otherwise. I was able to improve my skills and knowledge without breaking the bank." Participant 10 talked on the issue of cost stating, "MOCCS is often available at little or no cost to participants, making it an affordable option for professional development."

On the same theme, but in a different dimension, three participants (11, 18, and 7) noted MOOCs offered supplemental materials for learning. This is evidenced from the statement by Participant 11 who said, "MOCCS was a great way to supplement my formal education. I was able to take courses on topics that were not covered in my degree program." Participant 18 indicated that he received adequate support from the MOOCs team when he need help while Participant 7 spoke about the expert guidance that he received from the MOOCs team.

Concerning the third code, Participant indicated that MOOCs offered a wide range of resources, which were helpful to the educators. For example, Participant 17 responded saying, "The resources and courses on MOCCS have helped me develop a deeper understanding of how to design effective lesson plans in mathematics education. This has increased my confidence in my ability to effectively teach and engage my students." Participant 8 explained how MOCCS offers a range of courses and resources that can help mathematics instructors.

The analysis revealed that participants identified MOOCs as a useful tool that could help in teaching and learning mathematics. From the three codes that represented the responses from participants, the theme on MOOCs as resources was developed. This theme clearly outlined how valuable MOOCs are in providing quality, cost effective, and diverse resources to the educators and learners.

Educators face challenges when using MOOCs in professional development

From the analysis, two major codes were aggregated to form this theme: Limited interaction, lack of relevance, and inadequacy of materials. This theme was identified by Participants who indicated they faced challenges when using MOOCs. These two challenges attained data saturation as the responses of a significant number of participants evidenced them. Five participants indicated that MOOCs offered limited interaction with the learners. Participant 1 said, "Despite the interactive elements included in MOOCS, the platform still lacks the face-to-face interaction that some instructors may prefer for professional development." Participant four said, "While MOOCS does provide opportunities for peer interaction, some instructors may still feel isolated and unsupported during the learning process." Participant 15 said, "While MOOCS does provide opportunities for networking, some instructors may find that they are not able to connect with as many professionals in their field as they would like."

Eight participants indicated that the materials offered in MOOCs lacked relevance to the educators and hence lacked adequacy to improve the skills and knowledge of learners. Participant 1 said, "While MOOCS includes some customizable materials, instructors may find that the course content does not fully align with their specific teaching needs." Participant 4 focused on the inadequacy of the materials offered in MOOCs, saying, "MOOCS may not provide all the resources that instructors need to implement the strategies and techniques learned in the course fully." Participants 4 and 8 showed similar responses indicating that despite their usefulness, MOOCs are not self-sufficient and may not provide all needed resources to learn mathematics. Similarly, participant 14 also stated that MOOCs lacked comprehensive assessment abilities.

The researcher identified the theme on the challenges after noting a pattern from participants who indicated that they faced several issues. Two notable challenges were the inadequacy of the materials and the

limited interaction between the MOOCs team. From this theme, some participants indicted that despite the positive attributes that were associated with use of MOOCs, there were shortcomings that hindered its ideal use for professional development and training in mathematics.

VII. DISCUSSION

The purpose of this qualitative descriptive study was to explore the how educators utilized MOOCs for their professional development among Mathematics faculty in Saudi Arabian Universities. The preliminary findings had indicated that MOOCs are valuable tools that have gained popularity among the educators to help in their teaching. The findings from this study have revealed that MOOCs provide the faculty members with an opportunity to access latest information and trends in mathematics, which correspond with those by Taranto et al. (2021) that most educators enroll for the courses to stay up-to-date in their field. Taranto et al. (2021) further explains that MOOCs offer a wide range of materials that offer recent information, topics, and strategies across different aspects right from introductory to the advanced levels, which resonate with the findings in the current study.

In the current study, participants emphasized that MOOCs provide a platform to enhance collaboration, networking, and peer learning. This meant that MOOCs were not only useful to educators, but also to learners, which correspond to the statement by Chiappe et al. (2020), who indicated that online learning platforms provide for networking and collaboration among different stakeholders. Participants in Saudi Arabia faculties also noted that they experienced flexibility, greater engagement, and interactive sessions from the MOOCs, which relates to a study conducted by Bettiol et al. (2022) indicated that MOOCs were useful in healthcare profession in promoting a greater simulation and interactive learning. While there is limited studies that have focused on the importance of the MOOCs in promoting mathematics professionalism and training, the current studies adds insights to the already existing studies.

The faculty members in Saudi Arabia also indicated that MOOCs provided them with different teaching approaches and strategies. This finding supports the literature indicating that MOOCs offers diversity in the manner of delivery and pedagogy on various disciplines, where the faculty can learn (Qureshi, 2019). Qureshi (2019) conducted the study among the Pakistan's faculty and concluded that instructors learned new skills and teaching delivery approaches from the MOOCs. The current study, which is based on the Saudi Arabia faculty, adds more insights to the topic by focusing on a specific population of study. Nonetheless, there were findings that MOOCs also had some shortcomings, which were also captured in previous studies. For example, consistent with the findings from this study, Joseph (2020) indicated that MOOCs need to be complemented with some other convectional materials. Equivalently, Meet and Kala (2021) noted that the suitability of MOOCs depends heavily on its appropriateness and evaluation before it is disseminated for use in education.

Implications

The findings from this study have shown that the use of MOOCs among the Saudi Arabian faculty is associated with numerous benefits. The faculty members who participated in this study have indicated that MOOCs helped them to remain up to date on the latest trends in mathematics field. Furthermore, participants have also shown that with MOOCs, learners and educators can collaborate, and even form networks. Another notable advantage that has emerged from the study was that MOOCs helps in offering flexible, interactive, and engaging learning. Teachers can also improve their teaching strategies by using MOOCs. All these information depicts that MOOCs have been merited and is confirmed to be beneficial to the Saudi Arabian mathematics faculty. The implication of this is that it promotes greater usage among the Saudi Arabian mathematic faculty and there would even emerge greater consumption of the MOOCs in mathematics field.

The study has also demonstrated that the Saudi Arabian Faculty has noted some shortcomings in the MOOCs offered to them in professional development and training of mathematics faculty. Participants noted that MOOCs are not self-sufficient while others lack ideal interaction between the support team and the users. Based on these findings, there is a need for continuous improvement and proper evaluation of the MOOCs offered in the market to ensure appropriateness and enhance sufficiency for use by the faculty and learners.

Limitations

The researcher faced several limitations in this study. First, the researcher relied on data collected from self-reporting. The researcher provided open-ended surveys for the participants to indicate their responses relating to the phenomenon under study. This had the limitation that the participants could provide desirable statements relating to the question as opposed to being truthful, in order to attain social desirability. This may impede the credibility of the study, as some of the responses may not be an accurate. The researcher, however, mitigated this by assuring the participants of their rights and that the information collected would be treated with utmost confidentiality, while adhering to the anonymity principle.

The second limitation was that while MOOCs offer certificates upon completion, their recognition by employers and academic institutions varies. Some institutions and employers may not consider MOOC certificates as equivalent to traditional degrees or credentials. Quality varies across MOOC platforms and courses. Ensuring consistent quality and rigor can be a challenge, and some courses may lack depth or expertise. Also, certain skills, especially those that require hands-on experience or physical presence (e.g., laboratory work, clinical training), are difficult to teach effectively through MOOCs.

Recommendations

Continuously improving Massive Open Online Courses (MOOCs) will be required in order to address various aspects and to enhance the learning experience for participants.

Invest in well-structured and engaging course content with clear learning objectives, organized modules, and multimedia resources. Course content should also be regularly updated to keep it current and relevant to the latest developments in the field. MOOCs should be combined with in-person components or hybrid models to facilitate hands-on learning, lab work, or collaborative projects, especially for courses that require physical presence.

VIII. Conclusion

MOOCs have had a profound impact on education and learning, offering both opportunities and challenges as they continue to evolve and shape the landscape of education and professional development. From the Saudi Arabian Mathematics faculty, it can be concluded that use of MOOCs provides basis for better outcome and professional development. Educators in Saudi Arabia should be encouraged to use MOOCs as it would help in providing up to date information and trends, offer collaborative learning, provide information on new teaching strategies, and allow for interactive, engaging, and flexible learning. It is also imperative to offer continuous improvement on the quality of the content's information offered by MOOCs to make them sufficient and interactive. For the mathematics faculty, it is imperative to conduct proper evaluation of the quality and comprehensiveness of the MOOCs contents that is offered before using for professional development and training purposes.