



Economy Skills among Female Mathematics Students at University According to Their Perceived Future Roles

Mansour Saleh Alabdulaziz

Assoc. Prof., Department of Curriculum and Instruction, Imam Abdulrahman Bin Faisal University, Saudi Arabia, malabdulaziz@iau.edu.sa

Ishraga Arbab Hamad Abdelkarim

Asst. Prof., Department of Curriculum and Instruction, Imam Abdulrahman Bin Faisal University, Saudi Arabia, iaabdelkarim@iau.edu.sa

Hanaa Abdullah Madkhali

Lecturer, Department of Curriculum and Instruction, Imam Abdulrahman Bin Faisal University, Saudi Arabia, hamadkhali@iau.edu.sa

This study aimed to determine the degree of availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Saudi Arabia (Imam Abdulrahman bin Faisal University) according to their perceived future roles. To achieve this, a descriptive analytical method was employed and a newly developed questionnaire administered to a random sample of 100 female students. Data were analysed using the Statistical Package for Social Sciences (SPSS) (Cronbach's Alpha, Split-Half, Spearman's correlation coefficient, Arithmetic mean, Standard deviation, Standard error, Order). The results indicated a high level of problem-solving and decision-making skills (the first dimension) among students with an arithmetic mean of 2.68 (89.42%), followed by communication skills with an arithmetic mean of 2.63 (87.67%), innovation skills with an arithmetic mean of 2.42 (80.9%), both critical thinking skills and using technology with an arithmetic mean of 2.3 (78.33%), and a medium level of team-working skills with an arithmetic mean of 2.07 (69.25%). The arithmetic mean for the general level of skills was 2.42 (80.65%), indicating a general increase in the availability of knowledge economy skills among these female mathematics students. Statistically significant differences (0.01) in the availability of knowledge economy skills were also found in academic stage (Bachelor-Master) in favour of undergraduate students. The researchers recommend an increased focus on team-working skills, and that students, particularly master's students, should receive more training on knowledge economy skills and be encouraged to keep up to date with recent developments.

Keywords: knowledge economy skills, female mathematics students, the college of science, human studies, mathematics

Citation: Alabdulaziz, M. S., Abdelkarim, I. A. H., & Madkhali, H. A. (2022). Economy skills among female mathematics students at university according to their perceived future roles. *International Journal of Instruction*, 15(4), 889-914. <https://doi.org/10.29333/iji.2022.15448a>

INTRODUCTION

Knowledge economy is a branch of economic sciences that explores human capital in the economy and the progress of society (Afouneh, 2012). Numerous transformations have taken place in recent years in the field of education, perhaps the most important of which is its transformation into an area of the economy that produces, invests in, and employs knowledge. With the aim of improving and enriching life with information services and advanced technological applications, using human resources as capital, and employing scientific research to facilitate development in various areas of life, knowledge is a resource renewable in line with the renewal of generations (Al-Salem, 2016). The trend toward the knowledge economy has become global as it is one of the most important goals of international organizations such as UNESCO, the European Union, and the International Federation for Information Processing.

Increasing investment in the knowledge economy will be important in meeting the challenge faced by Arab countries (Abu Al-shamat, 2012). This requires urgent reforms in the education sector as this is an effective tool for human investment and is responsible for preparing students to be active in building a knowledge-based economy. To achieve this aim, the most important requirement is to define standards in academic programmes, evaluate and develop them in the light of those standards, and develop curricula in accordance with the knowledge economy so that it stems from a contemporary educational vision compatible with scientific updates and developments. This will involve applying a diversity of strategies for learning and teaching that take into account the nature of the course, the characteristics of learners, and their tendency to keep pace with contemporary requirements (Al-Ibrahim, 2004).

To enhance the learner's ability to pursue lifelong learning, it is essential to focus on knowledge economy skills such as problem-solving, critical thinking, decision-making, the use of information and communication technology, teamwork, cooperation, creativity and innovation, and mastering scientific research skills. This will equip effective learners with an integrated personality that contributes to building and developing their society in harmony with others, the international family, and ongoing societal changes while preserving their Islamic identity and a sense of belonging to their homeland (Al-Khamash, 2013).

The Kingdom of Saudi Arabia has adopted the Ninth Development Plan (2014-2010) to move toward a knowledge-based economy. This emphasizes that education constitutes the main system for the dissemination of knowledge in society, and the future plan for university education focuses on a number of trends, the most important of which is moving toward the knowledge economy (Al Salem, 2016). To achieve this goal, a plan (2030) has been established to create a knowledge society as the foundation for a knowledge-based economy (Al-Jaloud, 2019; Saaty, 2016). Hence, this study determines the degree of availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Jubail according to their perceived future role. The purpose of this is to contribute to the achievement of such vision in order to be aware of the shortcomings of the treatments and the strengths to continue with them.

Research problem and research questions

90% of Saudi Arabia's gross domestic product (GDP) emanates from oil resources (Ministry of Economy and Planning, 2010); therefore, the country is oil-reliant. Furthermore, the economy of oil-reliant nations can be severely destabilized if the price of crude oil is drop (Alomari, 2019). For instance, Venezuela's reliance on oil led to a national disaster (McCarthy, 2017). This is because GDP, exports and government income are highly dependent on oil revenue, and the recent decrease in the oil prices has decreased Venezuela's national revenue resulting in economic collapse as well as inflation (Alomari, 2019). Nevertheless, in consideration of the country's long-term growth, the Venezuela's government has become aware that reliance on oil cannot be maintained. If the country was to move from an economy based on resources to one based on knowledge, this would be a more feasible alternative. Generally, Saudi Arabia could become less dependent on oil revenues for economic growth and stability if the nation moved its economy from being based on resources to being based on knowledge (Nurunnabi, 2017).

It is clearly evident that there can be notable macroeconomic gains if women are able to contribute their full potential to the labor market (Loko and Diouf, 2009). Although women form around half of Saudi Arabia's populace, their level of contribution to the measured economic activity is some distance from achieving its potential (Saqib et al., 2016). During the course of time, in various countries, a significant and decisive link between the degree of economic development and the comparative role of women within society has been observed (Duflo, 2012; Matthias et al., 2012). Therefore, this study focused on female mathematics students at the College of Science and Human Studies in Saudi Arabia (Imam Abdulrahman bin Faisal University).

Another problem was identified through the researchers' work in the educational field, as well as through their interaction with numerous students from various specialisations. This was particularly the case with mathematics because the researchers are involved in this specialisation; consequently, they have noticed that in order to survive in the fast-paced knowledge economy, some students are developing and upgrading their skill sets. The researchers asked 30 students the following questions: Do you have the skills you need to be a competitive candidate in today's knowledge economy? What can you do to ensure you have the skills employers look for when they are hiring and promoting employees? To what extent are knowledge economy skills available for you? Of the 30 students, 24 answered "No" or "We do not know". As researchers, we are aware of the availability of knowledge economy skills among mathematics students. Furthermore, by acquiring such skills through university programmes and other means, a person can impress his/her employer or, if on the job market, any hiring manager.

Based on the foregoing, and despite the efforts made by Arab countries to develop their educational policies to achieve a knowledge-based society, the 2004 UNESCO report clarified the gap between the achievements of Arab countries and that of their counterparts from East Asian countries, which indicates the weakness of educational outcomes (UNESCO, 2004). Studies such as that of Abdel Samie (2007) have emphasized the need to obtain knowledge from its sources. Furthermore, Al-Zambati

(2011), Al-Qays (2011), Ramadan (2015), and reports of the National Center for Human Development (2010) confirmed that students do not have the necessary practical skills.

Ramadan (2015) recommended conducting more field studies on the acquisition of knowledge economy skills. In order that students may expand their skills, Thalgi (2020) suggested that universities' academic members should enhance the abilities of their students. Consequently, this study established the level of availability of knowledge economy skills of female students of mathematics at the College of Science and Human Studies in Jubail according to their perceived future role, the purpose of which is to help Saudi Arabia stakeholders to obtain some benefit from the participants' responses in order to help both current and future students. Hence, the study problem was addressed in the following questions:

- 1- What is the degree of availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Jubail according to their perceived future roles?
- 2- Are there statistically significant differences in the degree of availability of knowledge economy skills among this cohort in terms of academic stage (Bachelor - Master)?

This study demonstrates its importance in the following ways: firstly, the importance of the study is due to that of its connection with the requirements of the age for which the students need to prepare in order to keep pace with them. Secondly, the study aimed to encourage innovation and creativity, and to support research and development. This provides an interactive environment which encourages students to produce knowledge and invest it perfectly, thereby contributing to the application of a set of comparisons between universities. This is in order to determine the level of development of its outputs to meet the requirements of the labour market. Thirdly, the current study aligns with modern educational trends at local and global levels that call for more attention to be paid to the knowledge economy. Fourthly, the study contributes to updating and developing the content of university development programs, which will reflect positively on the performance of female students. Fifthly, the study benefits researchers by identifying the degree of availability of knowledge economy skills among students, and opens up avenues for modern scientific studies in other fields. Finally, it helps the developers of programs to focus and pay attention to the knowledge economy.

Imam Abdulrahman bin Faisal University is enthusiastic about the development of both graduate and postgraduate programs as well as its interest in scientific research in order to attain the same level as international universities, it also utilizes educational techniques for developing every domain — economic, medical, and educational — in order to attain the Kingdom's Vision 2030, being the national transformation plan (Imam University, 2019a). It is essential that the university persists in recognizing problems and finding successful solutions in view of its interest in developing programs, this is because such challenges have an impact on these programs with their numerous components: namely academics, students, study courses as well as various types of scientific research. Many studies, such as Salem (2017) has sought to detect the

problems which graduate students encounter. Such difficulties present administrative, financial and technical challenges which, to various levels, have an impact on graduate students. This indicates that it is necessary to find solutions to these difficulties and to concentrate on them, enabling students to be updated, while simultaneously obtaining the research skills and abilities enabling them to undertake the necessary tasks in their community. From the perspective of the students, Al-Dhuwaihi (2020) recognized the problems which postgraduate students encountered at the College of Education at Imam Abdulrahman bin Faisal University. The greatest problems were associated with finance, while academic difficulties were in second place, followed by administrative challenges, and then technical problems. Students' awareness of the teaching and learning procedure, as well as an improved performance, is obtained by increasing the quality of services provided for them (Gautam et al., 2016; Wolfe and Freeman, 2013).

Theoretical Framework

In 1996, the Organisation for Economic Cooperation and Development (OECD) published a report entitled *The Knowledge-Based Economy*. In this report, they stated that "knowledge is now recognised as the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance" (p. 3). Employment in the Knowledge Economy was seen by the OECD (1996) as involving an increased demand for highly skilled workers, prompting the need for government policies that focus on upgrading human capital. The key argument was that in order to remain competitive for the needs of a global economy (Rizvi & Lingard, 2009), knowledge must become an economic commodity and "the primary source of all future economic growth" (Gilbert, 2005, p. 25). The Knowledge Economy assumed the presence of a global labour market in which all nations must compete (Friedman, 2005, cited in Lauder et al., 2012). Success in this market was based on innovation and knowledge (Lauder et al., 2012). It included a strong focus on digital technologies which would support and enable new forms of innovation and entrepreneurialism to emerge (OECD, 1996). As a result, the key purpose of education was redefined in terms of human capital development.

The shift towards the knowledge economy and a drive towards improved economic efficiency have meant that countries now require a means of measuring their human capital to profile how their citizens can contribute to an internationally competitive economy (Davies & Bansel, 2007; Lingard et al., 2013). The OECD has played a key role in this respect by developing internationally comparable indicators of skills and competencies for human capital. In 1999, using data from initial Programme for International Student Assessment (PISA) tests, a framework for the development of key competencies was compiled (Salganik et al., 1999). These key competencies outlined the skills and abilities students should possess in order to lead successful lives, and to support a well-functioning society in the Knowledge Economy. The project, named the Definition and Selection of Competencies (DeSeCo) project, produced a framework of three broad categories, including the abilities to use tools interactively, interact in heterogeneous groups, and act autonomously (OECD, 2005).

The knowledge economy represents one of the basic issues for education in the twenty-first century. This is because 21st century learners are highly autonomous and capable of using technology with ease. Proponents of the need for 21st century learners argue that as a result of the Knowledge Economy and a push to improve the economic potential of human capital, current traditional education systems need to change (Bull & Gilbert, 2012; Gilbert, 2005; Prensky, 2001). They argue that the current model does not cater to current students' educational needs and hence there is a need to transition to a 21st century learning model (Bull & Gilbert, 2012). A closely associated idea is that there has been a change in the meaning of knowledge, in that "people are increasingly thinking of knowledge as not a thing, developed and stored in people, but as a kind of energy, something that does things" (Gilbert, 2005, p. 75). Underpinning these ideas is the fact that vast generational change has occurred, and students think and learn in a fundamentally different way; therefore, schooling as we know it has to change.

Therefore, the knowledge economy has become a central concept around which several opinions and viewpoints revolve, and has been addressed in numerous studies, research studies, and reports. It has been a key topic for conferences, seminars, and workshops at a global level, which emphasizes the increased interest in the concept of knowledge society. The knowledge economy is a modern branch of economics based on knowledge, its investment, and its transformation as a source of national income to improve sustainable economic development in a competitive environment. A knowledge society is thus based on innovation and creativity (Bukhamseen, 2020).

The knowledge economy is a new pattern that differs in its features and characteristics from the old economy. It focuses on knowledge as the most important commodity in the state. It also represents an independent science in itself, upon which numerous research studies have been conducted. Among its chief characteristics are the following:

(A) Investing in humans and their capabilities according to the vision and aspirations of the state; (B) providing highly qualified human cadres to control change, providing them with a variety of jobs and working to improve the level of employment and (C) relying on knowledge as a key driver of the economy and making it digital to develop the country as a whole (An et al., 2020).

Knowledge Economy Skills: The knowledge economy represents one of the basic issues for education in the twenty-first century, where knowledge has become the principal form of capital. A study by Eustache (2018) confirmed the existence of a positive relationship between the progress of countries and indicators of the knowledge economy. He concluded that the advanced knowledge economy depends on innovation and knowledge production. Hence, providing renewable job opportunities for female graduates is not based solely on the acquisition of modern tools and equipment in the economic sectors. Rather, it focuses on implementing a renewed work strategy based on creativity. This generates a benefit from employing knowledge in the fields of work.

In an attempt to develop a proposed model for developing students' skills in view of the knowledge economy at the Faculty of Management in the Academy of Economic Studies in two regional centers in Bucharest and Piatra Neamt in Romania, the results obtained by Ion and Andreea (2011) indicated that a considerable amount of educational

literature emphasized the necessity of adopting new teaching and learning methods based on developing students' creative and critical thinking skills. Such literature also stressed the usage of appropriate technology to increase the partnership between higher education and the labor market on the one hand, and compatibility with the requirements of the knowledge society on the other. However, there is no consensus in this literature regarding the type of activities and stages that may lead to the development of students' skills in order to achieve the above. Moreover, the study showed that it has become imperative for universities to collaborate regularly with other research institutions, and to participate in international research networks in order to design better academic programs for a new generation of students corresponding to the era of knowledge economy.

Similarly, Schwalje (2013) attempted to build a conceptual model for the formation of national skills for developing knowledge economics in the Arab world. In this case, the results of his study indicated that there is currently no general system for analyzing national skills development systems in the Arab countries. The results also revealed the necessity of an integrated and systemic vision which depends mainly on the fact that institutions and stakeholders are highly interconnected in the context of knowledge economic development, and in achieving economic, political, and social goals in the Arab world.

With regard to the skills required by the knowledge economy in 2020 in the higher education system in the UK, a study conducted by Laurence and Charles (2010) indicated concerns about the rate of expansion of higher education and current levels of graduate unemployment. However, despite this, the study revealed that the UK economy has no graduates who keep pace with the requirements of the development of a knowledge economy dependent on activities such as promotion, organizational development and branding, which depends largely on the types of general skills acquired at university.

Regarding the extent to which universities teach the skills required for the knowledge economy, the study (Tony, 2014) suggested that it is impossible to predict or judge the types of work, business, or the quality of deals in the future. It also stated that it is essential for universities to work in two directions, the first of which is to determine these skills and their inclusion within academic programs. The second is that these skills are developed to ensure, on an ongoing basis, that they are those required in the knowledge economy.

Focusing precisely on the nature of the skills required by the knowledge society (Ivan et al., 2012) indicates that businessmen expect that the most important skills in the next five years will be as follows: critical thinking, problem-solving, information technology application, teamwork, cooperation, creativity and innovation, and managing knowledge diversity effectively. The results of the study also indicated that the process of creating skills and knowledge is determined by an interactive relationship which can be clarified as follows: the educational institution as an agent of knowledge, the acquisition of skills and knowledge, the rooting of management of knowledge, and education.

Furthermore, Ledward and Hirata (2011) identified the skills necessary for acquiring the knowledge economy within the context of the skills of the twenty-first century. These include four basic elements of learning and innovation as follows: critical thinking, communication, cooperation, and creativity.

The study conducted by Al-Sutri et al. (2010) divided the knowledge economy skills of preparatory year students at King Saud University into six main skills: communication, decision-making, problem-solving and thinking, teamwork, responsibility, and self-awareness. The results of the study indicated that teamwork skill ranked first, while problem-solving and thinking skills ranked last.

The following is a more detailed explanation of a set of key skills needed to achieve scientific leadership in the era of knowledge:

Problem-solving and decision-making skills: A problem-solving skill is a process in which the individual uses his or her acquired knowledge, previous experiences, and skills to respond to the requirements of a situation with which he or she is unfamiliar. The process may be based on a mental skill, emotional performance, or a combination of both. Maxwell et al. (2010) confirmed that problem-solving ranks first among the skills graduates must possess. We know that having good and strong problem-solving skills will make a tremendous difference to lives and careers in the future (Alabdulaziz and Higgins, 2021). A decision-making skill is a mental or motor process associated with a situation or problem in which a solution is chosen from among several alternatives in order to reach an appropriate decision and achieve the required goal or objective.

Critical thinking skill: FathAllah (2008) defined critical thinking as the ability to analyze and test the individual's information on the subject under research and study with the aim of distinguishing between right and wrong ideas. Critical thinking is defined by the National Council for Critical Thinking as a disciplined mental process represented in the assimilation, analysis, and evaluation of information accrued through observation or experience, or as a result of connection and communication as evidence of belief and action. The ideal model for critical thinking is based on universal intellectual values such as clarity, accuracy, consistency, relevance, depth, correct evidence, breadth, and fairness (Marwan, 2021).

Teamwork skill: This refers to the skill of cooperating with colleagues and working in study team. It is a skill in which students learn by sharing with each other in an organized collaborative manner after being distributed into small heterogeneous study groups to acquire concepts, principles, laws, theories, ideas, and other knowledge. Brungardt (2011) describes teamwork skills as those needed by an individual in order to work with others to achieve an objective or to promote a positive change. According to the report given by the NCTM (National Committee of Teachers of Mathematics) in 1989, group work in mathematics education plays an important part in students asking questions, discussing opinions, listening, being responsible for what they learn, criticizing constructively, and constituting an atmosphere of mathematical learning (Koçaka et al., 2009).

Communication skill: This includes speaking and listening skills, dialogue and discussion, persuasion, and writing, all of which are part of an interactive process through which information, ideas, and trends are exchanged using specific stimuli in the form of written or oral messages accompanied by facial expressions and body language. Communication skills are the abilities employed when presenting and receiving information in its various forms, which allows a person to understand others and to understand the information correctly (Attia, 2019).

Innovation and renewal skill: This is a skill that results in something new, whether this is an idea, a subject or a material entity, or a transition from old elements to new ones. The knowledge society is based and depends on innovation and creativity, and economic support through incentives, legislation, and laws that regulate the work of intellectual capital through the dissemination and exchange of knowledge as an economic activity where knowledge is the commodity (Aziz, 2002).

Information and communication technology (ICT) skills: ICT is defined by UNESCO as a form of technology that can be employed in the processes of information building, processing, storage, transmission, presentation, sharing, and exchange through various technical aids such as mobile phones, digital devices, networks, and software, and their associated services and applications (UNESCO, 2009). This is technology related to the storage, retrieval, circulation, and dissemination of information and the production of oral, textual, and digital data by electronic aids through the integration between computers and visual communication systems (Bello et al., 2018).

These are the necessary skills that the current study seeks to determine its availability among female mathematics students as an essential point in the study.

Previous studies

Alghamdi (2019) aimed to determine the degree of embedding knowledge economy skills in the middle-school art education curriculum from the perspective of art education teachers in Mecca City. The results of the study revealed that the degree of availability of knowledge economy skills, included in the middle-school art education curriculum, were at a medium scale in all axes as follows: creative thinking skills, teamwork, knowledge growth, economic production, information technology, and problem-solving skills. Additionally, the study found statistically significant differences among art education teachers' perspectives of creative thinking skills axis, and problem-solving skills axis related to the qualification variable in favor of the PhD qualification. They also found that the cognitive development axis and economic production axis were attributed to the years of experience in favor of over 20 years of experience, and that all axes are related to gender variable in favor of art education teachers.

Al-ahmadi and Al-Anzi (2016) aimed to identify the degree of availability of knowledge economy skills in middle-school mathematics textbooks in the Kingdom of Saudi Arabia. The results showed the availability of knowledge economy skills in relation to the knowledge domain in the teacher's guide book (3.73), and the average value of this guide was ranked first, ahead of the average value of the student's book which was (3.62). This is despite the difference being limited between the average values of the

student's book and the teacher's guide. In the last rank, the average value of the exercise book had a value of (2.70). The research presented numerous recommendations, the most important of which are working to reconsider the inclusion of knowledge economy skills in the exercise book for the third intermediate grade, and addressing the weakness that generally exists in it compared to the student's book and the teacher's guide.

Annab (2016) determined the training needs of mathematics teachers in the upper basic stage according to their future roles in the knowledge economy. The results indicated that estimates of the training needs of mathematics teachers in the upper basic stage according to their future roles in the knowledge economy came were high. They also differed according to gender in favor of males, varied according to years of experience in favor of those with experience (from 5-10 years), and differed according to educational qualifications. Based on the results, the authors recommend paying attention to elements of professional development and developing them to suit the future needs of teachers, and training mathematics teachers during their service through programs based on their professional field and knowledge needs. They also emphasized the need for an actual follow-up after they finish participating in any course or a training program to verify the degree to which they are applying what they have learned .

A study by Irsheida's Ako (2013) aimed to identify the perceived training needs of Arabic language teachers at the secondary stage in the light of the knowledge economy. The results indicated that the training needs of Arabic language teachers were moderate, and there were no statistically significant differences ($\alpha = 0.05$) in the training needs of Arabic language teachers in terms of gender, academic qualification, or experience in all fields. The researcher recommended that teachers should be trained in how to develop students' attitudes toward scientific openness and a love of research and curiosity, and that further studies should be conducted on other samples.

Al-Quraan (2013) aimed to demonstrate the impact of the use of educational techniques in the development of human resources to an acceptable level in the knowledge economy, proportionate to its level in developed countries. The results indicated a direct statistically significant relationship between expenditure on university education and gross domestic product. The study also recommended intensifying investment in advanced technology as improving the technological level in the Jordanian economy will lead to an increase in demand for university graduates, especially in the private sector.

Having reviewed previous studies, the following points were noted: Most of the studies that deal with the knowledge economy in the twenty-first century indicate the modernity of the topic and its importance. In addition, the researchers benefited from the literature in formulating their research methodology. Moreover, what distinguished this study is that it dealt with determine the degree of availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies according to their perceived future roles, and this was not studied before.

METHOD

The researchers adopted a descriptive analytical approach in which data were collected to determine the availability of knowledge economy skills among female students at the

College of Science and Human Studies in Jubail according to their perceived future roles. The current study included the following variables: (1) The independent variable (the degree of availability of knowledge economy skills); (2) The dependent variable (students' future roles).

Research tool

The researchers designed a questionnaire to determine the degree of availability of knowledge economy skills among female students at the College of Science and Human Studies in Jubail according to their perceived future roles. The researchers administered the tool to the study population. The objectives of the study tool and its importance were clarified, and the response method was clarified through the instructions included in the tool. This denotes those to whom the results of the research can be generalized, whether it is a group or individuals, according to the objective of the research problem (Al-Assaf, 1995). Accordingly, the study population was represented by female students of the Mathematics Department at the College of Science and Human Studies in Jubail.

These samples were chosen randomly, and comprised 100 females as a representative sample of the population. An invitation to participate in the questionnaire was sent by the Blackboard, and then we drew lots by putting participant numbers in a container, the lots were then mixed and drawn one by one in random order. With regard to postgraduate students, the university accepts only a limited number. Thus, there were just six master's students who specialised in mathematics, and hence data were collected from them all. The study was conducted in the second semester of the academic year 2020-2021. The steps in building the tool, measuring its validity and reliability, and its application were as follows:

In preparing the questionnaire, the researchers applied the following steps: (1) The study relied on building the questionnaire on the study conducted by Ledward and Hirata (2011), and that conducted by Al-Sutri et al. (2010); (2) A theoretical study of the literature which addresses the knowledge economy in educational science; (3) The researchers considered Arab and foreign studies related to the topic. Based on the above, they constructed the initial form of the tool, and subsequently, the questionnaire was presented to a group of arbitrators specializing in curriculum and teaching methods, as well as a group of mathematics teachers. In view of their comments, the questionnaire comprised six main skills distributed across 24 sub-questions.

The validity of the questionnaire: The validity of the questionnaire refers to whether it measures what it purports to measure (Obeidat, 2004). The researchers adopted face-validity and content-validity. Oppenheim (2001) stated that "content-validity seeks to establish that the items or questions are a well-balanced sample of the content domain to be measured" (p. 162). There are actually numerous methods of attaining content-validity, ranging from dependable research construction by submitting the plan to experts, to analysing the validity and reliability statistically. There are formulae; for example, Cronbach's Alpha coefficient which ranges from zero to one (unreliability-reliability) (Gay & Airasian, 2000). To assess the validity of the tool, the content was presented to a group of arbitrators in the field of educational research and educational specialists among the faculty members at the College of Science and Human Studies in

Jubail, who were asked to express their opinion regarding the relevance of the items to the content, the adequacy of the tool in terms of the number of items, the comprehensiveness of the tool given the topic, the diversity of the content, the level of linguistic formulation, and any modifications or changes they felt needed to be made. The researchers considered the arbitrators' comments and suggestions and made several modifications, such as changing and deleting some of the content of the items. Furthermore, the questionnaire was submitted to an expert in the analysis of statistics for the purpose of assessment, as well as to receive help in selecting the correct measurement (Cohen et al., 2004; Gay & Airasian, 2000; Oppenheim, 2001). The researchers viewed this as ensuring both the face and content validity of the tool, and thus considered it valid for measurement.

Table 1

Distribution of sample members based on academic stage and age group variables

Variable		Frequency	%	Total
Academic stage	Bachelor's	94	94.00	100
	Master's	6	6.00	
Age group	Less than 20 years old	43	43.00	100
	From 30-20 years old	57	57.00	
	More than 30 years	0	0.00	

Distribution of questionnaire items: The results are presented in the below table:

Table 2

Distribution of questionnaire items according to skills and item numbers for each skill, 4 questions for each skill as follows:

N s	Number of items	Paragraph or statement numbers
1 Problem solving and decision making	4	Q1, Q2, Q3, Q4
2 Critical thinking	4	Q5, Q6, Q7, Q8
3 Teamworking	4	Q9, Q10, Q11, Q12
4 Communication	4	Q13, Q14, Q15, Q16
5 Innovation	4	Q17, Q18, Q19, Q20
6 Using technology	4	Q21, Q22, Q23, Q24
Total	24	

The reliability of the questionnaire: The reliability of each dimension of the questionnaire and its overall reliability were estimated using Cronbach's Alpha coefficient and Split-Half. The results are presented in the following table:

Table 3

Reliability coefficient values (Cronbach's Alpha and Split-Half) for each dimension of the questionnaire and its overall reliability

General dimensions of the questionnaire	Number of statements	Cronbach's Alpha	Split-Half Coefficient
Problem solving and decision making	4	0.863	0.768
Critical thinking	4	0.780	0.704
Teamworking	4	0.843	0.748
Communication	4	0.853	0.758
Innovation	4	0.849	0.768
Using technology	4	0.780	0.738
The overall reliability coefficient	24	0.828	0.747

As indicated in Table (3), the overall reliability coefficient of the tool was 0.828 using the Cronbach's Alpha method and 0.747 using the Split-Half method. These values are

high and above the acceptable minimum, which indicates that the tool has a high degree of reliability and was thus suitable for use in the current research. It ought to be mentioned that some researchers; for example, Alassaf (2010), are of the opinion that Cronbach's Alpha coefficient should be at least 0.80 in order to ensure reliability. However, other re-searchers, for example, Nunnally and Bernstein (1994), claim that Cronbach's Alpha coefficient should be at 0.70 or above. Moreover, Cohen et al. (2007, p. 506) contend that this coefficient may be considered as "> 0.90 very highly reliable, 0.80-0.90 highly reliable, 0.70-0.79 reliable, and 0.60-0.69 marginally/minimally reliable."

Validity: Table (4) shows Spearman's correlation coefficient between each item of each dimension and the total score for each dimension

Table 4

Spearman's correlation coefficient between each item of each dimension and the total score for each dimension

Item or question	Correlation coefficient	Interpretation of the degree of correlation	Item or question	Correlation coefficient	Interpretation of the degree of correlation
Q1	*	Significant at the (0.01)	Q15	.620**	Significant at the (0.01)
Q2	**	Significant at the (0.01)	Q16	.705**	Significant at the (0.01)
Q3	**	Significant at the (0.01)	Q17	.530**	Significant at the (0.01)
Q4	**	Significant at the (0.01)	Q18	.731**	Significant at the (0.01)
Q9	**	Significant at the (0.01)	Q19	.718**	Significant at the (0.01)
Q10	**	Significant at the (0.01)	Q20	.628**	Significant at the (0.01)
Q11	**	Significant at the (0.01)	Q21	.565**	Significant at the (0.01)
Q12	**	Significant at the (0.01)	Q22	.524**	Significant at the (0.01)
Q13	**	Significant at the (0.01)	Q23	.620**	Significant at the (0.01)
Q14	**	Significant at the (0.01)	Q24	.718**	Significant at the (0.01)

Internal consistency was verified through the correlation between the items for each dimension and the overall degree of skills. The values for the skills ranged between 0.436 - 0.731 and all correlation values were significant (0.05, 0.01). This verifies the internal consistency between the statements of the tool and its suitability in terms of measuring what it was designed to measure (Field, 2013).

Construct validity: Construct validity denotes the extent to which each skill assessed by the questionnaire items is related to the total score of all the questionnaire items by using Spearman's correlation coefficient (Aldaamin, 2007), in the following table:

Table 5

Spearman's correlation coefficient for each skill with the total score for the questionnaire

Dimensions or general skills of the questionnaire	Correlation Coefficient	Interpretation of the degree of correlation
Problem solving and decision making	.806**	Strong correlation Significant at (0.01)
Critical thinking	.939**	Strong correlation Significant at (0.01)
Teamworking	.906**	Strong correlation Significant at (0.01)
Communication	.929**	Strong correlation Significant at (0.01)
Innovation	.839**	Strong correlation Significant at (0.01)
Using technology	.876**	Strong correlation Significant at (0.01)

*. Correlation is significant at the (0.05) level

** . Correlation is significant at the (0.01) level

Coefficients were also calculated to identify the degree of correlation of each dimension of the tool with the total score of the scale. As indicated in Table (5), the correlation coefficients for skills were as follows: first dimension (0.806), second dimension (0.939), third dimension (0.906), fourth dimension (0.929), fifth dimension (0.839), and sixth dimension (0.876). All correlations of the dimensions with the scale were positive, strong, and statistically significant (0.01), which indicates the validity of the scale construction and its relevance in terms of measuring what it aims to measure (Field, 2013).

Correction of the tool and the adoption of an estimated balance according to the Likert scale: The tool was built according to the 3-point Likert scale because its relevance to the responses of the questionnaire items (Jacoby and Mattell, 1971), see table 6:

Table 6
Estimated balance according to 3-point Likert scale

Responses	Weighted average	General trend (describe responses)
Never: 1	1.67 --- 1	Strongly disagree
Sometimes: 2	2.33 ---- 1.68	Neither agree nor disagree
Always: 3	3 ---- 2.34	Strongly agree

The statistical methods employed in the research

- 1- To generate the results, the Statistical Package for the Social Sciences (SPSS) program (IBM SPSS v. 24) was used and the following statistical methods were applied:
- 2- The reliability of the questionnaire was calculated using Cronbach's Alpha and Split-Half.
- 3- Validity was calculated through Bivariate Correlation using Spearman's correlation coefficient to calculate the correlation coefficient between the variables.
- 4- Descriptive statistics (Arithmetic mean, Standard deviation, Standard error, Order), frequencies, and percentages were used to summarize the responses of the sample, the variables, and the results of the research.
- 5- A t-test was performed for two independent samples to identify differences between the two groups in terms of academic stage and age group variables.

FINDINGS

The degree of availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Jubail according to their perceived future roles.

The following table shows the responses of the study sample, arithmetic and relative mean, standard deviation, standard error, and rank on the scale as a whole and on each of the skills

Table 7

Responses of the study sample, arithmetic and relative mean, standard deviation, standard error, and rank on the scale as a whole and on each of the skills

N	Item or statement	N	Arithmetic mean	Relative mean%	Standard error	Standard deviation	Order	The level of using the skill
Q1	Find the causes of the problem through my previous knowledge and skills before choosing the appropriate solution	100	2.780	92.67	0.042	0.416	3	Always
Q2	Gather information about the problem	100	2.810	93.67	0.042	0.419	2	Always
Q3	Provide appropriate solutions	100	2.230	74.33	0.062	0.617	4	Sometimes

Q4	Compare the different results and solutions and choose the best one	100	2.910	97.00	0.032	0.321	1	Sometimes
	Problem solving and decision making	100	2.683	89.42	0.045	0.44		
Q5	Distinguish between true and false information	100	2.410	80.33	0.060	0.605	4	Always
Q6	Analyze the information and place it on several different sites	100	2.160	72.00	0.087	0.873	1	Sometimes
Q7	Explain ideas with supporting evidence	100	2.490	83.00	0.066	0.659	3	Always
Q8	Prove the results that I reach to it	100	2.340	78.00	0.082	0.819	2	Always
	Critical thinking	100	2.35	78.33	0.0738	0.739		
Q9	Cooperate with my colleagues to develop a work plan	100	1.640	54.67	0.067	0.674	2	Always
Q10	Take responsibility for my turn	100	1.930	64.33	0.087	0.868	1	Always
Q11	Respect the turns of my colleagues	100	2.360	78.67	0.067	0.674	3	Always
Q12	Contribute to the management of the group's work	100	2.380	79.33	0.056	0.565	4	Sometimes
	Teamworking		2.078	69.25	0.0693	0.695		
Q13	Use correct and appropriate phrases while speaking	100	2.530	84.33	0.058	0.577	2	Always
Q14	Express my opinion very well	100	2.400	80.00	0.065	0.651	1	Always
Q15	Participate actively in discussions	100	2.780	92.67	0.042	0.416	4	Sometimes
Q16	Listen carefully to my colleagues' opinions	100	2.810	93.67	0.042	0.419	3	Always
	Communication	100	2.63	87.67	0.052	0.516		
Q17	Update the information that I own	100	2.230	74.33	0.062	0.617	2	Sometimes
Q18	Use my ideas to build a new idea	100	2.910	97.00	0.032	0.321	4	Always
Q19	Present innovative ideas on the topics presented	100	2.410	80.33	0.060	0.605	3	Sometimes
Q20	Contribute my ideas to useful things	100	2.160	72.00	0.087	0.873	1	Always
	Innovation	100	2.428	80.915	0.0602	0.604		
Q21	Take advantage of search engines to acquire knowledge in a short time	100	2.410	80.33	0.060	0.605	4	Always
Q22	Use technology to communicate with the teacher and peers to share knowledge	100	2.160	72.00	0.087	0.873	1	Always
Q23	Use technology to collect, store, organize and display knowledge for reporting and research	100	2.490	83.00	0.066	0.659	3	Sometimes
Q24	Use technology to analyze and evaluate information	100	2.340	78.00	0.082	0.819	2	Always
	Using technology	100	2.35	78.33	0.074	0.739		
	The general trend for all dimensions of the questionnaire	100	2.42	80.65	0.062	1.012		Always

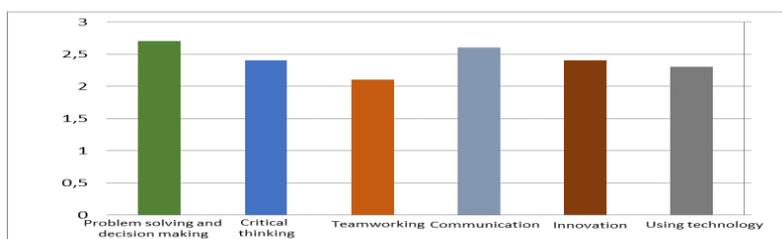


Figure 1
Arithmetic mean for each of the questionnaire skills

Table (7) and Figure (1) display the results regarding the knowledge economy skills of female mathematics students. The results indicated a high level of problem-solving and decision-making skills among the students with an arithmetic mean of 2.68 (89.42%), followed by communication skills with an arithmetic mean of 2.63 (87.67%), innovation skills with an arithmetic mean of 2.42 (80.9%), both critical thinking skills and using technology with an arithmetic mean of 2.3 (78.33%), and a medium level of

teamworking skills with an arithmetic mean of 2.07 (69.25%). The arithmetic mean for the general level of skills was 2.42 (80.65%), indicating a general increase in the availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Jubail.

Identifying statistically significant differences in the availability of knowledge economy skills among this cohort in terms of academic stage (Bachelor – Master) as shown in Table 8.

Table 8

Results of the analysis of variance ($\alpha < 0.05$) to identify differences between average responses on the dimensions of the questionnaire and the total score in terms of academic stage (Bachelor - Master).

Educational level and dimensions		Sample number	Mean	Std. Dev.	Std. Error	Degrees of freedom	T value	Statistical Significance	The result
Problem solving and decision making	Bachelor	94	2.553	0.353	0.037	98	3.290	0.001	Statistically significant difference in favor of Bachelor students
	Master	6	2.128	0.315	0.111				
Critical thinking	Bachelor	94	2.243	0.414	0.043	98	2.972	0.004	Statistically significant difference in favor of Bachelor students
	Master	6	1.793	0.365	0.129				
Teamworking	Bachelor	94	2.243	0.414	0.043	98	2.972	0.004	Statistically significant difference in favor of Bachelor students
	Master	6	1.793	0.365	0.129				
Communication	Bachelor	94	2.553	0.353	0.037	98	3.290	0.001	Statistically significant difference in favor of Bachelor students
	Master	6	2.128	0.315	0.111				
Innovation	Bachelor	94	2.397	0.344	0.036	98	3.566	0.001	Statistically significant difference in favor of Bachelor students
	Master	6	1.959	0.323	0.114				
Using technology	Bachelor	94	2.553	0.353	0.037	98	2.972	0.003	Statistically significant difference in favor of Bachelor students
	Master	6	2.128	0.315	0.111				
Total degree	Bachelor	94	2.397	0.344	0.036	98	3.466	0.001	Statistically significant difference in favor of Bachelor students
	Master	6	1.959	0.323	0.114				

To achieve this, arithmetic means, standard deviation, and standard error were calculated and t-tests were performed. As indicated in Table 8, there are statistically significant differences (0.01) in the level of knowledge economy skills on the scale as a whole and on each of the dimensions (problem solving and decision-making, critical thinking, teamwork, communication, innovation, use of technology) between academic stages (Bachelor-Master) in favor of Bachelor students.

The results indicated a high level of problem-solving and decision-making skills (the first dimension) among the students with an arithmetic mean of 2.68 (89.42%), followed by communication skills with an arithmetic mean of 2.63 (87.67%), innovation skills with an arithmetic mean of 2.42 (80.9%), both critical thinking skills and using technology with an arithmetic mean of 2.3 (78.33%), and a medium level of teamworking skills with an arithmetic mean of 2.07 (69.25%). The arithmetic mean for the general level of skills was 2.42 (80.65%), indicating a general increase in the availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Jubail. Statistically significant differences (0.01) in the availability of knowledge economy skills were found in academic stage (Bachelor-Master) in favor of undergraduate students.

DISCUSSION

The study aimed to identify the degree of availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Jubail according to their perceived future roles. Tony (2014), stated that universities must work in two directions, the first: determining these skills and their inclusion within academic programs on the one hand, and the second: that these skills are developed to ensure on an ongoing basis that they are the skills required in the knowledge economy. Ramadan (2015) highlighted the need to conduct more field studies on the acquisition of knowledge economy skills. To achieve this, a descriptive analytical method was employed and a questionnaire administered to a sample of 100 female students. This is in line with studies by Alghamdi (2019), Annab (2016) and Irsheida's Ako (2013) who employed the questionnaire as a tool for data collection and analyzed the data using the SPSS program.

The questionnaire comprised six main skills (problem-solving and decision-making, critical thinking, teamworking, communication, innovation, using technology). Focusing precisely on the nature of the skills required by the knowledge society, Ivan et al. (2012) indicate that businessmen expect that the most important skills in the next five years will be the following: critical thinking, problem-solving, information technology application, teamwork, cooperation, creativity and innovation, and managing knowledge diversity effectively. The results of the study also indicated that the process of creating skills and knowledge is determined by an interactive relationship which may be clarified as follows: the educational institution as an agent of knowledge, the acquisition of skills and knowledge, the rooting of management of knowledge and education.

The arithmetic mean of using problem-solving and decision-making skills among female mathematics students at the College of Science and Human Studies in Jubail was 2.68 (89.42%) which was high. The researchers noticed a rise in this skill, compared with the rest of the skills, and the researchers attribute this to the nature of the requirements of the abstract courses in mathematics and the applied activities accompanying the mathematical solution. This means that this skill is expected to rise compared with other skills of knowledge economy skills. The high arithmetic means for using problem-solving and decision-making skills are attributable to the fact that the student of mathematics uses her previous knowledge, skills, and experience to address the

requirements of a situation that is neither new nor unfamiliar. The process may be based on a mental skill or emotional performance, or perhaps both, by searching for the causes of the problem before choosing the appropriate solution and comparing the final results. This skill is extremely important for students, as Maxwell et al. (2010) confirmed that problem-solving ranks first among the skills graduates must possess, because having good and strong problem-solving skills can make a tremendous difference to lives and careers in the future (Alabdulaziz and Hignis, 2021)

The communication skill came with an arithmetic average of (2.63) with a percentage of (87.67%) in the second degree, and this arrangement was unexpected. The researchers attribute this perhaps to interactive activities through active learning within the lectures that require the interaction of the student by speaking, listening, dialogue and discussion effectively using correct and appropriate phrases while speaking and expressing their opinions well while listening to the opinions of her colleagues with interest and persuasion, and this come with the department's policies in the college by asking faculty to apply different interactive activities, which allows a person to understand others and to understand the information correctly (Attia, 2019).

The arithmetic mean for using innovation skills among female mathematics students at the College of Science and Human Studies in Jubail was 2.42 (80.9%), which was in the third degree, and this is unexpected because innovation is the highest levels of cognitive thinking skills. The knowledge society is based and depends on innovation and creativity, and also economic support through legislation and laws regulating the work of intellectual capital through the dissemination and exchange of knowledge as an economic activity (Aziz, 2002). A student of mathematics differs from others in that they are logical in developing and benefiting from the information they possess, building a new idea based on the topics presented, and contributing ideas to the development of useful applications. This is true because Oginni (2013) claims that mathematics is embraced worldwide as an asset to all knowledge, since it influences all facets of human endeavor.

The arithmetic mean for using critical thinking skills among female mathematics students was 2.35 (78.33%) which was in the fourth degree after innovation skills. Ion and Andreea (2011) argued that a considerable amount of educational literature emphasised the necessity of adopting new teaching and learning methods based on developing students' creative and critical thinking skills. The researchers in this study expected that critical thinking skills will come before "problem-solving and decision-making skills", because of their impact on the mathematical solution. The nature of the courses in the mathematics curricula require the use of thinking to reach the correct solution. In addition, if there's one thing COVID-19 has taught us, it's the need to be agile and adapt – making changes to plans more often than we may like! As students they are expected to constantly learn, unlearn and relearn, in order to stay relevant in a world that is changing at an exponential pace. Focusing on knowledge economy skills such as problem-solving, critical thinking, and decision-making will enhance the learner's ability to pursue lifelong learning, and equip good learners with an integrated personality that contributes to building and developing their society in harmony with others, the international family, and changes in the times while preserving their Islamic

identity and a sense of belonging to their homeland (Al-Khamash, 2013). However, the high arithmetic mean for using critical thinking skills is attributable to the fact that this is one of the skills courses focus on to ensure it is acquired by students. It is represented by the ability to derive information, distinguish between necessary and unnecessary information, identify logical contradictions, make predictions, and interpret ideas with supporting evidence, this appears consistent with FathAllah (2008) and Marwan (2021).

The arithmetic mean for the skill of using technology among female mathematics students at the College of Science and Human Studies in Jubail was 2.35 (78.3%), it came in the fifth degree, but still high. Actually, it was an expected percentage, and the researchers attributed this to the use of different systems in the study through the blackboard and the nature of the digital interaction of this technical generation and its entry into all areas of daily life. Most course activities took place online, which enables students to acquire that skill and benefit from search engines by accessing knowledge in an appropriate time, and to use technology when communicating with the teacher and peers to exchange knowledge. This skill is also employed to collect, store, organize, and display knowledge when preparing reports and research, and for analyzing and evaluating information (UNESCO, 2009; Bello et al., 2018).

The arithmetic mean for the use of teamwork skill among female mathematics students at the College of Science and Human Studies in Jubail was 2.07 (69.25%), which was in the last degree. The results were unexpected in this skill, due to the group activities that are applied within the courses, and given that working within a team is an important skill for the students, because it needed to achieve an objective or to promote a positive change (Brungardt, 2011). The researchers think that mathematics is not an abstract concept. It can not be learned or taught by reading or memorising it. Learning by the way of group work which is one of the integrated approach theories encourages students to discuss, criticise and be more attentive whilst rescuing them from memorising information. According to the report presented by the NCTM (National Committee of Teachers of Mathematics) in 1989, group work in mathematics education plays an important part in students asking questions, discussing opinions, listening, being responsible for what they learn, criticizing constructively and constituting an atmosphere of mathematical learning (Koçaka et al., 2009).

The arithmetic mean for the level of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Jubail was 2.42 (80.65%), which was high. These results indicate that the degree of possession of the concepts of knowledge economy by female students in the Department of Mathematics was high, researchers attribute the reason to this enabling female mathematics students for knowledge economy skills very well, perhaps the specialization played a role in this and the nature of the theoretical and applied courses, which was reflected positively in increasing the degree of their possession of knowledge economy skills. Actually the results differed from those of Al-Zambati (2011), Al-Qays (2011), and Ramadan (2015). This may be attributed to differences in the study community, limits, and the nature of the mathematics specializations.

Prior to considering the second question, it is interesting to note that only six master's students applied this year in this college. Furthermore, there is an admission fee for the students who are accepted, which may be the principal reason why many students are reluctant to enroll in a master's program. This is consistent with Al-Dhuwaihia (2020) who identified the challenges encountered by master's students at the College of Education at Imam Abdulrahman bin Faisal University, from the students' perspective. He found that financial challenges ranked highest, followed by academic problems, administrative difficulties, and finally technical issues.

Regarding to the second questions, the researchers found that there were statistically significant differences (0.01) in the level of availability of knowledge economy skills for female mathematics students according to academic stage (Bachelor-Master) in favor of undergraduate students. The result was unexpected, and the researchers attribute this to the weak inclusion of knowledge economy skills in the content of the master's curricula. As previously mentioned, this study was unique in that it sought to determine the degree of availability of knowledge economy skills among female mathematics students at the College of Science and Human Studies in Jubail according to their perceived future roles, and had not been studied previously either in Arab or non-Arab countries. This is evident in the following studies such as those conducted by Alghamdi (2019), Al-ahmadi and Al-Anzi (2016), Annab (2016), Irsheida's Ako (2013), and Al-Quraan (2013), all of which their study's aims differ from this study. This is giving the further researches to determine the degree to which the content of the postgraduate mathematics curriculum in Saudi Arabia includes the concepts of knowledge economy according to the requirements of the six key skills required by knowledge economy.

It can also be attributed to the teaching methods that are used in the bachelor's stage, where they focus on the amount of knowledge in the academic courses, in addition to the tests in most theoretical courses aimed at measuring the achievement of female students. Perhaps this is one of the reasons for the development of master's programs recently. Imam Abdulrahman bin Faisal University is pursuing its educational path to keep pace with international universities because it is enthusiastic about developing graduate studies' programs, and has an interest in scientific research. It also uses educational methods to develop all fields, including educational, medical and economic in order to achieve the goals of the Kingdom's Vision 2030, namely the national transformation plan (Imam Abdulrahman bin Faisal University, 2019a).

Given the university's interest in developing graduate studies, it is essential that it continues to identify challenges and finds effective solutions for them. This is because such problems affect the course of graduate studies with its various components: students, academics, study programs, and the diverse methods of scientific research. Many studies, such as Salem's (2017), have aimed to identify the challenges encountering graduate students, revealing technical, administrative, and financial challenges which affect graduate students to varying degrees. This reflects the need to consider and develop solutions to these challenges, enabling students to keep pace with all that is new, while acquiring the knowledge and research skills to perform the roles and tasks required of them in their community. Raising the quality of services provided

them increases their performance, knowledge, awareness and involvement in the learning and teaching process (Gautam et al., 2016; Wolfe & Freeman, 2013).

CONCLUSIONS AND IMPLICATIONS

The results indicated a high level of problem-solving and decision-making skills (the first dimension) among the students due to the nature of the requirements of the abstract courses in mathematics and the applied activities accompanying the mathematical solution. While the use of teamwork skill among female mathematics students at the College of Science and Human Studies in Jubail came in the last degree (the last dimension), the results were unexpected in this skill, due to the group activities that are applied within the courses, and given that working within a team is an important skill for the students. In addition, the researchers found that there were statistically significant differences (0.01) in the level of availability of knowledge economy skills for female mathematics students according to academic stage (Bachelor-Master) in favor of undergraduate students.

Based on the findings, the researchers recommend the following: Spreading awareness among students particularly master's students of the importance of acquiring knowledge economy skills by enrolling on training courses and keeping up to date with developments. In addition, the study recommended a greater focus on teamwork skills, and adopting the application of assessment methods which encourage students to work as a team. Moreover, consideration is given to the degree of availability of knowledge economy skills as a basic criterion for evaluating students at all levels of study in order to achieve the principle of lifelong learning. Furthermore, this involves integrating knowledge economy skills into university curricula in all disciplines. Finally, it is necessary to conduct further studies in the field of acquisition, and to determine the availability of knowledge economy skills among students in universities. The purpose of this is to provide officials in higher education institutions with an objective and with scientific results regarding the determination of this level.

LIMITATION

The emphasis of this study sample is solely on mathematics students at the College of Science and Human Studies in Jubail, thus excluding faculty owing to the challenges associated with eliciting approval to extend the survey to a larger audience. This study focused only on government universities in the east of Saudi Arabia (Jubail city). However, the researcher believes that this city was a good place to conduct this study, because it has a big population which is drawn from different parts of the Kingdom of Saudi Arabia.

REFERENCES

- Abdel Samie, M.M. (2007). Higher Education in the Arab World, Developing Performance and Distinguishing Outputs. *Proceedings of the Tenth Conference of Ministers Responsible for Higher Education and Scientific Research*. Arab League Educational, Cultural and Scientific Organization. Taiz: Republic of Yemen.
- Abu Al-Shamat, M. (2012). Trends of the Knowledge Economy in the Arab Countries. *Damascus University Journal of Economic and Legal Sciences*, 1(28), 591-610.

- Afouneh, B.A. (2012). *Education based on the knowledge economy*. Dar Al-Bidaya: Amman.
- Al Salem, A. (2016). *Education curricula and knowledge economy*. Retrieved 19 February, 2022 from <https://www.alriyadh.com/125822?Msclkid=ad2db6f7a93111ecbc2c06f0d80b4246>.
- Alabdulaziz, M. S., & Higgins, S. (2021). The Compatibility of Developed Mathematics Textbook Content in Saudi Arabia with NCTM Standards: A Critical Review. *International Journal of Instruction*, 14(2), 461- 482. <https://doi.org/10.29333/Iji.2021.14226a>
- Al-ahmadi, S., & Al-Anzi, N. (2016). The degree of availability of knowledge economy skills in middle school mathematics textbooks in the Kingdom of Saudi Arabia. *The world of education*, 17(53). 1- 49. <https://doi.org/10.12816/0031751>
- Al-Assaf, S. (1995). *Introduction to Research in the Behavioral Sciences* (1st ed.). Obeikan Printing Company and Sports Publishing: Saudi Arabia.
- Alassaf, S. (2010). *An introduction to research in behavioral sciences*. Obaykan Bookshop.
- Aldaamin, M. (2007). *Fundamentals of scientific research*. Amman: Dar Al Masirah for publishing, distribution and printing.
- Al-Dhuwaihia, A. (2020). The Challenges Facing Masters Students in the College of Education in Dammam. *International Journal of Innovation, Creativity and Change*, 13(8), 298-319.
- Alghamdi, F. (2019). *Degree of embedding knowledge Economy Skills in the Middle School Art Education Curriculum from the Perspective of Art Education Teachers in the City of Mecca*. Retrieved 20 February, 2022 from https://www.researchgate.net/publication/335700361_Degree_of_embedding_knowledge_Economy_Skills_in_the_Middle_School_Art_Education_Curriculum_from_the_Perspective_of_Art_Education_Teachers_in_the_City_of_Mecca
- Al-Ibrahim, Y.H. (2004). Education and Human Resource Development in a Knowledge-Based Economy. *Emirates Center for Strategic Studies and Research*, Abu Dhabi, 102-103
- Al-Jaloud, S. (2019). *Scientific Research and Vision 2030*. Retrieved 23 February, 2022 from https://www.aleqt.com/2016/12/17/article_1111039.html
- Al-Khamash, M.R. (2013). *The shift towards a smart university according to the requirements of the knowledge economy (a proposed conception for Saudi higher education institutions)*. (PhD thesis), Umm Al-Qura University, College of Education, Makkah.
- Alomari, A. (2019). Knowledge-Based Economy in Saudi Arabia. *Preprints*. <https://doi.org/10.20944/preprints201907.0131.v1>.
- Al-Qays, M. (2011). *Features of the knowledge economy included in the content of Sharia science courses in the secondary education development project in the Kingdom of Saudi Arabia*. (Master thesis), Mutah University, Jordan.

- Al-Quraan, E.S. (2013). *The impact of the use of educational technologies in the development of human resources in order to reach an acceptable level in the knowledge economy commensurate with its level in developed countries*. (Master thesis), Mutah University, Jordan.
- Al-Salem, A.Y. (2016). *Education curricula and knowledge economy*. Imam Muhammad Bin Saud Islamic University. Retrieved 04 April, 2021 from <https://www.walukah.net/sharia/0/99466/>
- Al-Sutri, H.O., Al-Wasel, A.A., A.H., & Al-Anazi, A.H., & Battis, A.A. (2010). The extent to which preparatory year students at King Saud University possess twenty-first century skills. *Conference of education in a changing world*, April 7-8, College of educational sciences, Hashemite University, Jordan.
- Al-Zambati, A.F. (2011). *Modernizing general secondary education in light of the requirements of the knowledge society - a future study*. (PhD thesis), Suez University, College of Education, Al-arish.
- An, M.H., Ri, G.Y. & Rim, G.N. (2020). Intellectual Product and Method of Assessing the Competitiveness of an Enterprise with It. *Journal of the Knowledge Economy*, 11, 1059–1085. <https://doi.org/10.1007/s13132-019-00593-5>
- Annab, R. A. M. (2016). *The training needs of mathematics teachers in the upper basic stage according to their future roles in the light of the knowledge economy*. (Master thesis), The Hashemite University, College of Educational Sciences Jordan, Zarqa.
- Attia, N. (2019). *Defining communication skills*. <https://mawdoo3.com>
- Aziz, M. I. (2002). *The Foundations of the Educational Curriculum in the Knowledge Society*. The World of Books: Cairo.
- Bello, G.A., Oludele, L.Y., & Ademiluyi, A.B. (2018). Impact of information and communication technology on teaching and learning. *Nigerian Journal of Business Education (NIGJBED)*, 3(1), 201-209.
- Brungardt, C. (2011). The Intersection between soft skill development and leadership education. *Journal of Leadership Education*, 10 (1), 1-22. <https://doi.org/10.12806/V10/I1/RF1>.
- Bukhamseen, A. (2020). *The knowledge economy and knowledge society in the Kingdom*. Retrieved 05 March, 2021 from <https://www.al-jazirah.com/2020/20201204/cm9.htm>
- Bull, A., & Gilbert, J. (2012). *Swimming out of our depth? Leading learning in 21st century schools*. Wellington, NZ: New Zealand Council for Educational Research.
- Cohen, L., Manion, L. & Morrison, K. (2004) *Research methods in education* (6th ed.). Routledge.
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (7th ed.). RoutledgeFalmer.

- Davies, B., & Bansel, P. (2007). Neoliberalism and education. *International Journal of Qualitative Studies in Education*, 20(3), 247-259. <https://doi.org/10.1080/09518390701281751>
- Duflo, E. (2012). Women Empowerment and Economic Development. *Journal of Economic Literature*, 50 (4), 1051–1079
- Eustache, M. (2018). Correlation Between Transmission Power and Some Indicators Used to Measure the Knowledge-Based Economy: Case of Six OECD Countries. *Journal of knowledge of economy*, 9 (4), 1168-1183. <https://doi.org/10.1007/s13132-016-0408-2>
- Fathallah, A. (2008). *Developing thinking skills, the theoretical framework and the practical side*. Dar -alnasher for Publishing and Distribution: Riyadh.
- Field, A. P. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). London: SAGE.
- Gautam, C., Lowery, C. L., Mays, C., & Durant, D. (2016). Challenges for global learners: A qualitative study of the concerns and difficulties of international students. *Journal of International Students*, 6(2), 501–526.
- Gay, L. R., & Airasian, P. (2000). *Educational research: Competencies for analysis and application* (6th ed.). Prentice Hall.
- Gilbert, J. (2005). *Catching the knowledge wave? The knowledge society and the future of education*. Wellington, NZ: New Zealand Council for Educational Research.
- Imam Abdulrahman bin Faisal University. (2019a). *About the university's deanship of graduate studies*. Retrieved 25 February, 2022 from <https://www.iau.edu.sa/ar/ad-ministra-tio/n/d/e/a/ns/hips/deanship-of-graduate-studies/about>
- Ion, P., & Andreea, Z. (2011). A Possible Model for Developing Students' Skills within the Knowledge-Based Economy. *Amfiteatru Economic*, XIII (30), 482-496.
- Irsheida's Ako, A.A. (2013). *Training needs of Arabic language teachers at the secondary stage in light of the knowledge economy from their perceptions*. (Master thesis), Amman Arab University, College of Science and Psychological Education, Jordan.
- Ivan, M., Petar, B., & John, J. (2012). Knowledge and skills needed in knowledge economy. *Central European Conference on Information and Intelligent Systems*, Faculty of Organization and Informatics September 19-21, Croatia, 181-493.
- Jacoby, J., & Matell, M. S. (1971). Three-Point Likert Scales Are Good Enough. *Journal of Marketing Research*, 7, 495–500. <https://doi.org/10.1177/002224377100800414>
- Journal of Leadership Education, Vol. 10 No. 1, pp. 1-22, doi: 10.12806/V10/I1/RF1.
- Kearney, M. L. (2017). Whither Women Graduates in the Knowledge Economy? *In The Changing Role of Women in Higher Education* (pp. 3-30). Springer International Publishing. https://doi.org/10.1007/978-3-319-42436-1_1
- Koçaka, Z.F., Bozana, R., & Iúik, Ö. (2009). The importance of group work in mathematics. *Procedia Social and Behavioral Sciences*, 1. 2363–236. <https://doi.org/10.1016/j.sbspro.2009.01.414>

- Lauder, H., Young, M., Daniels, H., Balarin, M., & Lowe, J. (Eds.). (2012). *Educating for the knowledge economy? Critical perspectives*. New York: Routledge.
- Laurence, H., & Charles, L. (2010). *Shaping Up For Innovation: Are we delivering the right skills for the 2020 knowledge economy?* Retrieved 26 February, 2022 from http://www.the-work-fo-undation.com/As-sets/Doc-s/Publica-tions/262_-Shaping_up_for_Innovation.pdf.
- Ledward, B. C., & Hirata, D. (2011). An overview of 21st century skills. In *Summary of 21st century skills for students and teachers* (p. 1). Honolulu: Kamehameha Schools-Research and Evaluation/Pacific Policy Research Center.
- Lingard, B., Martino, W., & RezaiRashti, G. (2013). Testing regimes, accountabilities and education policy: Commensurate global and national developments. *Journal of Education Policy*, 28(5), 539–556, <https://doi.org/10.1080/02680939.2013.820042>
- Loko, B., & Diouf, M. S. (2009). *Revisiting the Determinants of Productivity Growth: What's New?* IMF Working Paper 09/225 (Washington).
- Marwan, M. (2021). *Definition of Critical Thinking*. Retrieved 14 January, 2021 from <https://ma-wd-oo-3.com/>
- Matthias, D., Tertilt, M., & Voena, A. (2012). The Economics and Politics of Women's Rights. *Annual Review of Economics*, 4, 339-372.
- Maxwell, G., Scott, B., Macfarlane, D., & Williamson, E. (2010). Employers as stakeholders in employability skills development: expectations and responsibilities. *International Journal of Management Education*, 8(2), 1-11.
- McCarthy, M. (2017). Venezuela's Crisis: Beyond Economic Explanations. *Georgetown Journal of International Affairs*, 18 (2), 129-136.
- Ministry of Economy and Planning. (2010). *General aims and strategically basics of the 8th development plan*. Retrieved from <http://www.planning.gov.sa/>
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory*. McGraw-Hill.
- Nurunnabi, M. (2017). Transformation from an oil-based economy to a knowledge-based economy in Saudi Arabia: the direction of Saudi vision 2030. *Journal of the Knowledge Economy*, 8 (2), 536-564
- Obeidat, Y. A. (2004). *The educational computer and its educational applications*. Dar Al-Masirah for Publishing and Distribution: Amman, Jordan.
- OECD. (2005). *Definition and selection of key competencies: Executive summary*. Paris :Author
- OECD. (1996). *The knowledge-based economy*. Paris: Author.
- Oginni O.I. (2013) the relationship between secondary school students body parameters and their mathematics performance in Southwest Nigeria. *International journal of education and culture* 5,101-111.
- Oppenheim, A. (2001). *Questionnaire design, interviewing and attitude measurement*. Continuum.

- Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5). Retrieved 18 April, 2022 from <http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf>
- Ramadan, E. J. (2015). The degree of availability of knowledge economy skills at the Faculty of Social Sciences at Imam Muhammad Ibn Saud Islamic University from the point of view of faculty members and students. *The Jordanian Journal of Educational Sciences*, 11 (2), 219- 237.
- Rizvi, F., & Lingard, B. (2009). *Globalizing education policy*. London: Routledge.
- Saaty, A. (2016). *Kingdom's Vision 2030 .. establishes the building of a knowledge society*. Retrieved 28 February, 2022 from https://www.alet.com/2016/12/17/article_1111039.html?msclid=ee08a59aa93211ecae266be180902dce
- Salem, S. J. (2017). *The challenges facing graduate students in Jordanian public universities, from their point of view*. (master's thesis). Middle East University, Jordan.
- Salganik, L. H., Rychen, S. R., Moser, U., & Konstant, J. W. (1999). *Projects on competencies in the OECD context: Analysis of theoretical and conceptual foundations*. Neuchâtel: Swiss Federal Statistical Office.
- Saqib, N., Aggarwal, P., & Rashid, S. (2016). Women Empowerment and Economic Growth: Empirical Evidence from Saudi Arabia. *Advances in Management & Applied Economics*, 6(5). 79-92.
- Schwalje, W. (2013). *A Conceptual Model of National Skills Formation for Knowledge-based Economic Development in the Arab World, Sheikh Saud Bin Saqr AlQasimi Foundation for Policy Research*. Retrieved 27 February, 2022 from <http://mp.raub.unimuenchen.de/id/eprint/30302>.
- Tony, B. (2014). *Are universities teaching the skills needed in a knowledge-based economy?* Retrieved 25 February, 2022 from <http://www.tonybat.es.ca/2014/05/29/articles-universities-teaching-the-skills-needed-in-a-knowledge-based-economy/>
- UNESCO. (2004). Annual report 2004: UNESCO Institute for Education. Retrieved 01 March, 2022 from <https://uil.unesco.org/annual-report-2004-unesco-institute-education?msclid=ec592036a92d11ec84cfb90e0c290940>
- UNESCO. (2009). *Guide to measuring information and communication technologies (ICT) in education*. Retrieved 02 March, 2022 from http://uis.unesco.org/sites/default/files/documents/guide-to-measuring-information-and-communication-technologies-ict-in-education-en_0.pdf
- Wolfe, B., & Freeman Jr., S. (2013). A case for administrators of color: Insights and policy implications for higher education's predominantly White institutions. *eJEP: eJournal of Education Policy*, 1-11.