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Research Article

# Effectiveness of Educational Technology Applications in Saudi Arabian Secondary Schools

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**Abstract.** The integration of technology tools into classrooms is a growing trend worldwide. Research studies indicate that technological tools are crucial in creating an environment in which students play an active role in the learning process. The Saudi Arabia government has heavily invested in the *Information and Communication Technology* (ICT) field, but is yet to fully benefit from the investment. There are a myriad of enablers and hindrances affecting the successful implementation of ICT in Saudi schools. Successful implementation of ICT can be realised through the promotion of constructivist learning environment. This study utilised mixed methodology approach in collecting data from teachers to evaluate the factors affecting effective ICT implementation in Saudi secondary schools. The factors affecting the practical use of educational technology include lack of management and technical support, time limitations, lack of ICT and pedagogical training, negative attitudes and beliefs towards educational technology, lack of clear policies and strategies on ICT adoption in learning institutions and resistance to change and inadequate technological resources. No single factor is capable of guaranteeing the successful ICT implementation in schools; therefore, a multifaceted approach is needed.

**Keywords.** Educational technology; Information communication technology; Technological tools/equipment; Constructivist learning; Improved learning outcomes

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## 1. Introduction

*Information and Communication Technology* (ICT) is vital in shaping all aspects of life today. The adoption of ICT has significantly increased following the advent of Web 2.0 technologies. Digital devices have become cost-effective, smaller and more powerful. The current generation is driven mainly by the power of information. Information has become highly accessible anywhere, anytime, at the tip of a finger. The implementation of ICT in the educational sector has an essential role in promoting learning (Kozma [15]). Education is vital in the society since it plays a key role in ensuring that members of the society are skilled and knowledgeable in various aspects of life. According to Oyaid [19], ICT has been integrated into education to facilitate the teaching of many subjects. The application of ICT in education is associated with many benefits.

Educational technology refers to various electronic devices and applications used in assisting the delivery of learning materials and supporting learning in classrooms. It comprises video and embedded multimedia, *Integrated Learning Systems* (ILS) and *Computer-Assisted Instructions* (CAI). The main types of educational technology include comprehensive models and innovative technology applications (e.g. ITA, supplemental technology and *Computer-Managed Learning* (CML)). Supplemental technology is also known as CAI and refers to an integrated learning system that is made of various programmes, such as WICAT, Destination Reading, Waterford and Plato Focus (Cheung and Slavin [11]). The programmes are vital in providing additional instructions for students to assist in assessing the level of need for supplemental traditional classroom instruction. Reading Reels is made up of brief embedded multimedia pieces that provide reading instructions for first-grade students. CML programmes, such as that for accelerated readers, use a computer in assessing the reading levels of students. It also assigns reading materials to students based on their levels and score tests in reading, and charts the progress of students. Comprehensive models use CAI and non-computer activities as the core reading approach for students (Gray, Thomas and Lewis [13]).

Most research studies indicate that educational technology has a small to moderate effect on learning outcomes. Computers are viewed as essential tools for teaching and learning. Educational technology is associated with the following outcomes: enhancement of student achievement; substantial savings in instruction time; fostering a positive attitude towards technology; and helping learners in becoming better problem solvers, calculators, writers and readers (Lim [18]). Kulik [16] conducted a study on the impact of ICT applications on several subjects. The study examined various programmes, such as reading management programmes, ILS and writing-based reading programme. The results of the study varied depending on the type of programme. The study found that there was no significant positive impact in nine controlled studies of ILS. Most of the studies examined by Kulik [16] were brief and did not include a control group. There have been few studies that examine how the features of technology affect various aspects of learning.

This paper examines the impact of ICT on learning outcomes in Saudi Arabia by bringing out factors that promote and hinder effective implementation of ICT in schools. Technology can

have a positive impact on the quality of instruction, by presenting content that is varied, well-designed, compelling and visual. Animation, static graphs and videos can be used in illustrating key concepts. The content should be well-organised and aligned to desired learning objectives. Although the presentation of content using technology can be beneficial, it is also capable of distracting learners from attaining key objectives and can interfere with the learning process. The use of technology can also replace the instruction of teachers, thereby sacrificing the benefit that teachers contribute to learning through the delivery of interesting and compelling lessons (Bingimlas [8]). Technology should not be used to replace teachers since the positive relationship that teachers form with their students is essential in facilitating learning. Teachers understand their students better since they know what interests them, what they have already learned and how they learn. Technology can also interfere with cooperative learning or peer-to-peer discussion. It is possible to avoid these problems by designing technology-enhanced systems (Al-Harbi [4]).

This study aimed to provide a portrait of ICT implementation in Saudi secondary schools. Defining the factors that promote or hinder the effective implementation of ICT is useful in developing a strategic plan to guide the successful integration of technology into teaching and learning processes. Oyaid [19] asserts that the lack of educational policy and strategy on the adoption of ICT hampers the effective implementation of educational technology. ICT adoption can be supported with a clear policy framework that is vital in creating a supportive school culture. Policies that encourage the incorporation of educational technologies in schools should be established. Saudi Arabia educators advocate for elaborate policy planning to address ICT implementation in schools. Successful adoption of educational technology can be influenced by the perception of educational policy makers. Some scholars argue that the successful implementation of ICT can be realised when the common visions of educators are articulated in school policies (Oyaid [19]).

Many nations in various parts of the world have allocated a significant portion of their budgets in implementing ICT in education. The development of strategic plans with the aim of increasing ICT investment in education has been on the increase since the late 1990s. The United States spent USD$9.5 billion on ICT in public schools in 2006. It has been estimated that the British government invested approximately GBP£880 million in education between 2008 and 2009 (SETDA [20]). Most European nations have integrated ICT into their educational processes to realise the full benefit of ICT. The application of computers and IT tools in the education sector is critical in Saudi Arabia. In 2007, the King of Saudi Arabia began pursuing major reforms in the education system of the nation. The Public Education Development Project (Tatweer [21]) is considered one of the most important education reforms in the Arabian nation. The project seeks to equip learning institutions with IT tools, such as laptop computers, interactive whiteboards and projectors. The project was also crucial in training approximately 400,000 teachers in various disciplines on the use of IT equipment. The project started in 2007 and took more than six years. Saudi Arabia spent SAR 9 billion in the implementation of the

project (Albugami and Ahmed [3]).

## 2. Theoretical Framework

The success of a country is determined by the standard of education of its people. Real borders in the current world are defined by the ability to access ICT which is considered to be a strategic resource in the educational sector. Resources like computers, mobile devices, interactive white boards and the Internet are commonly used materials in classrooms. According to Asenso-Okyere and Mekonnen [7], the adoption of technology in classrooms is crucial in helping students become active learners. This active learning approach is unlike the conventional method in which students play the role of passive observers and listeners. The immense benefits associated with the adoption of ICT in education have made it a crucial element in educational reform. The United States has spent over $10 billion per year on educational technologies in public schools. The government of Saudi Arabia has also shown a strong commitment towards reforming its education sector using educational technology (Oyaid [19]).

ICT was introduced as a subject in Saudi Arabia in 1985. During this time, it was taught only in private schools. The government made ICT a compulsory subject in secondary schools in 1991. The Saudi educational sector previously used computers for administrative purposes only. The government has shown commitment towards the integration of ICT into instructional practices since 2005. As a result, several projects have been established by the government. These include digital technical centres, learning resource centres and computer labs across various parts of the nation. Decision makers in the Saudi education sector are still grappling with the challenge of the successful implementation of educational technologies (Dahlan [12]). Vallance, Vallance and Matsui [22] posit that the lack of clear reasons for justifying ICT incorporation in schools is one primary reason for the ineffective implementation of educational technology. ICT adoption in Saudi schools has been largely performed without clear guiding values and a solid understanding of how technologies can enhance learning. The desired benefit of technology is yet to be realised fully in Saudi Arabia, despite substantial investment (Vallance, Vallance and Matsui [22]).

The Saudi government has invested heavily with the aim of advancing public education. The government spent over £2 billion in 2007 with the aim of reforming and enhancing education through the use of contemporary technologies. The Saudi educational curriculum was revised to include technological devices. The introduction of electronic tools to assist in learning has enhanced public learning. Training and development schemes targeting educators have been initiated with the aim of promoting ICT utilisation in learning (Almadhour [5]). In 2015, more than a quarter of the Saudi budget was allocated to the education sector. The allocation augmented the already immense finances in the education sector whose target is integrating technology into the school curriculum and enhancing ICT amenities (Tatweer [21]). Saudi Arabia still lags behind when compared with other developed nations, despite massive investment and governmental support. The Saudi government should focus on developing an

effective strategy for the integration and practical application of ICT in education (Almalki and Williams [6]; Abbitt [1]). The effective implementation of ICT is hampered by several factors, such as the beliefs and attitudes of educators towards educational technology, lack of adequate organisational support, training, infrastructure, planning and resources. Inadequate supportive resources are considered to be a hindrance to the implementation of ICT in education. One of the major obstacles facing both developed and developing nations in the incorporation of technology in education is the inability to access resources. Educators may not always have access to computers, since resources are shared in most institutions of learning. The successful implementation of ICT in education can be difficult without sufficient hardware and software (Buabeng-Andoh [9]). According to a study conducted by Dahlan [12]), ten students in Saudi secondary schools share one computer. Given that virtually all lessons in Saudi secondary schools require computers, the devices are insufficient for the students. The provision of enough supportive equipment for both teachers and students is crucial in the realisation of positive learning outcome.

Technical and management support is also essential in the successful implementation of ICT. School administrations should play the role of providing support and motivation to facilitate the use ICT in classrooms. Teachers can be discouraged from the use of educational technology due to technical issues such as poor Internet connectivity. The provision of ICT support services and ongoing maintenance can promote effective ICT implementation in schools (Buabeng-Andoh [9]).

### 2.1 Problem Statement

According to Almadhour [5], Saudi Arabia lacks the clear strategic framework needed to equip ICT in schools, despite immense funding by the government. Poor implementation is considered the reason behind the lack of a strategic framework. Studies have shown that the improvement of academic performance cannot be realised simply by the greater availability of ICT tools in schools. To address this problem, the following should be considered: the identification of educational problems; defining the desired accomplishments of students, educators and learning institutions; viewing the integration of ICT as a process and not a product; and focusing on using ICT tools in constructing knowledge, as opposed to instructional tools. Technological media have for a long time acted as vehicles for delivering instructions instead of influencing the achievements of students. Studies addressing the impact of educational technology on various aspects of learning have been on the increase since the 1980s. Most studies have concluded that the adoption of educational technology have small to moderate effects on learning outcomes.

### 2.2 Justification of the Study

It is essential to establish a clear rationale before investing in educational technology. Several factors justify the adoption of ICT in classrooms. These factors include boosting productivity, enhancing technological literacy and supporting learning. ICT can be implemented only successfully in teaching and learning if the problem and objectives of the curriculum are singled out. Dissatisfaction with the status quo is considered the main reason Saudi schools

are adopting ICT. Educational technology is vital to improving the educational opportunities provided to students. Educators can only choose the appropriate ICT tools if they have an elaborate understanding of the educational problem that needs to be addressed. It is impossible for the utilisation of ICT to be effective without knowledge of the most appropriate ICT tools (Lane [17]).

The availability of ICT tools alone cannot guarantee the effective implementation of technology in education. The desired effect of educational technology can be realised only if techno-centric thinking is avoided. Academic achievement cannot be improved by ICT on its own. Research studies have suggested that there is no direct relationship between positive learning outcomes and the utilisation of ICT (Buabeng-Andoh [9]). Successful implementation of ICT can be realised through the promotion of constructivist learning environments. Unlike the conventional classroom that is more teacher-centred, constructivist learning is more student-centred. Constructivist learning focuses on how students construct knowledge.

### 2.3 Research Questions

I. What are the factors impacting the implementation of ICT in Saudi schools?

II. What are the barriers hindering the integration of ICT in school curriculums?

### 2.4 Research Objectives

I. To determine the factors that impact upon the effective implementation of ICT in Saudi schools.

II. To determine the barriers hindering the integration of ICT in school curriculums.

## 3. Methodology

### 3.1 Study Design

The research questions were answered using a mixed methodology approach. A quantitative and qualitative research design was used to collect the data. The quantitative method involved the use of descriptive cross-sectional design while qualitative methods involved document analysis, in-depth interviews and focus group discussions. Structured questionnaires were used to collect quantitative data while in-depth interviews and focus group discussions involving key informants in the Saudi Arabia education sector were used in the collection of qualitative data. Thematic analysis was used to analyse qualitative data while quantitative data were summarised using descriptive statistics.

### 3.2 Study Area

The study took place in secondary schools in Saudi Arabia.

### 3.3 Study Population

The study focused on teachers teaching in secondary schools in Saudi Arabia.

### 3.4 Sample Size

The target sample comprised at least 385 participants. The targeted sample size was surpassed since 395 teachers successfully took part in the study. The calculation of sample size was based on Yamane's [23] formula:

$$N = N/1 + Ne^2$$

where $N$ = total number of targeted population

$n$ is the sample size and $e = 0.05$

$n = 10000/1 + 10000(0.05^2) = 385$

Random sampling was used in selecting participants for the study, and consecutive sampling was employed until the target sample size was attained.

### 3.5 Inclusion and Exclusion Criterion

- *Inclusion criterion*: Teachers and administrators of secondary schools in Saudi Arabia.
- *Exclusion criterion*: Teachers who are not teaching in secondary schools, and non-teaching staff in secondary schools.

## 4. Research Ethics

The study met all ethical requirements. Due process was followed in the recruitment of participants, and no one was coerced into taking part in the study. Necessary measures were taken with the aim of protecting the privacy and confidentiality of participants. The participants were informed of the implications of taking part in the study. The research study was conducted after approval by the Institutional Review Board. There was no conflict of interest since there are no personal or financial gains that the researcher could gain from the study. The researcher does not have any conflict of interest in connection with the study that may arise due to economic, political, national affinities, family, or emotional ties.

### 4.1 Data Management and Quality Control

The researcher enacted all necessary measures for data protection. The data were collected electronically using a tablet. The data collection tool (tablet) had a password that was known only to the researcher. The data was cleaned after collection and subjected to descriptive and inferential analysis using MS Excel. Quality control forms an integral part of the research process. It occurs at various stages, such as during the collection of data, entry or digitisation of data and data checking. The development of suitable procedures is essential before the beginning of data gathering (Oyaid [19]).

Standardised and consistent procedures were applied during data digitisation. Data checking was done to ensure the quality of data. Data checking involves editing, cleaning, cross-checking and validation.

## 5. Results

The study identified the following factors that promoted the effective ICT implementation in Saudi secondary schools: accessibility to computer labs and technical equipment; perception of teachers towards the use of ICT; educational policy and strategy planning; ICT infrastructure; and the technical knowledge and skills of teachers. Most of the teachers who took part in the study agreed that technical knowledge and skills of teachers are vital for successful ICT utilisation in classrooms (45% of the participants). A total of 22% of participants considered educational policy and strategic planning as the most important factors, followed closely by accessibility to computer labs and technical equipment at 18%. A total of15% of teachers considered the perceptions and attitudes of teachers to be essential in the successful implementation of educational technology. The percentage distributions are in Figures 1 and 2.

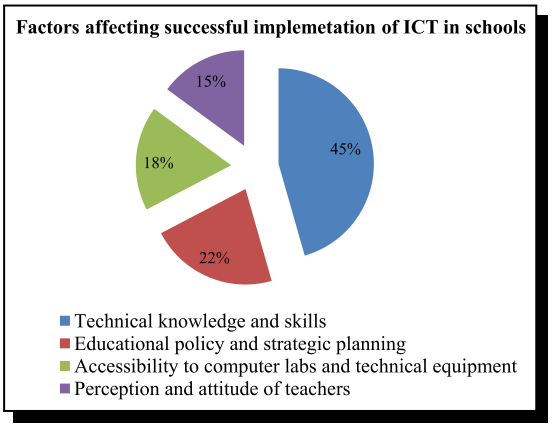


**Figure 1.** Factors affecting successful implementation of ICT in schools

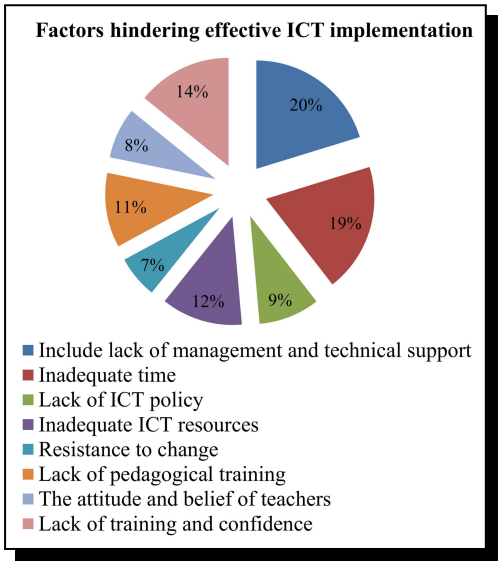


**Figure 2.** Factors hindering effective ICT implementation

The study identified several factors hindering effective ICT implementation. They include: lack of management and technical support; inadequate time; lack of ICT policy; inadequate ICT resources; resistance to change; lack of pedagogical training; the attitudes and beliefs of teachers; and lack of training and confidence among teachers. Most participants considered the lack of management and technical support as well as the lack of training and confidence among teachers as major contributing factors to the ineffective implementation of ICT in Saudi classrooms.

## 6. Discussion

The results of this study reveal that lack of management and technical support is the most crucial factor that hinders successful implementation of ICT in classrooms. It is important for school administrators to be conscious of the areas that require more attention for the successful

application of ICT. Teachers can be encouraged to use ICT within their lessons through the creation of a suitable working atmosphere. Such an atmosphere can be created when school administrators offer support and motivation. School teachers can be discouraged from using educational technology due to technical factors such as Internet connectivity. Experiencing technical and hardware problems make Saudi teachers reluctant to deploy technological resources. It is vital to provide adequate ICT support services and continuous technical training to teachers. Educational managers should focus on providing technical support to teachers.

The effective implementation of ICT can be realised when there are educational policies and strategies relating to the adoption of ICT. A clear policy framework is vital in creating a school culture that supports the adoption of ICT. Educational policy makers should focus on developing policies that incorporate educational technologies in classrooms. The implementation of ICT tools in school can be affected by the attitudes and beliefs of teachers. ICT implementation cannot occur automatically if teachers do not have the right attitudes and beliefs towards educational technology. This is so even when there is a favourable environment, adequate technical resources, supportive policies and sufficient training. Teachers are the ultimate decision makers on the use of technological tools in instructional practices. Teachers with positive attitudes towards educational technology are more likely to use and support ICT in classrooms as compared to those with negative attitudes.

The adoption of technology is expected to enhance student reading capabilities. The QAIT model is useful in addressing the possible impact of reading technologies. According to the model, teaching is influenced by four factors, including quality instructions; an appropriate level of instruction; time; and incentives. Incentives are vital in intrinsic and extrinsic motivation of children, enabling them to want to learn the material. Adequate instructional time should be provided. The QAIT model assists in understanding the possible achievement impact of various innovations (Campuzano, Dynarski, Agodini and Rall [10]).

Studies have established that many children love to work on computers. It is possible to harness the motivational potential of technology in teaching school subjects. Educational computer games mimic the motivational aspects of computer games. There are trade-offs in the use of software in the context of educational instruction. It is, therefore, important to establish whether computer software programs are capable of motivating children to learn specific academic skills that may be vital in schools. Despite the fact that enjoyment is essential in learning, trade-offs may not be beneficial for learning if content coverage or complexity is sacrificed for fun (Virvou, Katsionis and Manos [24]). Computer technology can play a vital role in providing opportunities for practice and feedback. The endless patience of computers makes them ideal for providing infinite opportunities to practise various learning skills.

Learning institutions should focus on the provision of more training to teachers, since it is considered a major barrier to successful ICT use in schools. Training is vital in providing the skills and knowledge required for effective utilisation of ICT in classrooms. It is crucial to boost the confidence of teachers in the use of educational technology (Bingimlas [8]). Studies by

Al Asmari [2] and Bingimlas [8] have confirmed that a lack of pedagogical training is a factor that contributes to ineffective ICT implementation in schools. Pedagogical training should be conducted in addition to ICT training since it is essential for educators to incorporate this acquired knowledge. Pedagogical training enables teachers to improve the learning of students using specific activities tailored to various subjects (Koehler and Mishra [14]).

The outcome of the study indicates that more needs to be done with the aim of ensuring that the integration of Saudi secondary schools results in positive learning outcomes. The lack of strategic policy framework is hampering the effective integration of ICT into schools. Many studies confirm that ICT implementation is yet to realise a significant success in many nations across the world. The use of ICT in education has been limited to facilitating administrative work for a long time. Despite the fact that the accessibility of ICT resources has significantly improved in Saudi Arabia, there is a lack with respect to the skills and knowledge required for the successful implementation of ICT in learning environments. Several studies have confirmed that the establishment of a clear and elaborate educational policy concerning the use of ICT is crucial in guiding the successful implementation of ICT in schools. The main factor hindering the successful implementation of ICT in Saudi secondary schools is the lack of adequate skills and knowledge to use ICT among teachers. Most teachers in Saudi secondary schools are ill-prepared to integrate ICT into classrooms. Teachers need to undergo regular training on how they can best use ICT in teaching various subjects. Educational policy and strategic planning should be adopted to empower teachers on the application of ICT.

The benefits of ICT can be maximised if teacher training and relevant professional development are conducted on a regular basis. Studies have shown that the existence of ICT is not capable of transforming teaching practice. The establishment of enabling conditions is essential in transforming teachers' practices. The pedagogical practices of teachers significantly influence the use of ICT in classrooms. ICT should be used in creating a learner-centric environment. ICT can be used as a presentation tool to assist in understanding difficult concepts, and reinforce traditional pedagogical practices. Although a technical mastery of ICT skills is essential for teachers, this should not be considered a sufficient precondition for effective ICT integration in teaching. Some studies have found that students tend to be more technical in their use of ICT when compared with teachers. Skills deficiencies and inexperience among teachers may be an important factor inhibiting effective utilisation of ICT in schools.

Teachers do not often have adequate time for integrating technology into instructional practices due to the overloaded curriculums. The implementation of ICT tools is hindered by inadequate time. Saudi teachers are often left with limited time for the incorporation of technology into their lessons. School administrators should work towards the provision of necessary support for the reduction of workload and creation of flexible timetables for teachers.

## 7. Limitations of the Study

The study utilised a structured questionnaire that is associated with several weaknesses. Structured questionnaires feature closed questions and tend to suggest ideas that the responded may not have had in mind. As a result, respondents lacking an opinion on a matter may have provided an answer that was unreflective of their intuitions. It may be possible not to notice misinterpretation of a question. The design may force participants to make choices they would not consider in the real world. There may be blurred distinctions between the answers of respondents. Close-ended questionnaires that offer many response choices may be confusing. Furthermore, marking wrong responses is possible with structured questionnaires. Respondents may be frustrated when choices in the questionnaire are not their desired answer. The study is also prone to biases by the researcher and respondents. Controlling the several confounding factors that may have influenced the outcome of the survey is difficult.

## 8. Conclusion

Saudi Arabia has heavily invested in ICT with the aim of transforming the education sector. The government is yet to conduct a detailed assessment of the outcomes of these investments on education. Developing an effective ICT-based learning environment requires a good understanding of the factors that facilitate and hinder the successful integration of ICT into the learning process. Despite the fact that the effective ICT utilisation in Saudi schools can have immense benefits, there are several factors hindering the effective use of educational technology. These include a lack of management and technical support, time limitation, lack of ICT and pedagogical training, negative attitudes and beliefs towards educational technology, lack of clear policies and strategies on the adoption of ICT in learning institutions and resistance to change and inadequate technological resources. The effective ICT implementation in Saudi secondary schools can only be possible if these barriers are addressed adequately. It is essential to note that no single factor is capable of guaranteeing the successful ICT implementation in schools. The presence of all these factors will increase the possibility of successfully implementing ICT in schools.

### Competing Interests

The author declares that he has no competing interests.

### Authors' Contributions

The author wrote, read and approved the final manuscript.

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