

PAPER

Information and Communication Technology and its Impact on Improving the Quality of Engineering Education Systems

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ABSTRACT

The emergence of the remarkable phenomenon of information and communication technology (ICT) in the last two decades of the twentieth century, and its integration into the formal education systems of leading countries, has expanded learning opportunities and facilitated easy access to educational resources. Due to the vast amount of information available, there is a growing emphasis on information management. This approach allows students to enhance their learning by utilizing various tools and visual aids. These tools help in teaching and training by engaging students' different senses, making learning more realistic, practical, and enjoyable. The quality of education and the effectiveness of educational systems are among the most important concerns for educational developers, and decision-makers in any country. The areas of education is one of the fields that has undergone fundamental changes with the emergence of information technology. Information technology has been recognized as an effective tool in the learning and teaching process. In this research, we will discuss the role of ICT and its impact on enhancing the quality of education systems. The results demonstrate that ICT plays an effective role in the design, planning, implementation, learning, educational evaluation, and structure of education. This includes aspects such as timing, suitability, accuracy, adequacy, realism, speed of transmission, learning accuracy cost reduction, and educational effectiveness. Based on the aforementioned points, educational institutions must offer a suitable framework for integrating ICT into education through thorough planning.

KEYWORDS

information and communication technology (ICT), education systems, quality of education systems, engineering education

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1 INTRODUCTION

At the beginning of the third millennium, information and communication technology (ICT) has become integrated into various aspects of human life, and ICT has become integrated into various aspects of scope and extent. It encompasses a wide range of tasks, such as general planning for engineering education, implementation, monitoring, evaluation, and improving the quality and quantity of university education, with the aim of increasing accuracy and raising the overall standard [1–3]. Information technology has had a wide-ranging, substantial, and cost-effective impact on learners, students, and teachers, facilitating the rapid exchange of information and cultural interactions. Students will undoubtedly enjoy improved educational, economic, and social opportunities when they have access to computers and ICT. The ICT revolution has given rise to educational, economic, and cultural movements, leading to the emergence of a new world. In the new millennium, communication technology rapidly spread across the world, impacting various aspects of human life, including education. In many countries around the world, the advancement of information technology in engineering education has been a focal point. By examining the statistics and information available about the development of information technology in engineering education, it is evident that there are comprehensive programs aimed at providing schools with various facilities, such as computers and the Internet. Given the increasing impact of information technology on human life, it is essential for students and teachers to be familiar with this technology and to master the use of its tools. To this end, some countries around the world provide the necessary resources for students and teachers, educating and preparing them for life in the digital world. Developing an educational system that can effectively teach individuals to thrive in a dynamic world is a top priority in modern society. Therefore, it is not surprising that many governments prioritize the integration of ICT applications in education, aiming to ensure continuous evolution within their countries. The vast amount of information and the way it is exchanged have brought today's society to the brink of entering a culture in which imparting information and knowledge is one of the most crucial pillars for societal progress [4–6]. In the era of ICT, educational systems need to both reconsider and reconstruct the computer literacy curriculum and also rejuvenate and enhance the learning environment to facilitate interaction among the teacher, the learner, and the learning resources. Therefore, many educational institutions have opted to replace traditional teaching methods with new approaches aimed at equipping learners with cognitive skills. Many developed and developing countries have made efforts to equip schools with various facilities, including computers, the Internet, and modern screens. They have also innovated new teaching methods and utilized educational engineering programs, multimedia, the Internet, and e-mail. As a result, educational networks expanded, leading to the emergence of e-learning and distance learning. This also led to improvements in the effective management of educational systems. Despite the numerous opportunities and advantages offered by this technology, many people face challenges in using ICT, including a lack of sufficient knowledge among stakeholders about the extent and dimensions of its impact on various aspects of life. This problem has resulted in some organizations failing to effectively utilize this technology. Therefore, the primary focus of our research is how to leverage ICT to enhance the quality of education [7–11].

1.1 Significance of the study

Today, with the introduction of new educational technologies, particularly access to the Internet and its influence on global cultures, a new situation has emerged

in which education is inevitably being adapted to new functions. Choosing and pursuing new careers requires a reevaluation of the education system. The reason we view new engineering educational systems as modern educational technology rather than a challenge in the educational system is the impact of these technologies on educational support in the classroom, which has been substantiated by extensive research. In this research, we aim to examine the role of information and communication technology in the educational system, including its benefits, barriers, and challenges. We also seek to explore the responsibilities of teachers and students in an education system that is based on information and communication technology.

1.2 Sub-study questions

This study aims to answer the following questions:

- Is the use of ICT effective in educational engineering design and planning?
- Is the use of ICT effective in implementing educational programs?
- Does the use of ICT have an impact on learning?
- Does the use of ICT impact the flexibility of the educational engineering structure?
- How does the use of ICT impact the educational evaluation of engineering students?

Recognizing the fundamental impact of ICT on various aspects of society, our study examines the different dimensions of ICT and identifies the contexts that influence the diverse educational functions and structures of schools and universities. The results of this study provide a solid foundation for fundamental changes in motor and educational practices, particularly in the context of utilizing communication and information technology effectively in education. With the clarification of how this technology impacts education, we hope that officials will be more motivated to provide more effective use of technology for various educational purposes.

2 INFORMATION AND ICT

The remarkable rise of ICT in the last two decades of the twentieth century and its integration into the formal education systems of leading countries have expanded opportunities for convenient learning and easy access to education. In this approach, ICT has been considered an effective tool in the learning and teaching process. It is considered a force that can change many aspects of life and a powerful tool for improving quality and expanding equal access. ICT encompasses the technology that enables us to record, store, process, retrieve, transmit, and receive information. Information technology has revolutionized the way we accomplish tasks. ICT is so interconnected that information acts as the machine and communication serves as its product. It collects, organizes, stores, disseminates, and utilizes information in various forms, such as sound, images, graphics, text, and numbers, through the use of computers and communication tools. The term ICT encompasses a wide range of new technologies, including mainframe computers, minicomputers, CD-ROMs, cordless telephones, modems, laser and color printers, mobile phones, motion pictures, computer animation, computer simulation, electronic publishing, digital cameras, fax machines, fiber optics, radios, televisions, floppy disks, geographic information systems, information superhighways, computer networks (local and global), multimedia, software, supercomputers, video telephony, virtual reality, wide area

networks, the web, and more. These technologies have contributed to the production, dissemination, and transmission of better and more widely accessible information. These programs have led to significant changes in the educational process, enabling students to access information beyond the classroom. This has increased their motivation to learn. Research has shown that nearly half of teachers use computers for educational purposes, often utilizing word processors, spreadsheets, graphics software, and searching for information through numerous scholarly websites. In many countries, there has been particular attention given to the use of ICT in the educational system to enhance the quality of teaching and learning methods. It establishes a framework for enhancing the quality of education. Students and teachers can utilize this technology to access a wide range of learning resources, enhance their motivation to learn, and accommodate different learning styles [12–14].

3 THE ROLE AND IMPACT OF ICT ON EDUCATION

Considering the current state of ICT in the education system, it is important to describe the significance of long-term planning, strategic objectives, and the mission of the comprehensive ICT development plan in the formal education system as follows [15–17]:

- a) Continuously narrowing the gap between students' use of information technology inside and outside formal educational settings, ultimately transforming the current situation and preventing educational disengagement within educational institutions.
- b) Continue to address and fully resolve the crisis of acceptance of the formal education system in the country by leveraging information technology capabilities to transform the current educational challenges into comprehensive development. This can be achieved through changes in the educational process, such as:
 - Transforming the scientific and educational environment, which includes educational materials, textbooks, educational curricula, devices, and equipment.
 - Transforming the role of teachers and their educational practices.
 - Transforming the role of learners and their educational behaviors, particularly in collaborative learning settings.

This technology has numerous dimensions that significantly impact learners, including the cognitive, social, cultural, emotional, and moral dimensions. It is important to utilize the latest technologies to educate the current generation according to the specifications of this era. Among the most important modern devices in education are digital interactive whiteboards, ultra-high-definition televisions (UHDTV), smart boards, digital projectors, tablet PCs, iPods, palmtop computers, personal digital assistants, and mobile phones.

3.1 The role and impact of ICT on the educational system

Experience has shown that ICT plays an important role in the educational system. Perhaps technology can liberate learning from the constraints of a linear curriculum, connecting learning within and outside educational institutions, at home and in remote settings. It can provide the foundation for the idea of learning to live together and the objective of learning to be (the development of personality and

the ability to act with greater independence, critical thinking and scrutiny, possessing clean power, and taking individual responsibilities). In this regard, education should not overlook any of the individual dimensions and abilities, including memory, cognition, aesthetics, emotions, physical strength, and communication skills. The primary function of the educational system is to train and nurture learners to fulfill their appropriate roles in society and to excel. However, this definition can be examined from various perspectives. However, in general, the development of the learner is interpreted as having information literacy, which is considered the ability to understand information more broadly. New developments have emerged in this field. Information technology and its impact on education are referred to as information literacy. Education is one of the fields in which the widespread and diverse application of communication and information technology has fundamentally changed its various dimensions. In this section, we will discuss the impact of ICT on various aspects of education [18, 19].

3.2 The role of ICT in educational planning

Information and communication technology play a significant role in designing and planning education, including the weekly course schedule, the weekly lesson schedule, required reports, archiving, monitoring, control, and all aspect that enhance the quality of education. This technology can be utilized in educational planning to provide improvements [20–22].

3.3 The role of ICT in structuring education

One way to reduce organizational hierarchy is to implement computer-based communication and information systems. The rapid growth of computer information systems has streamlined organizational hierarchies and led to decentralization. Modern information systems have diminished numerous hierarchies. In addition, unlike traditional structures, where coordination and control were slow. The emergence of computers and related information technology has brought about profound changes and impacts on higher education, including universities, schools, and their components such as professors, university students, teaching and learning methods, libraries, information sources, research, and strategic management. The existence of the Internet has made access to information universal, allowing students to access information in various ways. Under these circumstances, universities are compelled to venture into the field of distance education to meet the needs of knowledge seekers. This trend will naturally have profound implications for the structure and performance of university education. Distance learning provides flexibility from [23–26]:

1. Training time (not limited to a specific time)
2. Training location
3. Implementing training
4. Number of professors

Today, information and communications technology has become one of the most crucial educational tools. ICT has transformed the traditional methods of exchanging and sharing information in an academic environment. Instead of relying on

paper-based (printed or written) information exchange, it has opened new opportunities for academics to share and exchange information. Information technology plays a crucial role in various aspects of university operations, starting from a student's initial interaction with the university's website to the diverse systems used at the university level to deliver services and facilitate communication via desktop computers. As students' computer literacy increases, classrooms and laboratories are being designed to adapt and apply new forms of technology. Administrative systems and educational institutions have also modernized, moving towards a unified position to effectively communicate with the external environment.

3.4 The role of ICT in evaluation

The study involves examining various methods for assessing and organizing the educational system, as well as continuously monitoring and evaluating educational performance using specific scientific indicators that are suitable for the culture and societal needs. In the electronic method, evaluation forms are created digitally and distributed to respondents in either paper form or through a web-based system. After the questionnaires are completed by researchers and collected manually or through the system, the data is automatically analyzed. The results are then reported, identifying strengths, weaknesses, and feedback, and calculating parameters for the future growth and prosperity of the learning institution. This method establishes various levels of education and plays an effective role [27–30]. Its advantages include the following:

1. Accuracy of information because the model can be designed intelligently to prevent many errors that occur due to negligence and indifference.
2. Safe and secure processing of data without human intervention in the processing process.
3. A very short time to extract the evaluation results and the possibility of making appropriate decisions in the required time allows the evaluation process to be repeated over short periods.
4. Archiving and retrieving electronic forms is much easier and faster than regular forms.
5. Its cost is lower and evaluation forms are prepared only once.

Today, effective management of government institutions requires the efficient use of communication and information systems. Part of the requirements for leveraging high-quality information technology involves training employees and utilizing technology and information systems to enhance their skills. This service should receive greater attention because technological innovations may have been undertaken in different areas, perhaps the most important of which is the impact on government management through ICT. Progress in communications and information technology, with its rapid advancement, enables government organizations to develop their resources at a reduced cost, with increased speed and greater accuracy [31]. Furthermore, teachers play a crucial role in ICT. Classroom teachers must be prepared to offer students technology-based learning opportunities. The classroom teacher plays a key role in helping learners access technological capabilities. The willingness to implement technology and the knowledge of how technology supports student learning should be among teachers' core skills. On the other hand, research indicates that the use of information and communication technology allows students to develop proficiency in technology and self-awareness for the future.

This technology also enables the teacher to deliver informational content to the students and facilitate activities that promote learning, thereby transforming the teacher's role from a mere transmitter to that of a facilitator. The successful integration of ICT into teaching and learning hinges on the teacher's ICT competencies and experiences. The teacher's ability to skillfully integrate ICT into the teaching and learning process is crucial, and innovative teaching practices contribute to professional competence by aligning with national policy, curriculum, assessment, and educational standards. Teachers should be knowledgeable in organization, management, and professional development, as well as ICT skills. They should have a grasp of software and hardware basics, applications, web and communication software, trial software, and management applications. Additionally, they should be capable of designing and utilizing ICT to support development. Below are some points about the role and responsibility of the teacher in the educational system based on ICT [32–34].

1. To be technically prepared to use technology and access the information requested by the information producer
2. Designing groups, implementing cooperative learning strategies, and addressing individual differences
3. To facilitate and guide
4. Motivating students
5. It provides ethical, legal, and humanitarian lectures and advice on the use of computers and technology.
6. Educational supervision and leadership.
7. Evaluating and reviewing curricula and materials based on the evaluation results

Managers can enhance their performance in the management and training process by effectively utilizing information technology, including computers, the Internet, educational multimedia, and various software tools. They can use computers to access documents instead of spending a lot of time on manual recording and statistical work. Administrators can communicate with colleagues, parents of students, and higher-level administrators via email, exchange constructive opinions, and receive necessary feedback. Teachers and administrators can stay informed about the results of educational research and utilize proven research methods to enhance their effectiveness. They can also utilize distance learning programs to enhance their professional knowledge or further their education. The ability to utilize digital libraries and search across various websites saves time and money. Reducing the cost of long-term education, retraining teachers to enhance their functional skills and knowledge, fostering motivation and effort, integrating writing programs into the curriculum, and drawing from international experiences are additional factors that can significantly impact the learning and teaching process in education [35, 36].

3.5 The impact of ICT on students

By using ICT, the student will be able to absorb more information in a shorter period and will achieve many benefits, including [37]:

1. Producing works and inventions by combining words and ideas
2. Study ideas and present them to the public in different ways
3. Save and use a lot of information in different ways
4. Use simulation to do difficult things in real life

By utilizing ICT technologies, the student can achieve lifelong learning, recognize and evaluate rich information sources, understand their goals, and strive for them. This helps the student become a critical thinker, analyst, and decision-maker. Utilizes ICT techniques and tools to review and analyze information and data, gather data and information, and present them in the form of valuable and actionable knowledge [38, 39].

3.6 Obstacles in the use of ICT in education

There are numerous obstacles to the spread of information technology, both in developing countries and in industrialized countries, which hinder the growth and development of this technology [40, 41].

The lack of necessary infrastructure for communication and information technology. This is a significant obstacle, especially in impoverished countries. Therefore, we see that information technology is more prevalent in economically developed countries.

1. Lack of skills required to use operating systems based on communication and information technology.
2. One of the primary factors impeding the dissemination of information technology is the lack of sufficient awareness of its potential benefits.

Andrew Jones, from the UK Institute for Educational and Communications Technology, conducted a study in 2004 on the barriers to the use of ICT in learning institutions. This study report highlights several limitations and barriers to the use of this technology (Table 1).

Table 1. It shows that some obstacles to the use of ICT in education

1. Lack of confidence and anxiety of teachers in use	11. Resistance to change and negative attitudes
2. Inability of trainers to access ICT personally from a computer	12. Lack of access to resources
3. Lack of teacher ability	13. Lack of knowledge about the benefits of using ICT
4. Lack of time for training	14. Lack of equipment
5. Technical problems	15. The impact of public examinations
6. Lack of educational education	16. Poor organization of resources
7. Fear that something will go wrong	17. Age differences
8. Lack of training skills	18. Poor quality of devices
9. Lack of technical support	19. Differences between the sexes
10. ICT does not focus on education	20. Inappropriate software

4 RESEARCH METHOD

This research employed a descriptive approach as the most suitable method for studying and achieving the research objectives and for proving or disproving

the existing research hypotheses in order to understand the role of communication and information technology in education. The social survey approach was also utilized in this research. In other words, this study systematically analyzes and describes the current situation, studies its features and characteristics, and ultimately generalizes the results to the entire statistical community. In light of the study that we conducted, our research community included school principals, teachers, parents, and students. Given that the study population is classified into a spectrum of classes, a simple random sampling method was chosen. The sampling method was determined to be simple random using Morgan's finite population formula. According to Morgan's table, the number of required samples was 1200. We utilized the questionnaire form as a tool for gathering information, a method widely employed in academic research to study phenomena. The questionnaire is a tool used to study research and collect various data and information from samples selected from the research community. It involves asking several questions on various topics to identify facts related to the study and reveal research objectives and hypotheses. Our research questions remained the same as before:

- Is the use of ICT effective in educational design and planning?
- Is the use of ICT effective in implementing educational programs?
- Does the use of ICT have an impact on learning?
- Does the use of ICT affect the flexibility of the educational structure?
- Does the use of ICT impact the educational evaluation of students?

The questionnaire consisted of some questions that the public answered, and through them, we obtained the study results.

5 RESULT AND DISCUSSION

To better illustrate the results, several tables will be utilized, incorporating centrality and dispersion indicators. In descriptive analysis, we summarize the collected data and classify it using descriptive statistical indicators. In this chapter, we will explore and analyze the results of the data obtained through the questionnaire. We will begin by analyzing the demographic statistics of the sample population of the investigation, followed by an examination of descriptive statistics and the normality of the data. Finally, we will utilize statistical methods to analyze the data and address the research questions. To assess the significance of the relationship between the variables, we will utilize SPSS software.

Table 2. The percentages of valid gender

Gender	Numbers	The Valid Percentage
Female	650	48.15
Male	700	51.85
The total	1350	100.00

Table 2 shows that the sample that was approved was 650 respondents, equivalent to 48.15% are female, and 700 individuals, equivalent to 51.85% are male.

Table 3. The number of people and their age

Age	Numbers
15–25 year	300
35–26 year	500
45–36 year	380
46 years and above	170
The total	1350

Table 3 shows that 300 of the respondents were from 15 to 25 years old, 500 individuals from 26 to 35 years old, 380 individuals from 36 to 45 years old, and 170 respondents of respondents aged 46 and over.

Table 4. Educational level of proposed number

Educational Level	Numbers
High school degree	480
Technical diploma degree	520
Bachelor's degree	250
Master's and doctoral degrees	100
The total	1350

Table 4 shows that 480 of the respondents, held a High school degree, 520 individuals, held a Technical diploma degree, 250 individuals, a bachelor's degree, and 100 individuals, a master's and doctorate.

Table 5. Social level

Social Level	Numbers
Managers	60
Teachers	390
Fathers	510
Students	390
The total	1350

Table 5 shows that 60 of the respondents are managers, 390, are teachers, 510, are parents, and 390, are students.

Table 6. Is the use of ICT effective in educational design and planning?

The Use	Numbers	The Valid Percentage
Effective	803	59.4
Middle	287	21.3
Inactive	260	19.3
The total	1350	100.0

Table 6 shows that 803 of the respondents, equivalent to 59.4%, answered “Is the use of ICT effective in educational design and planning” with (effective), while the answer of 287, equivalent to 21.3%, was (average), and the answer of 260 Equivalent to 19.3% was (ineffective).

Table 7. Is the use of ICT effective in implementing educational programs?

Use	Numbers	The Valid Percentage
Effective	890	65.9
Middle	291	21.6
Inactive	169	12.5
The total	1350	100.0

Table 7 shows that 890 of the respondents, which is equivalent to 65.9%, answered is the use of ICT effective in implementing educational programs” with “effective”, while the answer of 291, which is equivalent to 21.6% Middle, and the answer of 169 of the respondents, which is equivalent to 12.5% ineffective.

Table 8. Does the use of ICT have an impact on learning?

Use	Numbers	The Valid Percentage
Influential	920	68.1
Middle	288	21.4
Ineffective	142	10.5
The total	1350	100.0

The most influential answers were for an option of 920, or 68.1%. is presented in Table 8.

Table 9. Does the use of ICT affect the flexibility of the educational structure?

Use	Numbers	The Valid Percentage
Influential	960	71.1
Middle	250	18.5
Ineffective	140	10.4
The total	1350	100.0

Table 9 shows that the majority of answers were for an influential option, with several 960 and a percentage of 71.1%.

Table 10. Does the use of ICT have an impact on students’ educational evaluation?

Use	Numbers	The Valid Percentage
Influential	919	68.1
Middle	282	20.9
Ineffective	149	11.0
The total	1350	100.0

Table 10 shows that the largest number of answers were related to an influential option, amounting to 919 answers, or a percentage of 68.1%.

6 RESULTS BASED ON THE DESCRIPTIVE ANALYSIS

Based on our study and through the questionnaire that we conducted on the selected sample, we obtained results that are presented in the tables above. The research sample revealed that the use of ICT is effective in educational design and planning, with 803 respondents (59.5%) indicating its effectiveness. Similarly, the results showed that the use of ICT is effective in implementing educational programs, with 890 samples (65.9%) choosing the effective option. One of the research objectives is to determine the impact of ICT use on learning and recognition. The results revealed that the majority of the responses favored an influential option, with 920, or 68.1%, which is more than half. Therefore, governmental, educational, and teaching agencies must develop content related to ICT. The results revealed the significant impact of ICT on the flexibility of the educational structure, highlighting its importance in education. According to the respondents, the majority (71.1%) found the use of ICT to be influential, based on 960 samples. This indicates the research participants' belief in the impact of using ICT. The public believes that the use of ICT has an impact on educational evaluation, particularly in terms of the flexibility of the educational structure. It received the highest percentage of responses for the influential option, with 919 answers, accounting for 68.1% of the total, which exceeded more than half of the respondents' answers.

7 CONCLUSION

Information and communications technology has impacted various aspects of life, including education, and has transitioned societies from traditional to information societies. The methods of education have also undergone changes due to the introduction of technology. The use of virtual education, employing new methods, makes educational systems more efficient and effective in human societies. Therefore, it is essential to utilize these technologies to enhance the quality and productivity of education in all institutions. Consequently, teachers and professors must undergo ICT and education courses to update their skills and stay abreast of global advancements. In this regard, it is the responsibility of higher education and pedagogy to offer relevant courses and provide the necessary knowledge to teachers and professors so that they are fully aware of its application in the teaching and learning process. Today, ICT can be utilized as a powerful tool to enhance the quality and efficiency of education. The rapid development of tools based on these technologies and their rapid adaptation to human needs has given rise to a new form of creative, active, and comprehensive learning and interactive environments.

Not only does ICT enhance fundamental skills in reading, writing, numeracy, and critical thinking, but it also has the potential to enhance information literacy. As a result, ICT skills have become integral to many education systems around the world. Life in today's world necessitates education grounded in knowledge, research, and innovation. And the use of new technologies. Given the significance of education in enhancing the knowledge and skills of students and employees, the need for its continuity, and the influence ICT on different aspects of society, especially education, the primary objective of this research is to elucidate the impact of information

technology on various educational functions. The results indicate that information technology has an impact on various aspects of education. Collaboration between education specialists and information technology experts can enhance education by effectively utilizing information technology.

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