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Enhancing capabilities and innovations via data mining technology with information security supported e-learning in basic education schools in Oman

تعزيز القدرات والابتكارات من خلال تقنية استخراج البيانات مع التعلم الإلكتروني المدعوم بأمن المعلومات في مدارس التعليم الأساسي في عمان

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Abstract:

The education sector is one of the most important sectors that working in information technology industry. The daily IT's processes linking to the educational process through developing capabilities in building and innovating intelligence, the Internet of things and information security through the application of this technology's algorithms. Also, it's accustoming users to find quick alternatives in times of crisis and activating technology in the continuity of scientific and practical life. Correspondingly, in order to ensure continuity of providing educational content and solutions related to it through e-learning, the education process use to determine the appropriate alternative as required by the resulting situation at that moment. The e-learning process also helps the suspension of study in schools to be an alternative framed by an organizational, interactive and security framework that provides the characteristics of continuous evaluation and follow-up of the work accomplished by students during the academic year. This study presents analytical indicators that contribute in developing capabilities and encourage innovations through the use of data mining technology and security controls. Similarly, it supports the continuity of e-learning in basic education schools in the Sultanate of Oman through the adoption of development tools and resources that support the current educational platform eportal.moe.gov.om. The study uses an integrated interactive model that explains the method and mechanism by which its components will be linked and follow the stages of design and completion step by step by taking advantage of experiences and innovations related to education. Then the results will help to make decisions related to planning and predicting the future of schools and educational content in the field of data mining and information security.

This study proved that interactive educational platforms must be activated and optimally exploited in distance education in order to be supportive in crises and

exceptional cases. Effectiveness and productivity, and the responses of 69 out of 85 responses of both genders considered that the use of educational platforms/portals is one of the elements of innovation in education because of the benefits of these platforms in this field, and 58% of the responses were about securing interactive educational devices and applications before and during their use, which ensures the safety and security of the information requested from the user when dealing with interactive educational platforms.

Key terms:

Data Mining, Information Security, Educational Portal

Introduction:

The transfer and storage of data through the database has become one of the considerations that must be considered due to its importance in development and sustainability in predicting the future and needs and making sound decisions based on a large amount of data ***(Jones et al., 2020)***. Education with all its components and tools that contribute to create a generation capable of keeping pace with changes and enjoying all the characteristics of discovery and innovation to be one of the elements of development and an engine of change and development in it, relying on the latest technology and techniques that support these trends (Abdul-Ghani et al., 2019). Among these technologies we will concentrate in the technology of mining and data extraction.

Research Objectives:

1- Discovering the potentials in the information technology industry and linking them to the educational process.

2- Developing capabilities in building and innovating the resources of the artificial intelligence system, the Internet of things and information security by making use of data mining technology.

3- Using modern technologies and benefiting from data in the educational process and ensuring the continuity of inventions and innovations in keeping pace with technical and knowledge developments to achieve the Oman 2040 vision.

4- Building educational projects in data mining technology and setting up an information security framework for it in a way that contributes to the sustainability, continuity, and quality of scientific productions in this field.

5- Familiarize users with finding quick alternatives in times of crisis and activating technology in the continuity of scientific and practical life in terms of identifying the appropriate alternative as required by the resulting situation at that moment.

6- Continuing the provision of educational content through e-learning in the event of suspension of studies in schools to be an alternative framed by an organizational, interactive and security framework that provides the characteristics of evaluation and continuous follow-up of the work completed by students during the school year.

Digital transformation in the Sultanate of Oman:

Digital transformation is one of the necessities for all governmental and private institutions that believe in the importance of continuous development and improvement of their administrative functions, services they provide, and facilitating their access to beneficiaries (Daniel, 2015). To complete services easier and faster through the quality of services provided, which contribute to reducing spending, speed of delivery and effectiveness of service providers in a manner that achieves flexibility and smoothness and supports the continuation of the digitization of operations and their electronic transfer through the ports and platforms that support them (Romero & Ventura, 2020). Digital transformation can be defined as employing information and communication technology within institutions and bodies, whether governmental or the private sector, with the aim of developing institutional performance and services, improving operational efficiency and increasing effectiveness and productivity. To add with, digital transformation serves the workflow within the institution in all its departments, as well as in its dealings with customers and the public to improve services and facilitate access to them, which It guarantees saving time and effort at the same time (Omanuna) (Wazid et al., 2019). The focus was on the axes of the digital Oman strategy and work to achieve the Oman 2040 vision on developing the information technology industry and empowering society and individuals to be able to deal with technological changes and keep

pace with the world in the field of digitization, which contributes to the development and modernization of electronic services and finding appropriate solutions according to the vision and plan prepared for it (Hammad & Al-Ani, 2021). The design and implementation of digital transformation projects goes through a set of stages that clarify the controls of digital transformation (Correani et al., 2020), which are clarified in the following diagram:

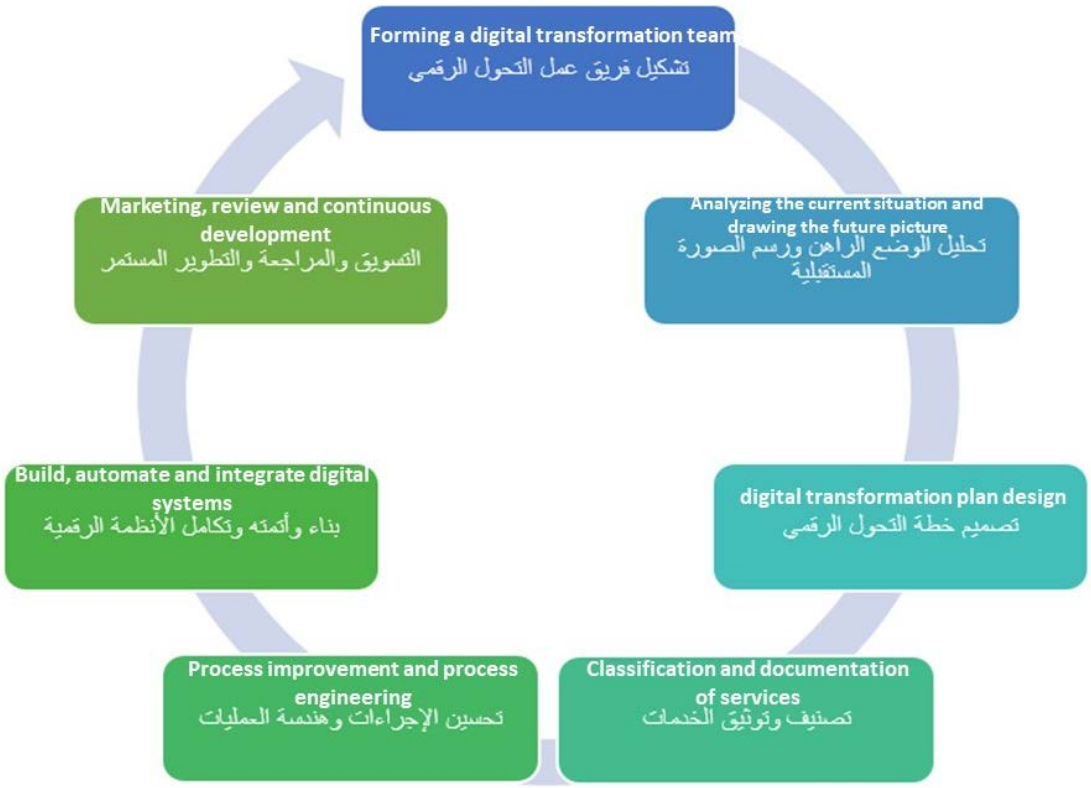

Figure: digital transformation stages

Blended Education in Omani Schools:

The vision of the Ministry of Education in the Sultanate of Oman is to provide high-quality education supported by technology and digital transformation. So,

a comprehensive process and multi-track in line with global educational changes the vision based on the promotion of innovation in a manner that enhances and provides a fertile environment for entrepreneurship and vocational education. Although, it facilitates the Omani student to determine his scientific and professional path in order to provide a good and dignified life and a bright future based on learning and knowledge that builds skills. The ministry's mission based on providing quality education, equitable and inclusive content for all, according to the highest standards of governance and competitiveness, in line with Oman 2040 vision. It achieves the 2030 Sustainable Development Goals and helps achieve economic growth and social well-being through high-quality inputs and processes. This process enable learners to acquire knowledge, increase their skills, raise their efficiency, and provide a fertile environment through partnership with the educational field, society and strategic partners.

The Ministry of Education has approved that blended learning will be during the 2021-2022 school year, where blended learning programs are one of the learning styles that combine network learning and full-time learning. The student in this style benefits greatly from modern technology in completing the subject academic programs are included in his academic program, and at the same time, he is required to devote himself in specific periods to attend a

number of workshops or make short visits to the school as an essential part of this academic program.

Mandarah Education Portal:

The blended education helped to be self-reliant during learning and provided many alternatives by re-listening to the lesson and expanding perceptions in the use of electronic applications and digital education based on self-skills and abilities that makes the most of the presented scientific material and implement activities, exercises, and assignments across various educational platforms (Tekin et al., 2021). The Ministry of Education in the Sultanate of Oman has built and established an advanced digital educational platform that led schools during the Covid-19 crisis in the academic year 2020-2021 by providing an electronic digital educational system for students of the first educational stage for primary education grades from 1 to 4 using the platform of Mandara educational through (eportal.moe.gov.om). Mandara is an interactive educational platform that helped the teacher and student in the continuity of education and in facing the challenges that prevented the availability of the direct education system during the school year (Hammad & Al-Harthi, 2021), (Heckadon & Tuzlukova, 2020).

An electronic educational platform established by the Ministry of Education and whose name was inspired by the Omani national identity. The platform is

directed to the first to fourth grades in which the student receives lessons, activities and tests in virtual classes where he finds the study units with the possibility of communication, interaction and conversation between teachers and students, follow-up of assignments and awarding of grades, as well as Various documents can be attached and lesson schedules and dates can be set (moe.gov.om) (Hammad & Al-Harthi, 2021).

Data mining:

Life is based on data, as it is considered one of the data that the individual can deal with the course of life by predicting and predicting the future of something (Daniel, 2015). Data mining is a technique that aims to extract knowledge from huge amounts of data based on mathematical algorithms, which are the basis of data mining and are derived from many sciences such as mathematics, statistics, logic, learning, expert systems, artificial intelligence, machine science, and science related to pattern recognition. And other smart and unconventional sciences (Rienties et al., 2020). The fields of data mining are different and multiple and have great importance in capacity building and contribute effectively to making positive future decisions that help in the continuity of life in a balanced, flexible and effective manner (Jones et al., 2020). In the field of education, the database is supplemented with a huge number of data that flows daily during official working hours (Chen et al.,

2017). In schools, this provides very large data that is stored in database servers for use in building, creating, and producing indicators and predictions about the course of education, its development, and updates by extracting these requirements using data mining technology (Mukherjee et al., 2017).

Data mining features:

Technology and modern technologies have become an integral part of human needs in the various affairs of his life, and with the multiplicity of use of technologies. Accordingly, data mining is necessary to deal with data in a way that helps to develop different educational systems according to the characteristics available during the use of data mining technology and to provide information and knowledge that has meaning based on big data (Toch et al., 2018). The followed are some features which are available in the databases:

1- Improving the education system and supporting decision-making
2- Contribute to building models that reduce the expected risks
3- Improving the safety of the educational system and following up on the implementation of the progress of operations through educational digital platforms
4- Developing the quality system and following up the work progress in the educational field using the educational platform

Mining and Information Security:

The information revolution in technology and its rapid development, especially regarding data and dealing with it, has become important to have security for this data, information and knowledge by providing a framework related to information security in order to maintain confidentiality and privacy and protect data from cyber-attacks and breaches that negatively affect the functioning of systems applications and technology (Sollins, 2019).

Electronic attacks are considered one of the most important threats to systems and data, and in light of the great development and rapid progress in distance learning, especially during the Corona (Covid-19) crisis, the use of technology and techniques in education has become imperative to support traditional education and help provide modern tools and techniques that contribute In the digital transformation and help in spreading knowledge among the various groups of the school community with the need to work to overcome and confront the risks related to information security and reduce them according to the available capabilities and tools in order to ensure the continuity and continuity of the educational process in schools. There are five common axes in the education process that need data security protection and information while using technologies and technology, which are:

1. **Authors**:

It is the category that provides educational material, including books, papers and publications, and presents it to students in an easy, coordinated and integrated manner, in addition to developing that material based on feedback from the beneficiaries, whether they were teachers, students or community members. Protecting it from unauthorized use and protecting the content from being altered or modified by unauthorized persons while dealing with supporting technologies and systems.

2. **Teachers**:

The teacher is the mediator who, in turn, transfers knowledge in a clear and easy way to students through his use of materials and means that organize the educational process such as books, activities, techniques and others. and storage media and ensuring that they are not tampered with, destroyed, or accessed except by authorized persons. It must be protected, whether from fraud, transfer, or in terms of tampering with it and changing it, which poses a great danger to the beneficiary.

3. **Students**:

They are the target group of the educational process, and they are the future generation, who must be sensitized and educated to ensure that they receive the educational material correctly and in proportion to their age group, in addition to instilling honesty in them to avoid any problems they may commit such as cheating, transferring and using evidence inappropriately. Hence The role of the legal framework comes to enact laws and regulations condemning the abuses and mistakes made by students. It should also be noted and instilled in them full knowledge of the danger of sharing personal accounts and passwords to any person, regardless of their role and proximity to them, such as friends, relatives and strangers who do not know them.

4. Managers

The principal is considered the top of the ladder in the school hierarchy, the role model for all, and the strongest link through which the educational course takes place. desired with perfection and confidence. The manager is responsible for the success of the education process so that he works hard to overcome all difficulties and reduce the risks facing this process, such as making an alternative plan in case of data loss by constantly following up on daily backup copies, and also there must be an action plan that can be implemented in case of any malfunctions that may turn from implementing the electronic educational

process and other difficulties, whether expected or surprising, which need a quick and urgent solution.

5. Data

It is the focus of the education process, which must be protected and preserved to ensure that it reaches the recipient at the appropriate time and in the required form, without prejudice to the principle of preserving intellectual property rights for it. Through this study and the foregoing listing the risks that impede the e-learning process, it has become imperative to have optimal solutions through which we can implement, develop, and improve the distance learning system to ensure continuity and safety, and the following are some of the solutions that gave successful results through their experience:

a. Encryption

The encryption process aims to transfer data between the two parties in a secure and encrypted manner, so that only the person to whom it is intended can see and know the content of the file. Security and confidentiality of data between the two parties.

b. Digital Right Management

Preserving the ownership of rights is an important matter that has become a concern for authors and innovators in order to secure their creativity. Also, as well as the desire of the owners of institutions needs security to preserve and document their interests in an appropriate manner in a safe work environment that ensures the consumer cycle of products of all kinds. Although, in this way these practices are documented and preserved using solutions technology, which is called digital right management (Correani et al., 2020). Just as in the work environment, digital content, services, and data are protected and classified according to their degree of sensitivity, and this also applies to e-learning and the digital data it contains. To reduce the risks that may arise in the electronic work environment, such as (learning aids, exam questions or tasks, results).

c. Distributed Firewall Solution

Security firewalls, whether computerized applications or network devices, are considered essential in building networks and protecting systems from any attacks or sabotage, as they repel all that is unwanted and detect any internal or external abuses that may occur on the information network. follows:

- Provide protection for systems and the network in general and give alerts in the event of risks in addition to recording all events to be analyzed later to find out any further facts.
- It protects the network against internal attacks, whether intentional or unintentional.
- It works to secure the devices of users connected to the internal network from sabotage or attack.

d. Biometric Authentication

Authentication techniques are among the tools that are used as an additional layer of protection while using technical resources such as websites, platforms, educational and digital libraries, and they differ from passwords or a smart card. It gives a high percentage of security to ensure that the password is not misused except by the owner and the authorized person only (Kaur et al., 2017).

e. Digital watermark

This type of solution allows the user to add copyright and intellectual property notices such as audio, video, and images, and thus this solution allows the database provider to be protected from unauthorized use by any unauthorized person using digital watermark technology, which can be hidden from the

naked eye Inside papers, books, and other means of education, and here reduces the process of sabotage or unauthorized access only to those involved (Mirza et al., 2008).

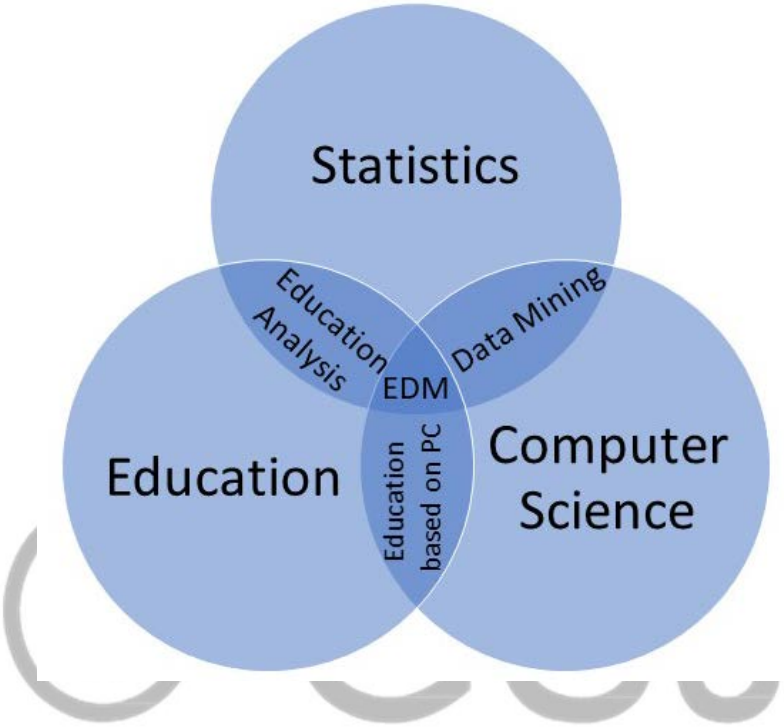

Figure: The main areas involved in extracting educational data

Methodology/Design:

The method of creating projects related to modern technology and data mining techniques, which will be through the adoption of development tools and resources that support the current educational platform (Mandarah Education

Portal) and through an integrated interactive model that explains the method and mechanism that will link its components to it, follow the stages of design and implementation step by step, and benefit from experiences and innovations related to education.

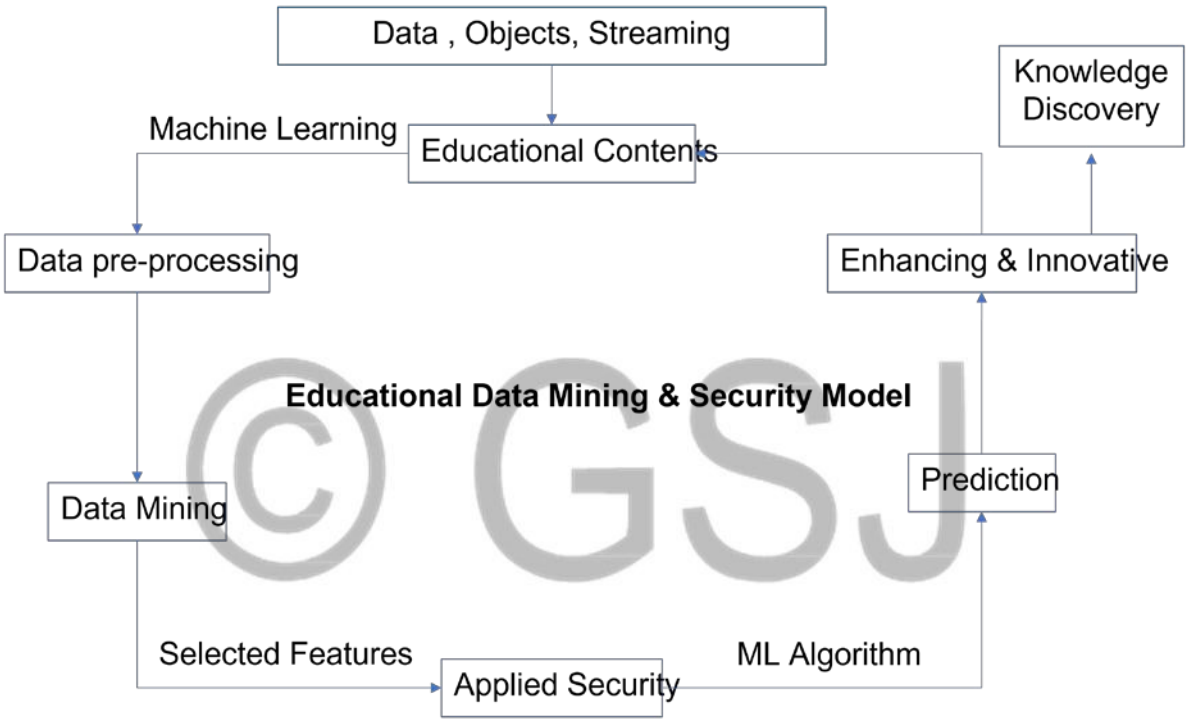

Figure: proposed model for educational data mining and security

Electronic questionnaires will also be used to raise the efficiency of research work, which are designed through computer programs or websites designed and prepared for such tasks as: Google form, and determine the type of questions related to research in terms of their type as essay or objective questions that are published to target groups through various electronic outlets and support From

social networks such as Facebook, Twitter, or others to extract user satisfaction (student-teacher-parent) to interact with educational platforms, append difficulties and face challenges that face distance education.

Sample and data collection tool:

Sampling and data will be part of a group that will be selected in building and creating the proposed model for the Internet of Things and employing it to serve the process, highlighting the role of data mining technology, by educating them and directing them towards digital transformation in terms of organizing and managing modern technology resources and keeping pace with the changes that occur in this field and knowing the foundations necessary to secure these projects in terms of Its information security and the plans that will build digital business and adopt it in the emergency plans necessary for the sustainability and continuity of the wheel of education in the Sultanate of Oman. As for data analysis methods, we will use one of the statistical programs and applications such as SPSS, Excel or BI to analyze, extract results, and display charts needed by the research. Indicators will also be used to display the readings and outputs that support the research.

The Importance of the Research:

The importance of creating projects, systems and models that care about technologies and support the educational sector lies in the need to activate modern strategies and the global trend towards building a generation capable of dealing with smart devices and technologies related to data mining technology to be supportive of artificial intelligence technology, robotics and automation, and the implementation of procedures related to building and establishing specialized methods to enhance technology In order to ensure the contribution to the digital transformation pursued by the government and the private sector in the Sultanate of Oman through Oman Vision 2040.

We have the following questions, which are related to the research:

1- Why do we need data mining technology in building and establishing educational projects through technology?
2- What is the benefit of having information security in applications and innovations stemming from data mining in future technologies such as the Internet of Things and artificial intelligence in education?
3- How to build a system that supports modern technology in a way that achieves the desired benefit and raises the level of knowledge for all those who have a connection with the educational process?
4- Are the resources of the Fourth Industrial Revolution in the informational aspect, using data, its exploration and in-depth analysis, contribute to

achieving the required development and change in the field of education in the Sultanate of Oman?

Expected results after analysis:

Analysis is considered one of the main pillars in knowing the path of research and the way to deal with it through the types and characteristics associated with it, starting from determining the requirements for analysis and supporting applications for building and creating models, questions and types of responses needed in research.

A questionnaire created to collect the opinions and responses that the research needs during the analysis phase. The questionnaire was divided into two parts. The first part included the general criteria for the responses and the fields through which we can distinguish and compare the responses, results, and linkages in them. The second part of the questions was categorized into three Aspects The first side included two questions related to data mining, and the second side contained two questions about innovation and invention, the trend towards modern technology and the future vision of the future. Through the use of the latest modern technologies in education and their effectiveness in carrying out digital transformation in education, and the last section also contained two questions in the field of information security and the link between distance education and data security of all those related to education

(teacher - student - guardian - employee) through Defining and confirming the method that guarantees them the technically safe use of the systems and applications supporting distance education whenever the need arises.

The questionnaire designed in the application of Google Forms for various segments of society in order to obtain real and realistic results from the experiences of users during the distance education period, in the table below an explanation of the results, responses and percentages obtained from the questionnaire. The qualification and the job through which the link between them and the results will be extracted as shown in Table below:

الوظيفة					Certificate						Age			Gender		Question
Other	Student	Job Seekers	Private Sector	Government	Other	PHD	Master	Bechlor	Diploma	Seconary	more than41	26-40	15-25	Female	Male	Answer
0	0	1	9	75	1	5	21	52	4	2	32	53	0	26	59	Quantity
0.00%	0.00%	1.18%	10.59%	88.24%	1.18%	5.88%	24.71%	61.18%	4.71%	2.35%	37.65%	62.35%	0	30.59%	69.41%	Percentage

Table1: Data collected in section1

In Table2, the responses and percentages were collected in the second section, which contains the questions with their three classifications (data mining - innovation and invention in education - information security and data confidentiality) and the link between them and distance education and the criteria extracted in Table1 in order to obtain results Realistic and coherent that supports the research path and achieves its outputs.

Question6			Question5			Question4			Question3			Question2			Question1			Question
Other	No	Yes	Other	No	Yes	Other	No	Yes	Other	No	Yes	Other	No	Yes	Other	No	Yes	Answer
9	26	50	9	24	52	2	6	77	6	10	69	4	13	67	4	8	73	Quantity
1.59%	30.59%	58.82%	10.59%	28.24%	61.18%	2.35%	7.06%	90.59%	7.06%	11.76%	81.18%	4.71%	15.29%	78.82%	4.71%	9.41%	85.88%	Percentage

Table2: Data collected in section2

The following tables and charts also show the distribution of responses and the number of choices in each of the three cases, which was by giving an answer identical to the type of request and the content of the required case for each answer. The research included about 85 participants whose responses varied according to the classification that was adopted in the questionnaire. Chart 1 shows the percentage of the number of males who answered the questionnaire reached more than 69%, while the percentage of females responded 30.6%. Accordingly, the number of males who participated in the questionnaire was 59, while the number of females reached 26, as shown in Table 3 and Chart 1 below.

Gender		Question
Female	Male	Answer
26	59	Quantity
30.59%	69.41%	Percentage

Table3: Gender Data Analysis

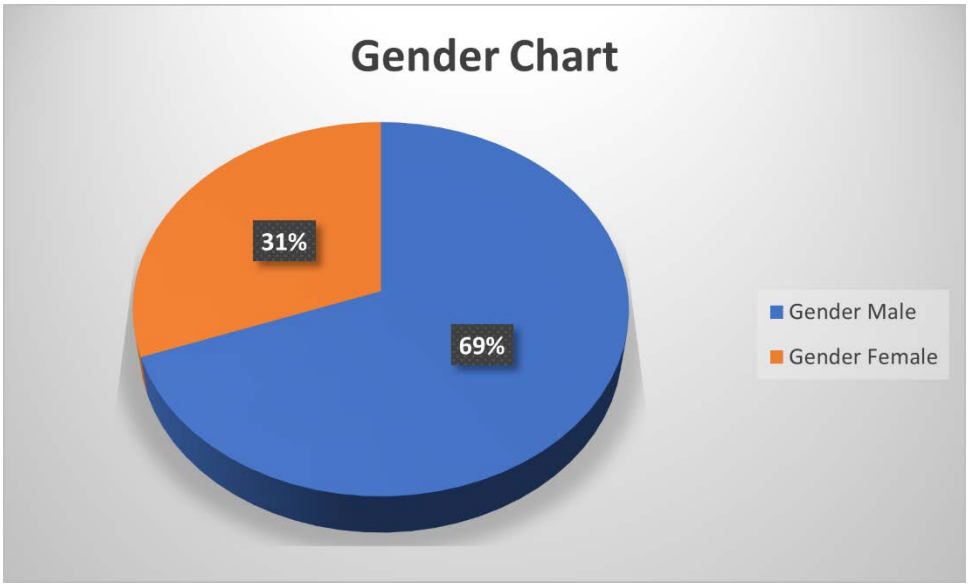

Chart1: Gender Chart Analysis

The results also showed that those aged between 26-40 years were the most participants in filling out the questionnaire, and most of the responses were positive, giving indications of digital transformation and raising the efficiency of activating distance education when it was used, as Scheme 4 showed age-related ratios.

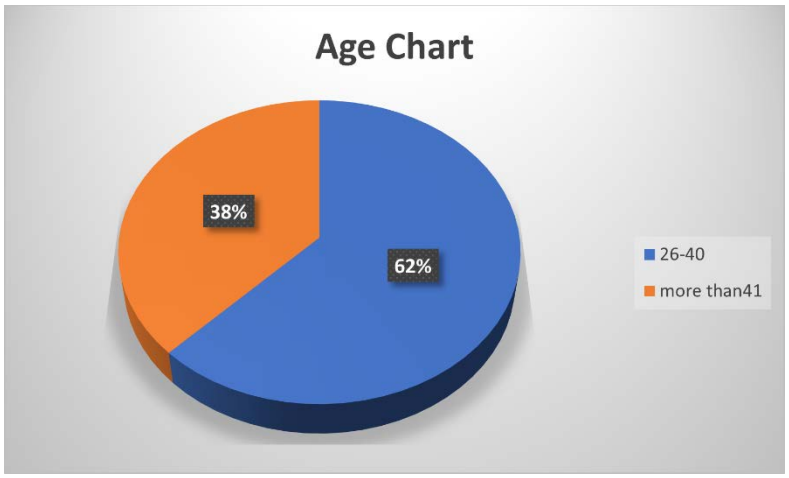

Chart2: Age chart analysis

As for the educational qualification of the respondent, the study showed that holders of a bachelor's degree had the highest percentage in the responses, reaching 51 responses, equivalent to 61.18% of the total distributed percentage in the qualifications that were included in this research, which affects the course of the research and is closer to reality in the areas of innovation Invention and the development of education through technology and modern technologies that support education, and this is illustrated by Scheme 3 below.

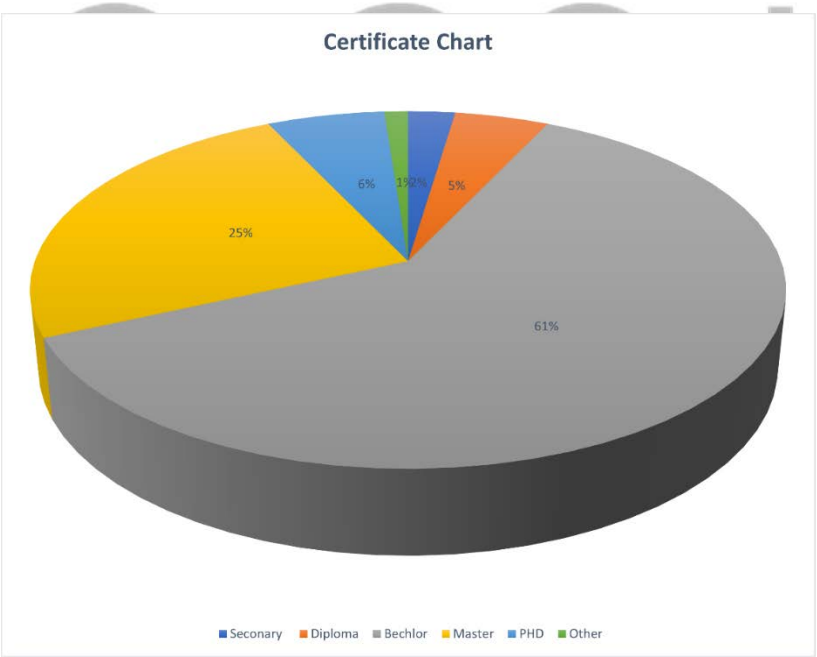

Chart3: Certificate chart analysis

Data mining, invention and innovation in education and information security and confidentiality were classified in the second section of the questionnaire, which included 6 questions based on the axes that the research focused on. In the first and second questions in the second section of the questionnaire, the results concluded that the technique of data mining has become an urgent necessity for forecasting and reading the future and its requirements, and the following table shows this in the two questions, as the percentages in the answer are close and large, which makes this an indication that distance education and interactive educational platforms It is undergoing change and development, and it is necessary to reconsider and make the most of the data that is stored and classified in the databases associated with the platform.

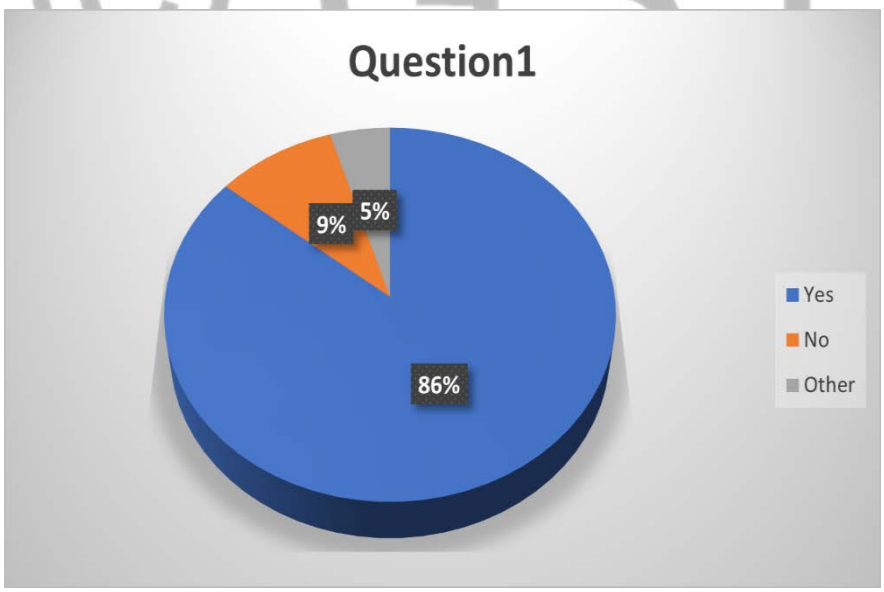

Chart4: Question1 analysis

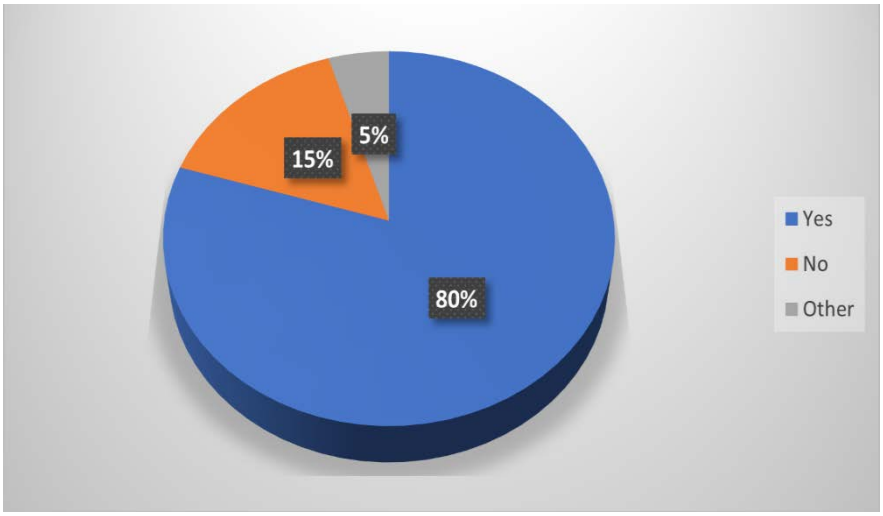

Chart5: Question2 analysis

The third and fourth questions of the second section focused on invention, innovation, and orientation towards technological sciences and modern technologies, and activating them in the manner and manner that support the trend towards a knowledge-based society based on technology and capable of innovation and interaction with interactive educational platforms and distance education with all its components and tools, so that the teacher and student are able to: Keeping abreast of global changes and knowing how to deal with and interact with them and facing sudden exceptional cases, and the ratios illustrate the importance of this through the following schemes 10.9:

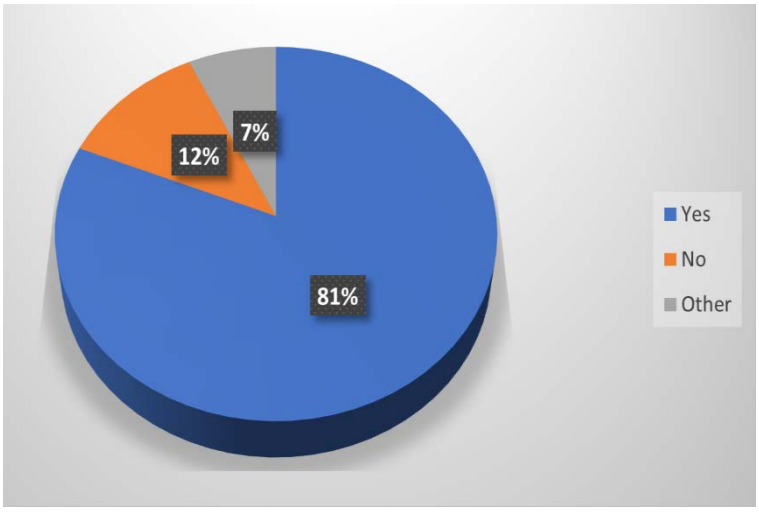

Chart6:Question3 analysis

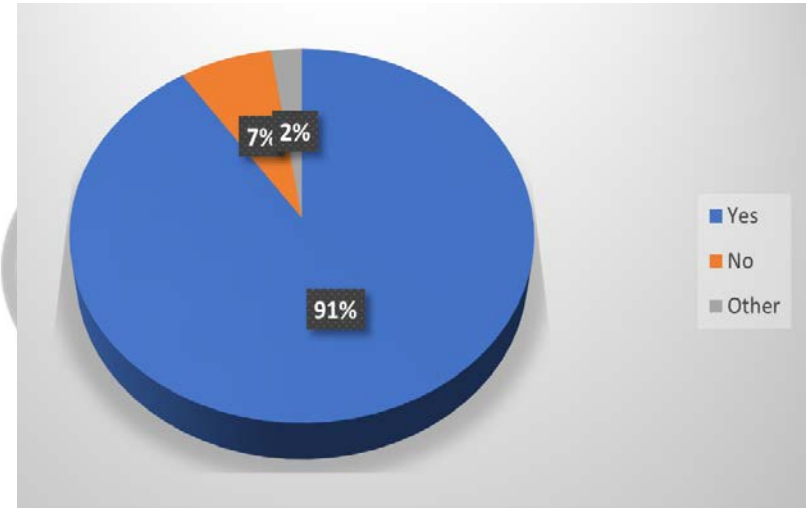

Chart7: Question4 Analysis

Information security in our time has become an urgent necessity in order to obtain an interactive technical system that is safe from the risks that threaten many, whether individuals or institutions, which makes this very important in the education sector and digital transformation that allows dealing with data and allows sharing some privacy during the desire to Linking with interactive

educational platforms that the teacher, student, and guardian deal with side by side.

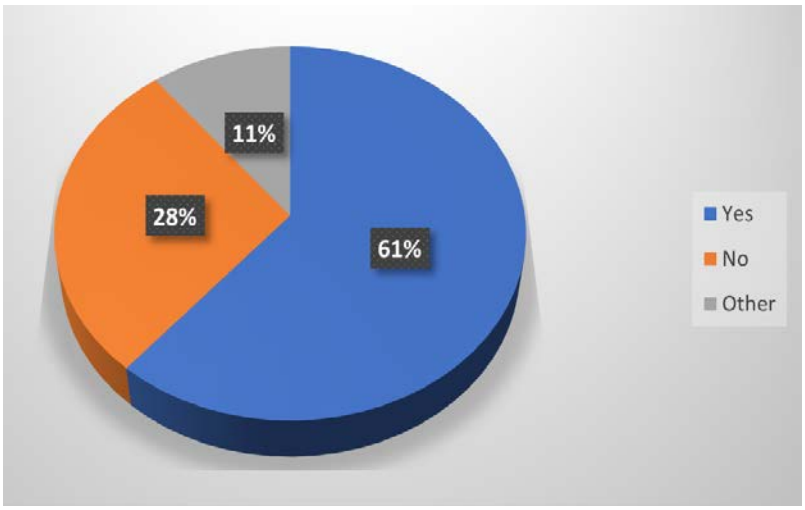

Chart8: Question5 Analysis

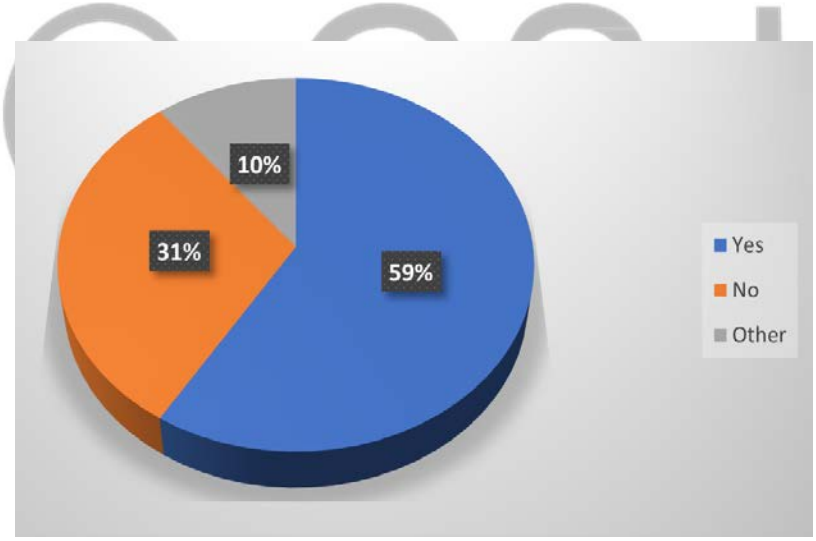

Chart9: Auestion6 analysis

Creating modern and advanced projects and applications in data mining technology and providing the necessary security wall will have many considerations, including:

1- The interaction of resources and tools related to data mining technology and its interrelationship with the educational content to achieve continuity of guidance for the provision and use of technology in the educational process.

2- Data mining tools, components and features will greatly contribute to the ability to interact and communicate between the traditional educational system and the technology-based educational system, giving an addition in understanding the content and the educational curriculum in a modern, smart, and advanced way.

3- That the next generation of school students be able to invent, innovate, and move towards technological sciences and modern technologies, which makes them able to keep pace with global changes and know how to deal with and interact with them and face sudden situations.

4- Planning and forecasting the future of schools and educational content in the field of data mining and information security.

5- Focus on applying the principles of the Fourth Industrial Revolution in the field of inventions and innovations related to data mining technology, information security and other promising future technologies.

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Appendix

Questionnaire

Section1- General Information القسم الأول (البيانات العامة)

النوع (الجنس):	ذكر	أنثى		
Gender	Male	Female		
العمر:	25-15	40-26	أكثر من 41	
Age			Up to 41	
المؤهل:	دبلوم	بكالوريوس	ماجستير	دكتوراة	غير ذلك
Certificate	Diploma	Bachelor	Master	PhD	Other
الوظيفة:	حكومي	قطاع خاص	باحث عن عمل	أخرى	
Position	Government	Private Sector	Searching for Job	Others	

Section2 – Relevant Questions القسم الثاني

1 - هل ساعد التعليم عن بعد خلال الازمات في جعل تقنية التنقيب عن البيانات أكثر فاعلية وانتاجية؟ نعم لا غير ذلك

Is distance education helped during crises to make

data mining technology more effective and productive?

2 - هل أسهمت المنصات التعليمية في زيادة المحتوى التعليمي اللازم لحصول التنبؤ عن مستقبل التعليم من خلال تقنية التنقيب عن البيانات؟ نعم لا غير ذلك

Have educational platforms contributed to increasing the educational content needed to predict the future of education through data mining technology?

3 - هل يعتبر استخدام المنصات التعليمية من مقومات الابتكار في التعليم؟ نعم لا غير ذلك

Is the use of educational platforms a component of innovation in education?

4 - هل سهلت المنصات التعليمية الدخول للحصص المتزامنة وتنفيذ الأنشطة والواجبات والتدريبات والاختبارات للطلاب خلال فترة الأزمات؟ نعم لا غير ذلك

Did the educational platforms facilitate access to simultaneous classes and the implementation of activities, assignments, exercises, and tests for students during the crisis period?

5 - هل توفرت مؤشرات الثقة الكترونيا عند طلب استخدام بياناتك الخاصة أثناء دخول واستخدام المنصات التعليمية؟ نعم لا غير ذلك

Are trust indicators available electronically when requesting the use of your private data while entering and using educational platforms?

6 - هل قمت بتأمين جهازك بأنظمة الحماية قبل وأثناء استخدامك للمنصات التعليمية؟ نعم لا غير ذلك

Did you secure your device with security systems before and during your use of educational platforms?