Evaluating the Design of Mathematics Courses Available on the Blackboard Platform at Prince Sattam bin Abdulaziz University According to Quality Matters Standards

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Abstract

Considering COVID-19 pandemic, interest in e-learning has increased at the global level. Therefore, the current study aimed to evaluate the quality of designing online mathematics courses according to quality matters (QM) standards at Prince Sattam bin Abdulaziz University. The study relied on a qualitative mixed explanatory sequential research design for data collection and analysis. A questionnaire based on the quality matters rubric (QMR) sixth edition was used to collect quantitative data from 31 mathematics faculty members and 75 university students studying mathematics courses online. To collect qualitative data, interviews were held with 10 of the participants. Intentionally based on the responses given in the questionnaire. SPSS 24.0 software was used to analyze quantitative data. The results indicated a high percentage of achievement of QM standards in mathematics courses from the point of view of the faculty members and achieved to a moderate degree from the students' point of view. Moreover, the results indicated that there are statistically significant differences ($\alpha<0.05$) between the estimates of faculty members and students in favor of faculty members in favor of faculty members. The results also revealed that there were statistically significant differences ($\alpha<0.05$) between the students' estimates of the academic achievement variable in favor of the outstanding students, while the results indicated that there were no statistically significant differences ($\alpha<0.05$) attributed to the level of computer skills variable. The results of the interviews revealed the existence of some suggested improvements on the Blackboard platform to suit mathematics courses and learning them online, and some obstacles faced students during the online learning period were identified. The study presented many recommendations and research proposals as future work.

Keywords: Blackboard platform, evaluation, higher education, math course design, quality matters rubrics

INTRODUCTION

We live in an era of competitiveness. Therefore, many universities are working on developing their goals, changing their strategies, and improving their programs to raise the level of quality of performance and improve their competitiveness to be abler to meet the needs of the beneficiaries and achieve their satisfaction with the competencies of the graduate.

The Kingdom of Saudi Arabia has recently launched a series of programs to translate the Kingdom's Vision 2030 into realistic practices. The human capacity development program (HCDP) is one of the most important of these programs, as the program focuses on developing a solid educational foundation for all that contributes to instilling values from an early age and preparing the graduate for the requirements of modern life. The education system in the Kingdom has witnessed many achievements, the most important of which is the

Contribution to the literature

- This article provided a theoretical framework on QM standards to be considered when designing higher education mathematics courses. It emphasizes the use of the learning management system (blackboard) for designing online mathematics courses, considering COVID-19 pandemic.
- The results indicated importance of taking opinions of faculty members and students into consideration when evaluating online courses according to international standards like quality matters (QM).
- Qualitative data indicated that participants suggested a set of improvements to the blackboard system to fit with mathematics courses.

continuation of the educational process despite the circumstances of the emerging corona virus pandemic. The Blackboard platform has been activated more effectively, and many digital platforms have been launched in public education such as the virtual kindergarten platform, the Madrasati platform, and the activation of synchronous and non-synchronous e-learning that is used as a supportive means of delivering educational content to students (Saudi Arabia Vision 2030, explained at https://www.vision2030.gov.sa/ar/v2030/vrps/hcdp/).

In line with HCDP, the Deanship of Information Technology and Distance Education at Prince Sattam bin Abdulaziz University seeks to improve e-learning practices and enhance the e-learning management system (Blackboard) for online courses that are compatible with international quality standards to achieve the desired educational outcomes. From this standpoint, the Deanship has established several training programs for faculty members to hone their abilities to design courses according to the best specifications.

Higher education courses differ from pre-university education courses as higher education courses aim to prepare a specialized graduate who has the ability to practice professions that enable him to compete locally and globally (Imran & Sorour, 2017, p. 12). Considering this, the courses and their teaching at Prince Sattam bin Abdulaziz University have witnessed a clear and tangible development in recent years. This development included changing the angle of view to the courses, making them into electronic forms, and teaching them through e-learning systems (Blackboard learning management system) in addition to face-to-face teaching to make the courses available to students at any time and places, which is called blended learning, to take advantages of available technological capabilities.

With the increasing demand for e-learning, especially considering COVID-19 along with the pursuit of excellence associated with global competition between universities, many trends have emerged around the world to enhance and ensure quality in the design of online university courses.

Several studies have indicated the effect of online courses on student satisfaction (Kaban, 2021). Online courses have a significant impact on student achievement and satisfaction with course delivery, and this depends on four factors: faculty member quality, course design, immediate feedback, and learner positivity (Gopal et al., 2021).

The importance of having criteria for judging the quality of university courses design lies in its attempt to build a bridge between theoretical sciences on the one hand, and psychology theories, especially learning theories and applied sciences in the use of educational technologies on the other hand.

Among the most popular standards that have gained wide popularity at the global level in measuring the quality of designing online courses are the standards adopted by the QM organization. QM is an integrated program to verify the quality of online courses considering educational specifications that have been carefully formulated and reviewed by a group of experts and reviewers. It was established in 2003 at the University of Maryland, USA with the aim of improving the post-secondary education program (FIPSE) with funding for three years from the US Department of Education, and since 2006 QM has not received any funding from any party, and relies on self-financing on its members who are constantly growing online (Shattuck, 2007).

QM is one of the leading organizations in the field of quality assurance of online courses, which has gained international recognition for its peer-reviewed approach and continuous development of education systems. The QM system consists of three parts, as follows:

1. The matrix of quality standards for course design (QMR),
2. The peer review process, and
3. The professional development of course designers, faculty members and administrators dealing with the system (Mancilla & Frey, 2021).

Dietz-Uhler et al. (2007) stress the importance of providing high-quality courses that comply with QM standards to ensure that students receive a distinct learning style that helps them accelerate the learning process. Mathematics courses with abstract properties need more attention, revision, and scrutiny than other courses, according to QM standards, cover the criteria for judging the quality of various courses.

There is no doubt that mathematics achievement increases by revealing the connections between the topics of one course, or the connections between the various math courses (García-García & Dolores-Flores, 2017; Rodríguez-Nieto et al., 2021). This is reinforced by QM standards. Through the Blackboard platform, students can make a scientific journey through the Internet to search for these connections. Therefore, the importance of designing mathematics courses in higher education according to QM standards is obvious.

With this understanding, the researchers in the current study conclude that teaching mathematics courses requires special teaching strategies that depend on interaction and positivity on the part of both the faculty member and the student. QM standards achieve this requirement through the eight standards that emphasize clarity of objectives, unity of knowledge, and the need for consistency of the components of the course designed through the Internet, as well as the necessity of activating e-learning strategies. Accordingly, it became apparent to the researchers that there was a need for a study targeting the fulfillment of QM standards in the design of online mathematics courses.

LITERATURE REVIEW

The Difference Between Face-To-Face Courses and Online Courses

Online courses differ from face-to-face courses in certain ways. For instance, the instructional content and instructional strategies in online courses can be designed and developed before a course is ever offered. Thus, when people talk about the quality of online courses, they often differentiate between how a course is designed and how it is taught. While a bad instructor can arguably find a way to ruin a well-designed online course (e.g., by being non-responsive), a well-designed online course is generally recognized as a hallmark of online course quality (Lowenthal & Hodges, 2015). E-learning helps the learner to learn through a scientific content that is different from this content presented on the pages of books. Online content depends on multiple media (texts, drawings, fixed pictures, video clips, and audio files). It is presented through modern electronic media such as computers, internet, and satellites (Mayer & Clark, 2007). Online courses can be designed to promote the development of technical, analytical, decision-making, verbal, and presentation skills (Compomizzi et al., 2019).

Quality Matters

According to Pollacia and McCallister (2019, p. 155), QM™ is a set of standards to measure the quality of instruction and design of online or hybrid courses. Adopted by a growing number of institutions nationwide, QM is based on best practices and instructional design research. To meet or exceed QM standards requires that resources and learning activities in an online course utilize the latest tools and technologies. In many instances, Web 2.0 technologies are the most appropriate for supporting this course content. This paper will give an overview of QM standards and rubric and demonstrate how Web 2.0 technologies may be utilized to meet QM requirements. According to the QM website, conferences and resources provide access to the QM community, which has nearly 100,000 members in the US and internationally. More than 1,500 organizations from 49 US states and 30 countries have committed to ensuring the quality of online learning in accordance with course quality standards. QM is continually improving and developing standards based on the results of research and studies related to online course design and blended learning, as the number of studies in 2021 reached more than 1,000 classified and reviewed studies, in recognition of QM that results of powerful research are basis and catalyst for improving quality assurance in course management and design (https://www.qualitymatters.org/).

QM standards can be applied to all types of e-learning, such as a supportive, blended, or fully online mode of learning that assists in meeting the learning outcomes of the course. The quality reference model is not limited to any course or discipline (Naim et al., 2021).

Higher Education Quality Matters Rubric

The higher education rubric is intended for use with courses that are delivered fully online or have a significant online component (hybrid and blended courses). Course designers use the rubric to aid in the creation of courses designed to meet standards from the outset. The rubric is also used to assess the level to which a course meets standards and highlight areas for improvement. A score of 85% (with essential standards being met) qualifies a course to receive a QM certification for quality course design. This rubric includes individual faculty and instructional designers, four-year accredited colleges and universities, and community colleges (Quality Matters, 2020).

The sixth edition of higher education quality matters rubric (HEQMR) consists of eight main standards, including 42 sub-criteria as in Figure 1. These standards have been developed and reviewed based on research findings and standards in the field of online instructional design, and these standards gain their importance because the reviewers are the same faculty members who have online teaching experience and have passed the reviewers' cycle of standards. There exist three levels of review of course design, as follows:

1. Self-review, where faculty members review their courses in light of QM standards,

Figure 1. Quality matters rubric

Figure 2. Continuous improvement model for assuring the quality of online courses

2. Informal review, conducted by a team of university colleagues for improvement and development, and

3. Official review, conducted by a team of reviewers accredited by QM, and accreditation of the electronic course requires that it meets QM standards with a total of 85% (QM, 2020).

The eight main standards of HEQMR are, as follows:

1. **Course overview and introduction:** It means providing background information and a helpful starting point. Faculty members ensure that students know early expectations, background knowledge, purpose, and how they will start to learn in this course.

2. **Learning objectives:** It refers to the fulfillment of a set of conditions in formulating the competencies to be imparted to learners through the study of the course, and it includes many aspects, including cognitive, emotional, self-kinetic, and life skills.

3. **Assessment and measurement:** Accurate descriptions of assignment expectations provide students with detailed information about important course assignments such as tests, papers, presentations, and all aspects of graded student performance requirements. Then, the assignment instructions and performance requirements go together.

4. **Instructional materials:** Each learning module features printed materials including access to e-texts; audio and visual lectures and tutorials; interactive technological exercises utilizing software such as GeoGebra Apps, turn-it-in peer evaluation software, Microsoft Office, project planning software, and data analysis software such as SAS and SPSS.

5. **Course activities and learner interaction:** The necessity of the availability of enrichment activities that support the content of the mathematics course, correspond to objectives of
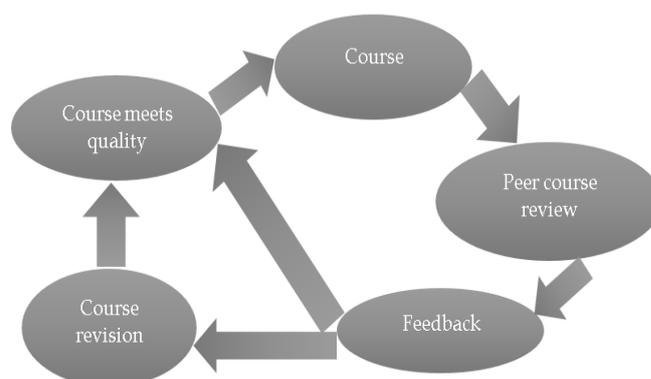
the course, and take into account characteristics, abilities, and tendencies of students.

6. **Course technology:** It means the learning management system (LMS) that the university adopts, such as the Blackboard or Zoom platform, in implementing the course.

7. **Learner support:** It means the availability of a technical support team along with the faculty members to address any technical problems in dealing with the online course; to provide support to students when they need it.

8. **Accessibility and usability:** The online course provides varied resources through employment of multi-media, such as photos, audio, video, and downloadable files, in addition to the ease of navigation between the components of the course.

Improvement Model for Assuring the Quality of Online Courses

QM is supported by research and best practices. The QM program and QM rubric undergo a continuous improvement process to retain the QM rubric and ensures that processes are current, practical, and applicable across academic disciplines and academic levels in course design, validation and by having faculty focus on course design (Robinson & Wizer, 2016). To meet QM standards, a course does not have to obtain 100% in the peer review; at a level of 85%, an online course is of high quality. But, course development and peer review to enhance quality improvement should be a continuous process. Figure 2 illustrates this process (Pollacia & McCallister, 2019, p. 155).

Quality Matters and Students

Designing online courses according to QM standards is beneficial to both the faculty member and the student. The faculty member is constantly aware of the learning outcomes and the continuous development of the course elements. As for the student, he is an interested follower of the assignments set on certain dates, carrying out the tasks on a regular basis (Hoffman, 2012).

QM standards make the student the core of the educational process. therefore, many studies have indicated that there are positive attitudes among students towards online courses that are designed according to QM standards (Alzahrani & Seth, 2021), as they contributed to achieving the targeted learning outcomes at high rates (McCarthy et al., 2019; Naim et al., 2021), increased students' learning and engagement in the course (Sadaf et al., 2019), and increased learning retention by approximately 95% (Dietz-Uhler et al., 2007). The students were fully satisfied with the course designed and revised according to QM standards (Alizadeh et al., 2019).

Success in achieving QM standards in teaching online mathematics courses is due to students owning computers that are compatible with modern technologies and programs, in addition to the need for students to possess technical skills, and to deal with mathematics programs efficiently (Saal et al., 2021). In general, QM offers numerous benefits, as follows (Crews et al., 2017; Legon, 2006; Lowenthal & Hodges, 2015; Lynch & Gaston, 2020; Martin et al., 2016; Mercer, 2014; Robinson & Wizer, 2016):

1. Improved student engagement and learning outcomes.
2. Adoption of a systematic and comprehensive continuous quality assurance process that includes faculty training, course development, and course improvement processes that are aligned with accreditation standards.
3. Incorporation of new technologies and research findings.
4. Students will have a better learning experience.
5. Opportunity to engage in benchmarking activities with peer institutions.
6. Ongoing faculty professional development.
7. Opportunity for peer-to-peer collaboration and sharing across institutions.
8. Online courses that meet a consistent and widely respected quality threshold.
9. Quality assurance in the design of undergraduate courses is a key factor in meeting students' needs.

There are many ways to measure quality in online courses including student interaction and engagement, which contributes to improved student learning. There was a connection between student engagement and learning outcomes as development of relationships in the course increased engagement (Smith & Crowe, 2017).

By evaluating a sample of higher education students for a set of courses according to QM standards, it was found that there is a need to improve these courses in the following aspects: providing the student with sufficient information about accessibility, technical support, course orientation, and descriptions of instructional materials (Kwon et al., 2017).

While Shin and Cheon's (2019) study showed a low degree of student satisfaction with the design of 90 of the online courses. Those courses were reviewed using a checklist derived from QM standards, and the results of the review showed that there is no consistency between the elements of the online course (e.g., the course activities are inconsistent with the learning outcomes and the number of course units). The results of this study provide a snapshot of current practice and mean that consistent organization, appropriate number of learning activities, and purposeful facilitation of learning must be considered when designing an online course (Shin & Cheon, 2019).

Quality Matters and Faculty Members

Faculty members are responsible for delivering inclusive online courses that allow all learners to be successful. Faculty members may start by self-assessing areas for personal growth and setting professional development goals. They can also foster an inclusive culture within their respective departments by advocating for accessibility and collaborate with colleagues to share resources that enhance their programs. Such resources may include a repository of templates and guides that model best practices for accessible course design (Mancilla & Frey, 2021).

Previous studies have also addressed the need for collaboration between faculty members and instructional designers while designing online courses to manage and improve online course quality (Caskurlu et al., 2021). The literature suggests that a strong connection exists between faculty professional development and course design quality (Bigatel & Edel-Malizia, 2018; Chand & Gabryszewska, 2021; Johnson, 2015; Koepke & O'Brien, 2012; McQuiggan, 2012; Mercer, 2014).

Additionally, there is the impact of training and the application of quality course design standards in the QM rubric (QMR) on the design and student outcomes for an Introductory Biology course over four terms. The results showed the importance of faculty professional development (Hollowell et al., 2017).

QM standards is providing faculty members with the most important guidelines in designing online courses and monitoring student learning and participation in course components (Martin et al., 2016). In the current study, the researchers agree with this, where it has been observed that students' participation in the learning process in online courses has increased more than in face-to-face courses (e.g., students' participation in the course forum has increased, follow-up of synchronous and asynchronous lectures, and completion of assignments on time) and this in turn creates a learning environment competitiveness among students, which would achieve the desired learning outcomes.

Additionally, there are many external factors that affect the performance of a faculty member over the internet, including the quality of students and the amount of training and guidance for a faculty member (Taylor et al., 2018). One of the most important factors affecting the quality of course design is the professional growth of the faculty member and the quality and quantity of training programs he receives (Gregory et al., 2020; Hollowell et al., 2017; Kearns & Mancilla, 2017). There is a strong correlation between the professional growth of faculty members and the achievement of Quality Matters standards in online designed courses (Abdelhamid, 2020; Gregory, 2018; Nolin, 2019). Ratings of implementation of effective online course design practices were higher when staff have completed at least 20 hours of professional development intended to prepare them for online teaching, and were engaged in QM course review, have experience as an online learner, and have experience as an online instructor (McMahon, 2021). Taking into account individual differences between faculty members in capabilities and specialization, and cost-effectiveness when evaluating faculty development programs (Meyer, 2013). Additional benefits from participating in QM training are related to specific modalities. Common online and blended impacts included changes in assessment practices as well as in modifying course materials to be more compliant with accessibility standards (Kearns & Mancilla, 2017).

Among the factors that contribute to achieving QM standards in online courses are the experience of a faculty member in design (Abdelhamid, 2020; Al-Judayi, 2021), choosing the appropriate instructional design model (Al-Qahtani & Al-Bishi, 2017; Bogle et al., 2009). One of the most important models of instructional design that has proven effective in the quality of online courses (ADDIE) model (Al-Judayi, 2021). This is confirmed by Mills (2020) in his blog, where he notes that students' academic success is highly dependent on the pedagogical and technological readiness of a faculty member, emphasizing that it is time for the online community to promote their successes and talk about the positive impact of quality design on student success. He criticized many universities that have rapidly moved to remote teaching as a result of COVID-19 with not respecting instructional design standards. But, the faculty had to be trained quickly in all tools: gradebooks, discussion boards, and assessments (Mills, 2020).

This commandment has already been implemented by Prince Sattam bin Abdulaziz University in Saudi Arabia, where the training programs for faculty members have intensified the use of all the features in the Blackboard platform, considering the design of courses according to QM standards, in addition to training programs on employing e-learning strategies in online learning, this is clear in the results of the current study in the mathematics courses offered to university students. If this is related to faculty members in general, higher education requires the availability of many technical and teaching competencies for those who design and teach mathematics courses, as it requires knowledge of mathematics software appropriate for the course he is studying, in addition to advanced software in statistics, algebra and calculus.

The Effectiveness of Designing Online Mathematics Courses via Blackboard Platform

Instructional design aims to develop educational products to achieve the desired learning and bring about the required changes in the behavior of learners. Therefore, it is necessary to understand the nature of the learning process, and the different theoretical explanations for its occurrence; Where the instructional designer needs answers to various questions about the characteristics of learners, how they learn, the conditions that facilitate this learning and its conditions, the appropriate methods and procedures for the occurrence of learning, and how to evaluate them, which are necessary questions for the design process, and teaching and learning theories are the ones that answer them (Abu Khatwa, 2018).

We need to design educational programs in a deliberate manner consistent with the characteristics of the learners, and their preparations, intelligence, abilities, tendencies, and tendencies, considering individual differences, and helping them achieve the desired educational goals in the least time, effort, and cost. Design focuses on human needs, encourages creativity, supports social work, maintains meaning and order, and manages evaluation processes.

Instructional design and development should be based on a learning theory. Effective design derives from the intended application of a particular learning theory, while we certainly have certain preferences for certain theories; designers need to be aware of their personal beliefs about the nature of learning, and to choose concepts and strategies from those theories that are consistent with their beliefs (Abdel Atti, 2012).

E-courses are a major component of the e-learning system. It contains the message to be conveyed to the learners; thus, the process of its design must be carried out in the light of scientific principles, and depend on different sources, such as learning theories that explain the learning process and how it occurs, and set principles that can be applied when designing different educational materials, as well as the results of previous studies and research, and science of educational technology depends on theory application in designing, developing, using, and evaluating learning materials; to be effective in achieving its goals (Abu Khatwa, 2018).

Instructional design, at the beginning of its emergence as a science, was closely linked to learning theories that aimed to reach the principles and methods

that achieve better learning for the individual in different situations, and it also aims to help specialists and researchers in the educational field to find the best conditions to achieve effective learning (Abdel Atti, 2012). The theory of learning provides us with a theoretical framework that enables us to understand the nature of learning, its various behavioral patterns, its conditions, how it occurs, the explanation of its causes, and its prediction.

Learning theories have contributed to building various educational design models, and among the most famous learning theories that have been applied in the field of instructional design: behavioral theory, cognitive theory, and constructivist theory. Behaviorism is concerned with studying the change in the learner's apparent behavior without researching the mental processes that resulted in it. This behavior, while the cognitivism theory is concerned with studying the mental processes that result in behavior, while the constructivism theory seeks to study the methods of building the learner's personal vision of the world around him based on his previous experiences and his multiple activities, and from the modern theories that have been linked to contemporary technological development, the communicative theory that seeks To place networked learning in an effective social framework (Abu Khatwa, 2018).

It is well known that the technical support team at Prince Sattam bin Abdulaziz University collaborates effectively with faculty members in the design of mathematics courses across the Blackboard platform, where the e-course is provided with a list of links and functions that make it easier for the faculty to achieve QM standards that emphasize the importance of observing the principles of learning theories when designing mathematics courses, especially building learning theories, where the Blackboard platform enables us to design a variety of activities within the course, based on learning strategies. Collaborative (simultaneous and non-synchronous division of students into collaborative groups) as well as discovery learning strategy, meaningful learning, cognitive journey strategy, and other teaching strategies on active learning, constructive learning and thinking learning.

Previous studies have confirmed the effectiveness of designing online mathematics courses in developing academic achievement (Alsalhi et al., 2021; Lin et al., 2017), increasing attitudes towards learning mathematics (Barbieri et al., 2021; Leong & Alexander, 2014; Lin et al., 2017; Meyer, 2013), increasing student engagements in the classroom environment (Lee et al., 2009; Leong & Alexander, 2014; Saal et al., 2021), and completing tasks faster and more attentively (Yimer, 2020). This in turn contributes to the development of conceptual and procedural knowledge of mathematics. Moreover, providing mathematics courses via online electronic platforms that allow the activation of many

teaching strategies based on active learning, such as: cooperative learning, project-based learning (Alashwal, 2020; Alibraheim & El-Sayed, 2021; Borba et al., 2016).

Students benefit from online mathematics courses by having high computer skills (Soboleva et al., 2021), and high-efficiency computers (Saal et al., 2021). Previous studies have indicated some of the obstacles to achieving QM standards in online designed courses, including students not owning computers (Abdelhamid, 2020; Compomizzi et al., 2019).

Based on the results of previous studies, the researcher concludes that some previous studies confirmed that online mathematics courses have many educational benefits for students, and studies that dealt with QM standards confirmed the educational benefits of applying QM to faculty members from in terms of teaching performance, technical competence in instructional design, and professional growth. Some studies emphasized the importance of QM in students' achievement, participation, and satisfaction with courses. The current study aimed to verify that the mathematics courses designed through the Blackboard platform meet QM standards.

The current study fills a gap observed by the researchers in previous studies, where previous studies focused on reviewing electronic courses through specialized reviewers, while the current study focuses on the importance of taking students' opinions in developing mathematics courses, and this is consistent with modern learning theories that emphasize student activity and active participation. In designing and developing the course that is presented to him. So that the student's needs, tendencies and problems are taken into account through activities included in those courses.

PROBLEM

By looking at previous studies, the researchers in the current study noticed the paucity of Arab research that dealt with evaluating math courses according to QM standards, and this does not correspond to the great effort made by the Ministry of Education in the Kingdom of Saudi Arabia to expand the online education system through many educational platforms such as the Blackboard platform (in university education) and the Madrasati platform (in pre-university education), in order to reduce educational losses as a result of online education in light of COVID-19 as well as in order to improve the educational process, in addition to the mathematics courses for them A special nature in terms of its teaching and learning, which is predominantly abstract in nature; This requires achieving high quality standards in providing these experiences to students.

Questions

1. To what extent are QM standards achieved in designing mathematics courses at Prince Sattam

Table 1. Mathematics courses reviewed by faculty members and students

No	Code	Course name	Level	Number of credit hours
1	2230 MATH	Statistics, Algebra, & Analytical Geometry for students of Physics	Third	3
2	3320 MATH	Multiple Calculus for Mathematics & Physics students	Fifth	3
3	3410 MATH	Differential Equations for Physics & Chemistry students	Fifth	3
4	1420 MATH	Mathematics I for students of Business Administration	First	3
5	1430 MATH	Mathematics II for students of Business Administration	Second	3
6	1050 MATH	Differential Calculus for the preparatory year	First	3
7	1060 MATH	Integral Calculus for the preparatory year	Second	3
8	1070 MATH	Algebra & Analytical Geometry for Engineering students	Third	3
9	2030 MATH	Calculus for Engineering students	Forth	3
10	2040 MATH	Differential Equations for Engineering students	Fifth	3
11	2440 MATH	Linear Algebra for Engineering students	Sixth	3
12	2540 MATH	Numerical Methods for Computer Sciences students	Fifth	3
13	2220 MATH	Linear Algebra for Computer Sciences students	Third	3
14	1050 STAT	Probability & Statistics for Computer Sciences students	Forth	3

bin Abdulaziz University from the viewpoints of faculty members and students?

2. How do participants' views differ in determining the extent to which QM standards are met in designing mathematics courses according to the participant type variable (faculty member/student)?

3. How do participants' views differ in determining the extent to which QM standards are met in designing mathematics courses according to academic achievement (less than 3.75 points/from 3.75 to 5)?

4. How do participants' views differ in determining the extent to which QM standards are met in designing mathematics courses according to the level of computer skills variable (average or less/ higher than average)?

5. How do participants' views differ in determining the extent to which QM standards are met in designing mathematics courses according to the gender variable (male/ female)?

Hypotheses

1. **H_o1:** There is no significant difference between faculty members and students in their views about achieving QM in math courses.

2. **H_o2:** There is no significant difference between participants' views about achieving QM in math courses according to academic achievement (less than 3.75 points/ from 3.75 to 5).

3. **H_o3:** There is no significant difference between participants' views about achieving QM in math courses according to the level of computer skills (average or less/ higher than average).

4. **H_o4:** There is no significant difference between males and females in their views about achieving QM in designing the math courses.

Study Objectives

1. The study aimed to develop mathematics courses at Prince Sattam bin Abdulaziz University, the study takes a global approach, based on international standards issued by the QM organization, therefore the study draws the attention of the designers of mathematics courses in general to the need to take into account the QM standards when designing those courses online, especially through the Blackboard platform.

2. A description of the compliance of faculty members to apply e-learning management system in accordance with QM Standards in mathematics courses design.

3. Determining the extent to which the assessment of online mathematics courses through the Blackboard platform differs according to some variables (participant type, academic achievement, the level of computer skills, and gender).

Delimitations

1. *Temporal delimitations:* The study tools were applied in the first semester of the academic year 2021 AD.

2. *Spatial delimitations:* The faculties of engineering, science, and business administration at Prince Sattam bin Abdulaziz University in the Kingdom of Saudi Arabia.

3. *Content delimitations:* 14 mathematics courses have been reviewed, which taught at the undergraduate level students, at the departments of mathematics, physics, computer sciences, business administration, and engineering (Table 1).
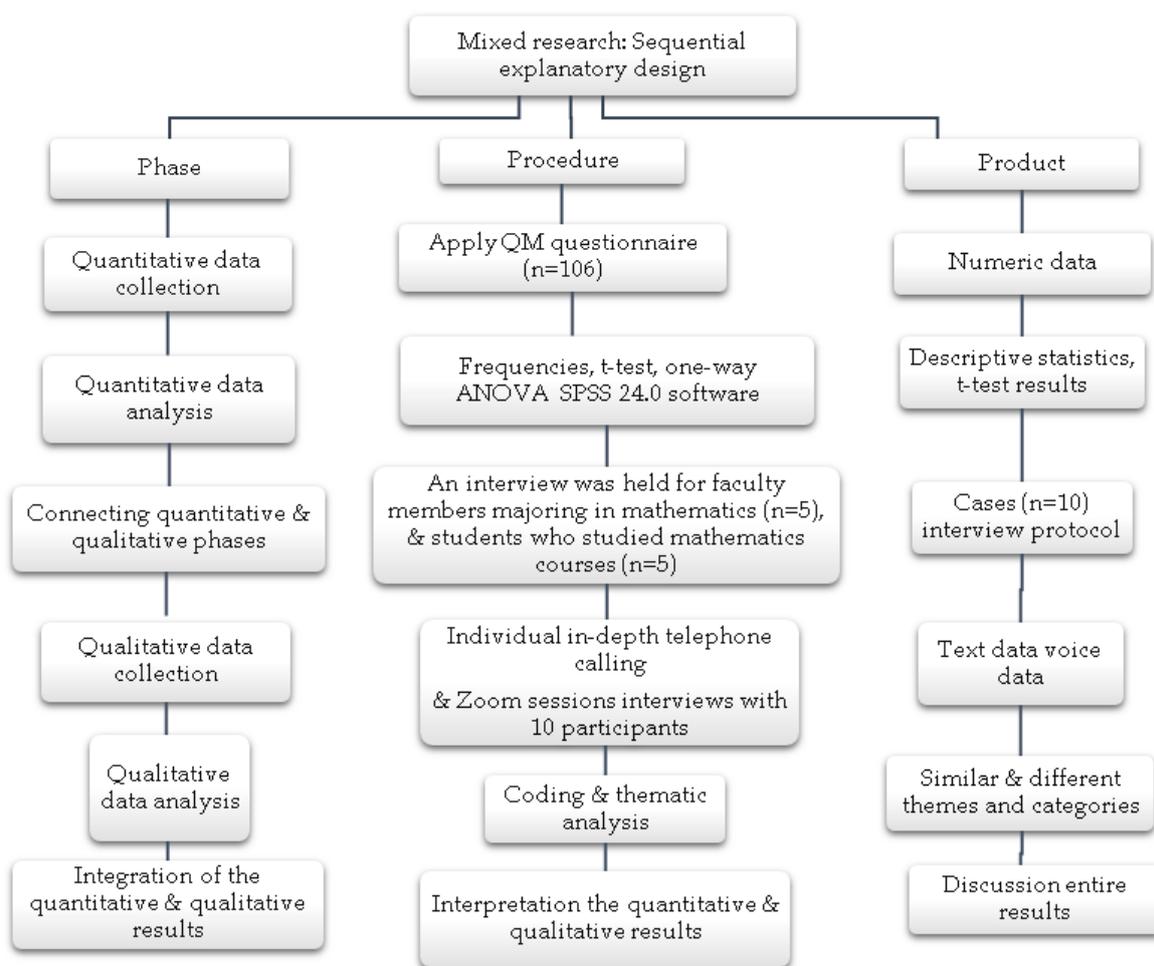
Figure 3. Mixed research: Sequential explanatory design in the current study

Table 2. Distribution of the study sample according to variables

		Faculty members			Students			Total
		Male	Female	Total	Male	Female	Total	
The level of computer skills	Less than average	1	3	4	14	25	39	43
	Average & more	15	12	27	13	23	36	63
	Total	16	15	31	27	48	75	106
Academic achievement	Less than 3.75	-	-	-	21	24	45	45
	3.75 & more	-	-	-	6	24	30	30
	Total	-	-	-	27	48	75	75

METHOD

Methodology

The current study used a mixed methodology of the sequential explanatory type. To answer the outlined research questions, phase one focused on quantitative data collection and analysis from (QM rubric responses), while phase two focused on qualitative data collection and analysis from interview tool responses (Ivankova et al., 2006, p. 4). Creswell (2014) defined mixed methods as methods which "involve combining or integration of qualitative and quantitative research and data in a research study.

Qualitative data tends to be open-ended without predetermined responses while quantitative data usually includes closed-ended responses such as those found on questionnaires or psychological instruments" (Creswell, 2014, p. 48). Figure 3 illustrates the research methodology.

Participants

The study sample was randomly selected from among the faculty members at Prince Sattam bin Abdulaziz University, Wadi Al Dawasir Branch, faculties of engineering and science, specializing in mathematics, and students studying mathematics courses in the first semester of academic year 2020/2021 AD. Table 2 shows the distribution of the study sample.

Instruments

Questionnaire based on QMR

The objective of the scale is to measure the quality of designing online mathematics courses through the Blackboard platform at Prince Sattam bin Abdulaziz University from the point of view of faculty members and students according to the HEQMR (2019)-sixth edition, which consists of 42 standards.

Validity and reliability of the scale is to ensure the statistical efficiency of the questionnaire, the following steps were followed: The correspondence researcher wrote to QM by e-mail to take approval for the implementation of QM standards, the sixth edition, which consists of 42 standards distributed over eight axes. The approval was taken to implement QM in the Arab environment. The QM scale was translated into Arabic and was reviewed by 2 faculty members specializing in the English language to ensure that the Arabic version matches the English version. The questionnaire was presented to 5 professors in the field of curricula and instructional design to ensure its validity. Then the questionnaire was administered, in both English and Arabic, to an exploratory sample consisting of 20 faculty members and 40 students to calculate the reliability of the questionnaire, based on the responses of the faculty members (Cronbach's alpha coefficient=0.958) and the students' responses (Cronbach's alpha coefficient=0.972). These reassured researchers to use scale as a tool for gathering quantitative data, and trust the results of its application.

The scale in its final form is preparation of questionnaire in its final form in both Arabic and English versions, in an electronic form, using Google forms, consisting of 42 standards distributed over eight axes.

Interview

It included six questions that were discussed with the participants: 5 faculty members and 5 students.

Variables

Independent variables are participant type (faculty members/students), academic achievement (less than 3.75/ 3.75 or more), the level of computer skills (average or less/higher than average), and gender (male/female). Dependent variable is achieving QM standards in math courses at Prince Sattam bin Abdulaziz University.

RESULTS

Quantitative Results Related to QM Questionnaire

Q1: To what extent are QM standards achieved in designing mathematics courses at Prince Sattam bin Abdulaziz University from the viewpoints of faculty members and students?

To answer this question, the average and standard deviation of the participants 'estimates of achieving QM standards in designing mathematics courses through the blackboard were calculated as shown in Table 3.

Table 3. Estimates of participants (faculty members & students) about designing mathematics courses online in accordance with QM standards (N=106)

General standards	Specific standards	Faculty members (N=31)		Students (N=75)	
		Mean	SD	Mean	SD
1. Course overview and introduction	1.1. It is clear in the instructions for mathematics courses how to start studying the course and where to find all the components of the course.	2.45	0.888	1.95	0.787
	1.2. Clear math course objectives and plan.	2.58	0.765	2.15	0.849
	1.3. Communication expectations for online discussions, e-mail and other forms of interaction are clearly defined.	2.19	0.749	2.12	0.788
	1.4. The policies of the mathematics courses with which the learner is expected to comply are clearly stated, or a link is provided to those policies.	2.35	0.661	2.05	0.804
	1.5. The minimum technology requirements for the course are clearly defined.	2.35	0.661	1.91	0.791
	1.6. Computer skills and knowledge of digital information skills expected of the learner are clearly stated.	2.29	0.693	1.89	0.815
	1.7. Expectations for prior knowledge in the course and/or any required competencies are clearly defined.	2.23	0.669	2.05	0.787
	1.8. Self-presentation by the lecturer is professional and available online.	2.39	0.615	2.04	0.845
	1.9. Learners are required to introduce themselves to their classmates at the beginning of the semester.	2.35	0.798	1.89	1.021
	Average of course overview and introduction	**2.35**	**0.720**	**2.01**	**0.830**

Note. SD: Standard deviation

Table 3 (Continued). Estimates of participants (faculty members & students) about designing mathematics courses online in accordance with QM standards (N=106)

General standards	Specific standards	Faculty members (N=31)		Students (N=75)	
		Mean	SD	Mean	SD
2. Learning objectives (competencies)	2.1. The course learning competencies describe outcomes that are measurable.	2.55	0.506	2.03	0.788
	2.2. The module/unit-level learning competencies describe outcomes consistent with the course-level competencies.	2.39	0.667	1.96	0.813
	2.3. Learning competencies are stated clearly and are written from the learner's perspective.	2.45	0.675	2.00	0.771
	2.4. The relationship between learning competencies and learning activities is clearly stated.	2.42	0.564	2.04	0.813
	2.5. The learning competencies are suited to the level of the course.	2.23	0.617	1.97	0.788
	Average of learning objectives (competencies)	**2.41**	**0.610**	**2.00**	**0.790**
3. Assessment and measurement	3.1. The assessments measure the achievement of the stated learning competencies.	2.45	0.675	2.12	0.734
	3.2. The course grading policy is stated clearly.	2.61	0.558	2.20	0.870
	3.3. Descriptive and specific criteria are provided for evaluating students' work.	2.61	0.667	2.08	0.749
	3.4. The assessment methods used are sequential, varied, and appropriate to the level of the course.	2.39	0.715	1.99	0.862
	3.5. The course provides learners with multiple opportunities to track their learning progress while providing them with timely feedback.	2.39	0.667	2.00	0.870
	Average of assessment and measurement	**2.49**	**0.660**	**2.08**	**0.820**
4. Instructional materials	4.1. Teaching materials contribute to the achievement of the learning competencies identified for the course.	2.48	0.626	2.09	0.857
	4.2. The relationship between use of learning materials in the course and completion of learning activities is clearly explained.	2.48	0.508	2.11	0.847
	4.3. The course represents the academic integrity expected of learners by providing both resources and permissions to use educational materials.	2.39	0.615	2.03	0.822
	4.4. The educational materials represent the latest theory and practice in the field of mathematics.	2.26	0.631	2.00	0.870
	4.5. A variety of teaching materials are used in the course.	2.26	0.682	2.01	0.846
	Average of instructional materials	**2.37**	**0.610**	**2.05**	**0.850**
5. Course activities and learner interaction	5.1. Learning activities promote the achievement of learning objectives or identified competencies.	2.42	0.672	2.03	0.788
	5.2. Learning activities provide opportunities for interaction that support active learning.	2.55	0.506	2.07	0.827
	5.3. The lecturer's plan for interaction with learners during the course is clearly stated.	2.45	0.624	1.97	0.805
	5.4. Learner interaction requirements are clearly defined.	2.39	0.715	2.00	0.805
	Average of course activities and learner interaction	**2.45**	**0.630**	**2.02**	**0.810**
6. Course technology	6.1. The tools used in the course support learning competencies.	2.35	0.798	2.01	0.780
	6.2. Course tools promote learner engagement and active learning.	2.45	0.723	2.05	0.837
	6.3. A variety of techniques are used that are appropriate for the nature of mathematics courses.	2.39	0.667	1.93	0.827
	6.4. The course provides learners with information about the protection of their data and privacy.	2.19	0.873	1.97	0.854
	Average of course technology	**2.35**	**0.770**	**1.99**	**0.820**
7. Learner and instructor support	7.1. The course instructions clearly describe the technical support provided and how to obtain it	2.06	0.964	2.00	0.854
	7.2. The course instructions outline the accessibility policies and services of the college or university.	2.19	0.946	2.01	0.797
	7.3. Course instructions outline or include a link to the university's academic support services and resources that can help learners succeed in the course.	2.23	0.956	2.04	0.845
	7.4. The course instructions outline or include a link to student services at university and resources that can help learners succeed.	2.26	0.999	2.01	0.862
	Average of learner and instructor support	**2.19**	**0.970**	**2.02**	**0.840**

Note. SD: Standard deviation

Table 3 (Continued). Estimates of participants (faculty members & students) about designing mathematics courses online in accordance with QM standards (N=106)

General standards	Specific standards	Faculty members (N=31)		Students (N=75)	
		Mean	SD	Mean	SD
8. Accessibility and usability	8.1. Navigating between course components is easy and flexible.	2.52	0.626	2.24	0.852
	8.2. The course is designed in such a way that its content is easy to read (course readability).	2.61	0.495	2.23	0.847
	8.3. The course includes accessible text and images to consider individual differences between students with different learning styles.	2.32	0.599	2.17	0.860
	8.4. The course provides alternative means of accessing multimedia content in formats that meet the needs of learners with different learning styles.	2.23	0.560	2.01	0.878
	8.5. Course multimedia is easy to use.	2.39	0.715	2.19	0.833
	8.6. The accessibility statements are available for the source of all technologies required in the course.	2.42	0.672	1.95	0.899
	Average of accessibility and usability	**2.42**	**0.610**	**2.13**	**0.860**
Total average items of QM		**2.38**	**0.450**	**2.04**	**0.705**

Note. SD: Standard deviation

Table 4. Independent samples t-test results according to the participant type variable

	Participant type	N	Mean	SD	df	t-test value	Sig. (2-tailed)	Significance
Total average items of QM	Faculty members	31	2.378	0.450	104	2.486	0.015	Significant at 0.05
	Students	75	2.037	0.705				

Table 3 illustrates that there is agreement between faculty members in achieving QM standards in mathematics courses in 7 standards with a high degree: course overview and introduction (mean=2.35 and standard deviation=0.72), learning objectives (competencies) (mean=2.41 and standard deviation=0.61), assessment and measurement (mean=2.49 and standard deviation=0.66), instructional materials (mean=2.37 and standard deviation=0.61), course activities and learner interaction (mean=2.45 and standard deviation=0.63), course technology (mean=2.35 and standard deviation=0.77), and accessibility and usability (mean=2.42 and standard deviation=0.61). As for the seventh standard (learner and instructor support), the verification rate was average (mean=2.19 and standard deviation=0.97).

On the other hand, the students agreed to achieve QM standards in mathematics courses in all standards with an average degree: course overview and introduction (mean=2.01 and standard deviation=0.83), learning objectives (competencies) (mean=2.00 and standard deviation=0.79), assessment and measurement (mean=2.08 and standard deviation=0.82), instructional materials (mean=2.05 and standard deviation=0.85), course activities and learner interaction (mean=2.02 and standard deviation=0.81), course technology (mean=2.35 and standard deviation=0.77), learner and instructor support (mean=2.19 and standard deviation=0.84), and accessibility and usability (mean=2.13 and standard deviation=0.86).

Q2: How do participants' views differ in determining the extent to which QM standards are met in designing mathematics courses according to the participant type variable (faculty members / student)?

H_o1: There is no significant difference between faculty members and students in their views about achieving QM in math courses.

T-test was calculated for independent samples test as shown in Table 4. Table 4 illustrates that there is a statistically significant difference between the average of the participants' responses ($\alpha < 0.05$) according to the participant type variable (faculty members/student) in favor of faculty members (instructors) with an average of 2.378 versus the average of the students (2.037). Therefore, we must reject the null hypothesis (H_01).

Q3: How do participants' views differ in determining the extent to which QM standards are met in designing mathematics courses according to academic achievement (less than 3.75/3.75 or more)?

H_o2: There is no significant difference between participants' views about achieving QM in math courses according to academic achievement (less than 3.75 points/from 3.75 to 5).

T-test was calculated for Independent Samples Test as shown in Table 5. Table 5 illustrates that there is a statistically significant difference between the average of the participants' responses ($\alpha < 0.05$) according to the academic achievement variable (less than 3.75/3.75 to 5) in favor of the students having academic achievement from 3.75 to 5 with an average of 2.240 versus the students having academic achievement that is less than 3.75 with an average of 1.902. Therefore, we must reject the null hypothesis (H_02).

Table 5. Independent samples t-test results according to academic achievement variable

	Academic achievement	N	Mean	SD	df	t-test value	Sig. (2-tailed)	Significance
Total average items of QM	Less than 3.75	45	1.902	0.779	73	2.074	0.042	Significant at 0.05
	From 3.75 to 5	30	2.240	0.526				

Table 6. Independent samples t-test results according to computer skills variable

	Computer skills	N	Mean	SD	df	t-test value	Sig. (2-tailed)	Significance
Total average items of QM	Average or less	43	2.003	0.561	101.484	1.822	0.071	Not significant at 0.05
	Higher than average	63	2.228	0.705				

Table 7. Independent samples t-test results according to the gender variable

	Gender	N	Mean	SD	df	t-test value	Sig. (2-tailed)	Significance
Total average items of QM	Male	43	1.976	0.750	104	2.112	0.037	Significant at 0.05
	Female	63	2.246	0.567				

Q4: How do participants' views differ in determining the extent to which QM standards are met in designing mathematics courses according to the level of computer skills variable (average or less/higher than average)?

H_o3: There is no significant difference between participants' views about achieving QM in math courses according to the level of computer skills (average or less/higher than average).

T-test was calculated for independent samples test as shown in Table 6. Table 6 illustrates that there is no a statistically significant difference between the average of the participants' responses ($\alpha<0.05$) according to the computer skills variable (average or less/higher than average). Thus, we must accept the null hypothesis ($H_0 3$).

Q5: How do participants' views differ in determining the extent to which QM standards are met in designing mathematics courses according to the gender variable (male/female)?

H_o4: There is no significant difference between males and females in their views about achieving QM in designing the math courses.

T-test was calculated for independent samples test as shown in Table 7. Table 7 illustrates that there is a statistically significant difference between the average of the participants' responses ($\alpha<0.05$) according to the gender variable (male/female) in favor of females with an average of 2.246 versus the males with an average of 1.976, then we must reject the null hypothesis ($H_0 4$).

Qualitative Results Related to the Interview

The interview is considered a type of "qualitative research", and it helps explain social phenomena and through it, unique and specialized information can be obtained in the least time. It also contributes to strengthening research and answers some of the questions that arise during the research procedures (Ivankova et al., 2006; Lune & Berg, 2017).

In this study, the participants who expressed a desire to participate in the interview were called to see if it was appropriate to meet with the researcher at an appropriate time during the tenth week of the second semester of the academic year 1442 AH. Due to COVID-19 pandemic and the application of health precautions, the interview was conducted through open-ended questions, and the participants were informed about the objectives of the study and how their information would be used in this study. The interview questions were based on the results of the questionnaire in this study. The interviews reinforced the interpretation of some of the results of the study. The number of interviewees was five faculty members majoring in mathematics and five students studying mathematics courses in various colleges.

After collecting data from faculty members and students, the information is divided into themes, and each theme includes a subset of categories. Emphasis was placed on data related to the topic of the research, which explain some of the results and increase the depth of the study (Majed, 2016).

Interview data coding

Lecturer: Faculty member who teaches math courses at Prince Sattam bin Abdulaziz University.

Student: Student who studies math courses at Prince Sattam bin Abdulaziz University.

Theme1: The importance of achieving QM standards in mathematics courses (category1: for the faculty member, category2: for the student).

Theme2: The difference between faculty members and students in the assessment of mathematics courses according to QM Standards.

Theme3: Technical or training needs that enhance the delivery of mathematics according to QM standards.

Theme4: Features that you would like to add to the blackboard platform to meet all your expectations from mathematics courses.

Theme5: Obstacles to achieving QM Standards in mathematics courses.

Interview results

After interviewing faculty members and students and coding the data, the results were, as follows:

Theme1: The importance of achieving QM standards in mathematics courses: The results of the questionnaire confirmed the achievement of QM standards in mathematics courses with a high degree from the point of view of faculty members. This was confirmed by the faculty members in the interview, as they believed in the importance of achieving these standards to help them achieve the educational objectives of the course. They mentioned that the Blackboard platform's achievement of QM standards helps in the administration and teaching of mathematics courses, as it has a positive impact on students' learning of research and scientific skills. Lecturer 1 mentioned that designing mathematics courses through the Blackboard platform according to QM standards contributed to the development of research and investigation skills among students and effective communication between students and all parties to the educational process. Lecturer 2 and lecturer 3 indicated the importance of having discussion rooms and exchanging mathematical ideas (the Blackboard platform helps to exchange ideas between students through the discussion link or the course forum).

Overall, the results of the interview with faculty members confirm the importance of achieving QM standards in mathematics courses and state that they are achieved to a high degree. This is a logical result due to the university's interest in activating e-learning in the educational process, and the large number of training programs held by the Deanship of Information Technology on designing courses via the Blackboard.

From the students' point of view, the interviews revealed the following results: The students confirmed that they saw the reflection of applying QM standards in most of the mathematics courses offered to them through the Blackboard, and they explained its importance in encouraging learning mathematics courses, as it is important in saving time and effort, and this was confirmed by student 1 and student 2 who stated that "math courses are excellent in saving time and effort, so it is important to try to meet these standards and they are available to a moderate degree."

Student 1, student 3, and student 5 shared that QM standards are achieved to a good degree in mathematics courses, and it is important to achieve these standards with a high degree to know the objectives of the course I am learning and link it to life. Student 2 emphasized this, saying, "the faculty member's interest in these standards raises our interest in activities and exercises that increase our understanding of mathematics topics." As for student 5, he said, "the math courses via the Blackboard help me in everything, in terms of interaction with the lecturer during the virtual semester and in terms of

solving assignments", while student 4 said that "I need encouragement through interaction with the lecturer in all math courses".

To sum up, the results of interviews with students emphasize the importance of QM standards for students and that it is verified in mathematics courses to a moderate degree.

Theme2: The difference between faculty members and students in the assessment of mathematics courses according to QM standards: The results of the questionnaire showed that there are differences between faculty members and students regarding the degree of achievement of QM standards in favor of faculty members. During the interview with the faculty members, they mentioned that the students' inexperience is the main reason for their judgment that the courses meet QM standards to an average degree. Lecturer 1 mentioned that "this may be due to the limited experience of their overall experience about the quality standards of QM e-courses."

Lecturer 2 and lecturer 3 mentioned that the reason is the weak interaction of students and their lack of knowledge of these standards, saying, "because mathematics courses require interaction between students and my students are not distinguished and do not have the ability to give a judgment," while lecturer 4 stated that the reason is due to the faculty member, as he stated that this is due to "the lack of commitment on the part of some faculty members to apply all QM standards in designing their courses." Lecturer 5 stated that some faculty members believe that teaching mathematics is more effective for students when studying face to face. He said, "some faculty members prefer teaching mathematics topics in the real class as it is better than the Blackboard platform for the educational process, which causes the course elements not to meet those standards when designing the course."

In general, the interview explained the reason for the differences between faculty members and students regarding the degree of achievement of QM standards in favor of faculty members, where it was due to the students' inexperience and limited experience, or lack of commitment by some faculty members to these standards when designing mathematics courses from the students' point of view.

Theme3: Technical or training needs that enhance the delivery of mathematics courses according to QM standards: The results of the questionnaire showed that the degree of achievement of the items of the seventh standard (learner and instructor support) was average for students and faculty members. Therefore, in the interview the faculty members emphasized the technical or training needs that enhance the fulfillment of QM standards in mathematics courses. The faculty members in the interview emphasized that technical support is moderate due to the increased teaching load. Lecturer 2

mentioned that "he does not know a clear description of the technical support provided to him, and how to communicate with him." Lecturer 1 and lecturer 3 also mentioned that "there is a need for training on modern mathematics software, which supports teaching strategies and assessment methods and training on them on an ongoing basis."

Lecturer 4 also emphasized the importance of linking theoretical education with practical application, saying, "we need practical training courses to benefit from mathematics in practical life," while lecturer 5 pointed out the importance of holding training programs, saying, "we need intensive training on designing mathematics courses according to QM."

Theme4: Features that you would like to add to the blackboard platform to meet all your expectations from mathematics courses: As for students' needs, there are special technical training needs that enhance their learning of mathematics courses according to QM standards. Student 1 said, "we need to get the technical support provided and training on how to use the discussions or forum course well," while student 2 and student 3 emphasized "training on the programs used in writing mathematical equations and simulation experiments," and student 4 emphasized "extensive training on blackboard tools and virtual classes that help us succeed."

Since mathematics courses have a teaching feature that differs from the rest of the courses, faculty members and students mentioned the advantages they would like to add to the Blackboard platform to achieve QM standards in mathematics courses.

All faculty members agreed on the importance of focusing on research activities and projects. For example, lecturer 1 mentioned "focusing on project-based activities and generating creative ideas. As for the course techniques: linking Bb learning management system with modern software in mathematics learning such as GSP and Mathematica GeoGebra 3D Calculator," while lecturer 3, lecture 4, and lecturer 5 emphasized "self-learning and linking theory to practice."

This was confirmed by both student 3 and student 5 who emphasized "interest in the applied aspect of mathematics," while student 3 mentioned the "need for immediate reinforcement of assignment solving across the Blackboard platform."

To sum up, we find that the results of the interview confirmed the agreement of faculty members and students that mathematics courses differ from other courses, so QM standards must include some requirements related to research activities and projects to enhance student learning.

Theme5: Obstacles to achieving QM standards in mathematics courses: As for the obstacles to achieving QM standards in mathematics courses through the Blackboard considering COVID-19 pandemic, some faculty members (i.e., lecturer 2, lecturer 3, and lecturer 4) mention some obstacles, including "lack of Blackboard features, lack of programs for writing equations, and lack of drawing tools for use in some mathematics courses." This was also confirmed by student 1 and student 4. As for lecturer 5, he referred to another obstacle, which is "the weakness of the technical skills of the faculty member who teaches mathematics, as well as the student in dealing with the blackboard."

Student 3 mentioned that one of the most important obstacles he faces in learning mathematics through the Blackboard is a technical problem that lies in "suspending the blackboard during the virtual lecture and during exams continuously, according to the search engines used."

Faculty members and students agreed on the obstacles they face in achieving QM standards related to the blackboard system that Prince Sattam bin Abdulaziz University uses in its e-learning, such as lack of training courses, the difficulty of writing mathematical equations, the lack of features, and the suspension of the program. All these difficulties lead to lack of achievement of QM standards in some math courses from the students' point of view.

DISCUSSION AND CONCLUSION

The purpose of this study was to assess the quality of mathematics courses design according to QM standards at Prince Sattam bin Abdulaziz University: branches of Wadi Al-Dawasir and Al-Sulayel. The results of the study showed that there is agreement between faculty members in achieving QM standards in mathematics courses in 7 standards with a high degree: course overview and introduction, learning objectives (competencies), assessment and measurement, instructional materials, course activities and learner interaction, course technology, and accessibility and usability. As for the seventh standard (learner and instructor support), the verification rate was average. This result is consistent with the findings of (Gregory, 2018; Naim et al., 2021). On other hand, the students agreed to achieve QM standards in mathematics courses in all standards with an average degree. This result is consistent with the findings of Alizadeh et al. (2019), Crews et al. (2017), and Sadaf et al. (2019), while it is inconsistent with the findings of Shin and Cheon (2019).

This result may be due to the training programs held by the Deanship of Information Technology and Distance Education at Prince Sattam bin Abdulaziz University for faculty members on course design skills through the Blackboard platform. This interpretation is consistent with the results of previous studies that emphasized the importance of professional development programs in designing online courses to achieving QM standards in delivering courses to students and achieving high educational effectiveness

(Bigatel & Edel-Malizia, 2018; Chand & Gabryszewska, 2021; Compomizzi et al., 2019; Gregory, 2018; Gregory et al., 2020; Hollowell et al., 2017; Johnson, 2015; Kearns & Mancilla, 2017; Koepke & O'Brien, 2012; McMahon, 2021; McQuiggan, 2012; Mercer, 2014; Meyer, 2013; Robinson & Wizer, 2016; Taylor et al., 2018).

The results showed that there was a statistically significant difference between the average of the perspectives of faculty members and students ($\alpha<0.05$) according to the participant type variable (faculty members/student) in favor of the faculty members. This result was explained by the results of the interview with faculty members, which may be attributed to the students' lack of experience in evaluating the design of online courses according to QM standards, or the poor skills of dealing with educational platforms among students or the low level of achievement of some students. This is consistent with the result of the study, which indicates that there are statistically significant differences between the students' perspectives in evaluating the design of mathematics courses according to QM standards in favor of high achieving students.

The results revealed that there was no statistically significant difference between the perceptions of faculty members or students in evaluating the design of mathematics courses ($\alpha<0.05$) due to the level of computer skills. This result is inconsistent with (Mills, 2020) which emphasizes the importance of a faculty member possessing technological competencies as a prerequisite for mastering the skills of designing courses online.

The results illustrated that there was a statistically significant difference between the perceptions of faculty members or students in evaluating the design of mathematics courses ($\alpha<0.05$) due to the gender variable (male/female) in favor of females. This result is consistent with the findings of (Al-Judayi, 2021) which showed differences between males and females in the views of faculty members in designing courses according to the ADDIE model in favor of females. This result may be due to the nature of the geographical environment, as male students are charged with family work and tasks in camel herding and being preoccupied with agriculture, while female students are different, as they are free to study only, which gives them the opportunity to follow the faculty members through the blackboard and watch the largest amount of educational and informative videos about e-learning.

Moreover, the study reached results through interviews with faculty members and students that emphasize the importance of designing mathematics courses considering QM standards. In addition, the faculty members pointed out some features that should be included in the blackboard platform to suit the nature of mathematics, (i.e., facilitating writing mathematical equations, graphs of some functions, linking the platform to some software in the field of mathematics such as GeoGebra).

Finally, the interviews also resulted in some difficulties faced by faculty members and students while teaching/learning mathematics courses via the Blackboard platform (such as suspension of the platform, internet outage during the virtual lecture). This result is consistent with the findings of Taylor et al. (2018).

Limitations

The study was limited to faculty members from two community colleges of science and engineering at Prince Sattam bin Abdulaziz University, 31 faculty members majoring in mathematics and 75 students. The researchers recommend that future studies consider the training of faculty members and students to master the techniques of reviewing the design of online mathematics courses according to QM standards. Moreover, the results of the present research should not be generalized because they are related to the evaluation of specific courses at Prince Sattam bin Abdulaziz University; and therefore, the subject of the study still needs to be researched more extensively.

Recommendations

According to the results of the current study, the researchers recommend the following considerations:

1. Faculty members should consider interactive activities while designing mathematics courses that keep the student active.
2. Training university faculty members to design and review their e-courses according to QM standards.
3. The university should follow a specific mechanism for reviewing online courses according to QM standards in three stages (faculty member review, university peer review, QM organization review to obtain recognition and accreditation).
4. Urging faculty members to take into account QM standards when designing their e-courses.
5. The developers of the Blackboard platform should take into account the nature of mathematics courses so that the program is provided with some features and interactive programs that are suitable for mathematics.
6. Training students to make the best use of the learning capabilities available on the Blackboard platform.
7. Forming a team of distinguished students who have mastered mathematics courses to review the courses according to QM standards.

Suggestions for Future Studies

1. Expansion of new studies on designing e-courses according to QM standards.

2. The need to conduct comparative studies between the conformity of mathematics courses designed across different electronic platforms to QM standards.

3. The need to conduct extensive qualitative studies to investigate why female students differ from male students in their perceptions of the quality of online mathematics course design.

4. Conducting studies on the evaluation of standards issued by QM.

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