



# IiCE: A Proposed System Based on IoTaaS to Study Administrative Efficiency in Primary Schools

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**Abstract.** Although many studies are conducted for ICT systems for educational organisations, there is a lack of understanding of ICT systems' usage for school administration. Infrastructure IT support Communication Experience and Training (IiCE) is a proposed framework based on the ICT that subsumes the IoT intending to improve the primary school administration tasks. This study is conducted on Saudi public primary schools. This study aims to investigate the current state of ICT systems used in primary schools' administration to provide a framework for the ICT systems usage. We carried out an electronic survey and analysed more than 500 responses. We include a detailed analysis reflecting different school members roles, including teachers, school principals, administrative assistants and parents. The findings of this study highlight the limitations in the existing ICT systems for school administration and provide a holistic understanding of influencing factors. Decision-makers for Saudi educational organisations can use the findings with the proposed framework to better understand the current situation of ICT systems and provide better solutions.

**Keywords:** Information and communication technology · School administration · Primary schools · School management · Education · IoTaaS · IoT · ICT

## 1 Introduction

Information Communication Technology (ICT) is a broad term that refers to any type of computer and communications hardware and software, which are used to create, store, transmit, interpret, and alter data in various formats [1]. While computers are typically linked with the phrase, it is also applied to a wide range of other media, including mobile devices, TVs, radios, seniors, IoTs and even

prints [2]. The extensive access to computers has increased the accessibility and the usage of information, similarly communicate with others and produce new knowledge and cultural artifacts [2]. The effects of ICT and technology on education, curriculum, classroom and students have been studied in a comprehensive manner in the literature such as [1,3–6]

Although the use of ICT from the education and learning point of view has been discussed comprehensively by a good number of studies [7–16], there is a dearth in the literature about using ICT for school administration purposes [1,15–19]. For example, Hoque et al. [1] conducted a study for the use of ICT in school management of Maldivian schools. They considered 26 school teachers and 3 principals in their sample study and targeted high schools in Maldives. The research shows that while certain Maldivian schools have ICT facilities and technology, ICT is not effectively employed in school management for educational purposes, but is used to some level for daily administrative tasks. Despite the benefits and importance of using ICT for school administration, there is no usage framework has been given in this study. It also does not consider all the stakeholders of the ICT systems such as students or administrative assistance. Another study by Hoque et al. [5] to determine the areas of ICT utilisation among Malaysian school teachers and principals. They considered 215 teachers and 45 principals who were studying Masters in Educational Management Program and have an experience of being a teacher. The sample represents the whole Malaysia. However, it assumes that all the teachers and principals are of high level of education. The findings of this research demonstrate the needs for establishing a clear policy for ICT in schools. Another study for ICT in Greek kindergarten schools is conducted by Prokopiadou [6]. Their goal is to assess the level of ICT infrastructure available, as well as the variables that influence ICT application in school management. Their finding highlights the importance of the need to establish an appropriate framework for ICT usage in school administration.

The usage of ICT for administrative purposes in schools and especially in primary schools does not have enough attention yet. Although an ICT usage framework in school management is still not established it is vital to understand the comprehensive situation of current ICT systems. To address this need the main goal of this study is to explore and investigate the current situation of using ICT for school administration. The domain of this work is public Saudi primary schools. The ultimate aim is to find the highest factors that affect the schools' use of ICT for administration purposes. This is important to fill the gap and provide better understanding of the ICT systems in primary schools and thus establish an appropriate framework for ICT usage for school administration purposes. The use of ICT for administrative purposes in schools, especially primary schools, has received insufficient attention in the literature [1,15–19]. Students typically attend primary school for six years, which is one of the most extended terms of study. In this article, we addressed the most often cited factors that influenced ICT use in schools. These components fall into four categories: infrastructure, information technology (IT) support, communication, and experience and training.

## 2 Background

In this section we address the most often cited factors that influence ICT use in schools. These components can be categorised into four groups: infrastructure, information technology support, communication, and experience and training.

### 2.1 Infrastructure

Infrastructure refers to hardware such as computers, scanners, photocopiers, printers, and projectors, as well as critical software that facilitates school management, teaching and learning [6]. The most common factors reported in previous studies to affect the ICT infrastructure in schools are the internet connection and Security and privacy.

Internet connectivity is crucial for ICT technology because it is used by the great majority of services and organisations; users may suffer when attempting to use ICT systems if the internet connection is repeatedly disrupted. This had been discussed in the literature, and they highlighted the importance of computer and internet connection for the ICT systems [5,6]. Stable and reliable internet connection should be provided to schools to allow the staff using ICT [1,11]. Schools in developing countries without reliable internet connections are struggling to use ICT to manage schools' tasks [6,12]. Moreover, the high cost of internet connection, particularly broadband connectivity, had a negative impact on students, schools staff and families use of ICT systems alike [6,20–22]. They continued by emphasising that the bulk of internet users reside in major cities, with Internet penetration in villages and rural areas remaining at a bare minimum [6,21,22].

Additionally, past studies noted the benefit of having an internet connection that includes good and dependable technical assistance, customer service, and emergency and routine maintenance [6,20–22]. As motioned in [6,7,20–22] it can be devastating for ICT users, especially those in schools, if there is insufficient support for the internet connection, such as technology support, equipped maintenance teams, and effective customer service. Another study arrives at similar conclusions that schools in urban areas maintain a digital advantage compared with schools in rural areas. Indeed, the lack of technological infrastructure such as a stable internet connection with high speed makes it hard for schools and their users to deal with ICT systems [6,21–23]. Numerous schools in remote locations may have trouble using ICT due to power issues, as electricity is not always accessible throughout the day in these areas. The authors in [6,24] emphasis that developing a sufficient infrastructure, in this context, refers to acquiring a decent internet connection, which is critical for schools and their users to use ICT systems efficiently.

ICT users' security and privacy must be well maintained during their usage, hence should take enough attention through the design and implementation. Securing ICT systems and ensuring the availability of vital education services would boost user satisfaction on all levels, including students, teachers, principals, and stakeholders, enabling uninterrupted usage of ICT systems

[12,20,22,25,26]. When the ICT systems did not match the users' needs and expectations, they were more exposed to cyber-attacks. For example, the current ICT systems do not help users to do their duty easily; consequently, they will use an out-source software application that is not secure and not authorised by the ministry. As a result of the use of third-party applications, the users' security and privacy are in greater risk [12,20,22,25,26].

In Arab countries, in most cases, there is a very high restrictions on the internet [12,20,22,25,26]. Internet users are highly constrained. In Saudi Arabia, for example, the government has declared that it will seek to protect its citizens from immoral Internet content, as a result, the government spends more in the firewalls and security systems [22]. While there is no dispute about the efficiency of investment in security systems and ICT, this does not guarantee that the ICT users will be completely protected from cyber-attacks [12,14,20,22,25,26]. ICT systems and all the digital technology will remain within the risk circle and the online terrorism such as disrupting communication, compromising security, phishing, stealing the users' information, destroying devices [22,27].

In previous studies [10,24] they mentioned that due to the massive influx of social media into people's everyday lives, it has become a fundamental component in educational organizations and ICT systems. ICT systems are not isolated from the rest of cyber technology; rather, they are an integral component of it and are directly or indirectly affected by other factors in the cyber world [12,24,28]. To illustrate, social media can be utilised in conjunction with ICT in schools for administrative purposes if handled properly [12,24,28]. Almost every school has an account on the social media. In addition, the school members are very likely to have accounts as well on social media. According to [12,24,28,29] there are no clear regulations that regulate the use of social media platforms in the name of a school. Therefore, using social media platforms in schools will not be based on a clear path; instead, that would be more according to individuals' views [12,24,28,29]. In addition, these unmonitored uses could cause a critical breach to the whole system and ICT in particular in terms of security and users' privacy that has been discussed in [30,31]. In previous studies [30,31] they continued to state that, social media applications require access to users' information or to other applications such as files; hence, users' privacy will be jeopardised, and the likelihood of ICT systems being breached dramatically increases. Information in educational organisations are critical as any organisation. With the prevalence of social media in schools and an insufficient understanding of how to use ICT technology to meet users' requirements, the possibility of data and circulars being leaked extremely increases [5,30,31].

Educational organisations use many different ICT systems; thus, they come up with higher risks regarding the security of the system and the users' privacy [12,20,22,25,26]. In addition, there could be more than one storage to store the information that may be due to the systems architecture. Many educational organisations use many different systems for administration purposes; moreover, these systems could be different from one department to another while they are in the same ministry [12,14,20,22,25,26]. The risk of using many different

systems and third-party applications is extremely high, whereas using reliable ICT systems that are authorised and maintained by the ministry are safer and more secure [12, 14, 20, 22, 25, 26]. Hence, schools members should avoid using ICT systems or applications not authorised by the ministry.

## 2.2 IT Support

IT support is a vital part of the life cycle of the ICT systems but not available all the times. According to [7, 16, 23, 32–34] ICT systems in schools must provide a “friendly environment” which includes providing technical support, encouraging ICT utilisation, and offering required training. It is crucial to maintain all components of ICT, both hardware and software, and ensure that technical support is available when users experience difficulties that have been discussed in [7, 16, 23, 32–34]. Usually, there is no specialised IT support staff to facilitate ICT systems in schools. Instead, that will be assigned to the principal or a school member to play that role in addition to their responsibilities in the school. Schools’ principals may be unable to address ICT technical issues due to their workload, a lack of essential expertise, or a fear of being distracted from their duties as school administrators. Moreover, school members might not solve ICT issues repeatedly as that could waste their time or put extra work on their shoulders as this is not their primary role in the school [32, 33, 35–37].

Some schools in poor and developing countries are lack of finance required for technical support such as countries in South America and Africa. Governments in these countries are not capable to provide IT support to each school, consequently, this can lead to useless ICT systems [6, 7, 12]. In addition, schools that are located in remote areas may wait for weeks or months to get the support. That is because IT experts are mainly located in the urban area where the education departments usually are located [6, 7, 12].

School principals are not authorised by the education department to take action that could solve the ICT issues such as communicate with local IT providers. In other words, unauthorised access to the ICT systems could cause major consequences to the school principals as well as to the other administration members. IT support in schools contributes to the sustainability and viability of ICT and improves school administration [7, 14, 28, 38, 39].

ICT users lack the opportunity to express their needs and goals when building and designing ICT systems. It is imperative that ICT systems reflect the needs of the users and make their daily responsibilities easier to perform, which will increase their productivity. In other words, the users in schools should have a chance to express and explain their needs during the design and implementation steps since they are the primary users of the ICT systems [17, 23, 39–42]. Moreover, users in rural schools may not get even a single chance to pass their thinking about the structure or the design of the ICT till the education ministry or the department inform them to start using them in their daily work [13, 17, 21, 41].

### 2.3 Communication

Lack of proper communication among the education ministry or any organisation will lead to coming up with weak and insufficient ICT systems [5, 43–45]. Communication is one of the fundamental steps during building ICT systems because these systems are designed to assist users in carrying and achieving the planned goals. So, if there is no proper communication channel between the users and the systems developers, that will lead to useless systems [5, 36, 43, 45]. For instance, [19] demonstrated that while school principals may possess a high level of knowledge about certain aspects of their schools' ICT systems, they are not sufficiently involved in ICT projects and implementation phases due to a shortage of communication.

At educational organizations, decisions are made by the higher departments, in general, are without communication with lower-level users. Usually, managers make decisions about the design and construction of ICT systems. In addition, they may ask users to use a specific system, and then after a while, they will tell them to stop using it. These ICT systems may have been designed and implemented very well from the technical point of view, resulting in high performance; however, they may not be user-friendly, especially for those without IT experience. For example, in educational organizations, most of the ICT systems users are teachers with a low amount of IT background. Furthermore, if the school members did not engage during the design and the implementation, they could not efficiently utilise the ICT systems [5, 6, 16, 23, 26, 34, 46].

The lack of communication also casts a shadow on parents, and the surrounding community [5, 8, 38, 47]. According to [47], a lack of communication between schools and families results in weak interaction or, in the worst-case scenario, a loss of this interaction. They continued by emphasising that the majority of schools that lack effective connection with students' families struggle to persuade them to adopt new ICT systems as a result of the families being excluded from the planning and design phases [47]. According to a prior study, technology alone does not guarantee improved outcomes, and that moving to ICT systems without positive communication with prospective stakeholders results in inefficient ICT technologies [11]. Negative implications for student accomplishment have also crept in as a result of non-existent or ineffective communication between educational institutions and parents, as declared in [8, 10, 47].

In the educational process, the main focus is on students. ICT systems can help students and their families. First, ICT systems provide a reliable channel for the school and the families to communicate with respect to their privacy and security. ICT systems also can improve the students' communication skills and their relationship with teachers, the school administration team and other students. Additionally, ICT can help teachers and parents to keep track of the student's progress and provide the necessary support by keeping students more connected to their schools [12, 13, 46, 47]. Many studies show that students who have access to the ICT achieve better results, consequently, ICT systems would positively involved in school administration [12, 13, 46, 47]. Communication using ICT systems can help schools and educational organisations to improve the cur-

riculum to match the students' skills. For example, for students who are shy or have difficulties expressing themselves in front of their classmates in face-to-face communication, ICT could help them overcome that issue and increase their confidence dramatically while they are interacting with the administrations' team, teachers, and their friends in the school [12, 13, 46, 47].

ICT systems helped schools very much during tough times to maintain the accessibility of E-learning to their students. For example, during times of crisis, such as the Coronavirus pandemic, all educational organisations globally suspended traditional face-to-face schooling. The optimum option was to transition to remote learning, and ICT serves as the foundation for remote learning. Schools without powerfully built ICT equipment failed to communicate with their students quickly. Thus, the students learning has been negatively affected [8, 12, 16, 40, 43, 47–49].

## 2.4 Experience and Training

Experience and training are essential to use ICT systems in a superior manner. The authors of [8, 23, 32, 34, 37] reported that training is a fundamental procedure for the users of ICT systems in school and educational organisations. Previous studies also have emphasised that schools principals were less knowledgeable users of ICT technology [23, 34, 50]. Using ICT for school administration is based on the school principals and their motivation to be active leadership. However, some of them feel they are overwhelmed by using the ICT systems without enough experience or training [19, 34, 50].

The previous research [19] shows that ICT users with experience and knowledge are more likely to be motivated about using ICT systems in schools, particularly for administration goals. Training and experience did not get enough attention in programs conducted to prepare school leaders. Additionally, there is no intensive training for the school principals during their work as school leaders besides being ICT leadership [34, 37, 50]. That is because they do not have time for attending workshops or training courses within their responsibilities as school leaders. Previous studies have shown that ICT training courses, most of the time held in urban areas that are difficult for the rural school principals to attend [6, 21, 26, 26, 34, 37, 50].

Training courses and workshops about using ICT should not be only for school principals but must include other stakeholders, such as parents and teachers. Mandatory use for ICT by the leaders and the school staff without enough training or solid background of dealing with technology could be problematic, as well as if they start to use it as they have to, they will not be confident [19]. That will make using ICT weaker in schools for administration purposes. In [2, 5, 38] they discussed the shortfall of training. Although schools try their best based on their capabilities to assist the parents and other users to utilise ICT systems, parents and families struggle or face difficulties using them [5, 38].

### 3 Methodology

The fundamental objective of this study is to explore the current situation of the ICT systems in Saudi public primary schools and provide a framework of ICT systems as tools for school administration. To fulfil this goal we conducted this work in an exploratory and descriptive nature. In the following subsections we explain the sampling design, instrument design and data collection.

#### 3.1 Sampling Design and Population

This study's intended audience comprises employees of Saudi Arabia's public primary schools and parents of children enrolled in these schools. Users from inside the educational circle are considered internal users, whereas families are considered external users. 42% of the public primary schools are located in three large regions in Saudi Arabia, and the rest 10 regions share the remaining 58%. These central regions are Riyadh province, Makkah province and Ash-Sharqiya province. The other regions are not as developed as these three large regions. We consider Makkah province schools for this study as a representative sample. Makkah province has a more diverse nature in terms of demographics and geography.

Given the size of the population, we chose to design the study using a random sampling of the entire population. Total population sampling is a purposive sampling that implies investigating the entire population for a specific set of qualities, features, experiences, knowledge, skill, and exposure to an event. Nonetheless, according to [18] there are two instances in which complete population sampling may be appropriate: (1) the population size is small and (2) the population have a common unique characteristic. In our case, users who are using ICT systems in primary schools are unique characteristics.

#### 3.2 Instrument Design

A questionnaire is a self-report instrument that can be used to collect data from a large number of respondents in a cost-effective and timely manner [51]. It can be used to gather both qualitative and quantitative data. We used a quantitative questionnaire with closed-ended questions to achieve precise and accurate responses. Based upon a 5-point Likert-type scale, anchors in the questionnaire ranged from 1 to 5 to indicate the degree of agreement. Moreover, the questionnaire has been given to a panel of 3 experts for validation, and the comments were just a few [52].

The questionnaire aimed to obtain information on different aspects, including available ICT infrastructure, available IT support, available ICT communication channels and training programs available for ICT systems. It also addressed the effect of each mentioned factor. Moreover, it gathers the knowledge and technical skills of ICT systems users in schools.

**Table 1.** Demographic information of the respondents

	Question	Frequency	Percentage
1	<b>You are older than 18 years:</b>		
	Yes	514	95.90%
	No	22	4.10%
2	<b>Your education level is:</b>		
	Secondary school degree or lower	75	14.59%
	Diploma degree	40	7.78%
	Bachelor degree	305	59.34%
	Higher degree	94	18.29%
3	<b>You are working or worked in an education sector:</b>		
	Yes	236	45.91%
	No	278	54.09%
4	<b>Your role in the school is:</b>		
	School principal	38	9.43%
	Teacher	267	66.25%
	Administrative assistance	53	13.15%
	School Deputy Headmaster	16	3.97%
	Other	29	7.20%
5	<b>You are working in:</b>		
	Primary schools	138	46%
	Secondary schools	92	32%
	Intermediate schools	59	22%

### 3.3 Data Collection

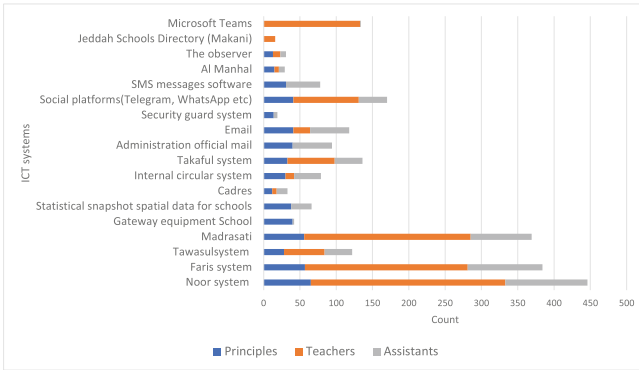
The questionnaire link was distributed using social media applications such as WhatsApp, Twitter and Telegram. These are the most widely utilised platforms in Saudi Arabia. More than 1000 respondents responded to the poll in total. The optimal sample size is 400 participants [53]. However, the total number of completed responses is 555.

### 3.4 Results and Discussion

The study’s goal was to analyze the use of ICT in Saudi public primary schools’ management and provide a framework for its usage.

## 4 Demographic Information

Table 1 shows the demographic information of the respondents. Almost all of the respondents are older than 18 years old, with more than 95%. Around 60% of the



**Fig. 1.** Common ICT systems used in Saudi public primary schools

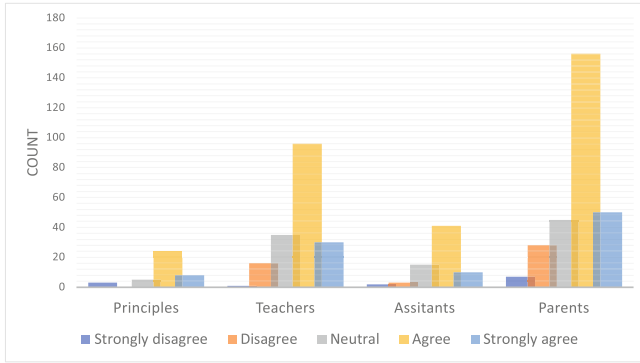
respondents hold a bachelor’s degree, while 15% of them hold a master’s degree, and just 3% have a PhD degree. Lower portion of respondents are with lower educational degrees include primary and intermediate, secondary or diploma degree. In addition, 54% of the participants work in educational organisations, and the rest are parents of children in primary schools. Interestingly, 46% of parents are not working in educational sector.

Among people who work in educational organisations only 46% of the respondents work in primary schools. In terms of their role at schools, 66% are teachers, about 9% work as school principals, 13% are administrative assistance, about 4% are school deputy headmaster, and the other 8% are working in school administration team such as librarian, activity pioneer, and clerk. The high portion of the respondents are teachers while the rest are of different roles in school administration. This low percentage for school administrators is expected because each school is associated only with one principal, and few number of other assistants.

#### 4.1 Current ICT Infrastructure

Numerous ICTs are utilised extensively in educational administration and management, particularly in primary schools. The results show that the most commonly ICT system used in Saudi primary schools is Noor system with about 80.36%, followed by Faris with 69.19%, Madrasati with 66.49%, Tawasul system with about 22% and social media with 31%. Figure 1 presents a summary of the existing ICT systems with their extent of use in terms of each rule in the school.

Noor system is an electronic system to administrate the students’ results. It provides reports for the students and some services for teachers such as internal and external transportation. Also, Noor system provides some services for parents, including the registration of students in public schools. Faris system is used to manage the human resources data. Madrasati is a virtual learning system introduced by the Saudi education ministry during the recent Coronavirus



**Fig. 2.** Security and Privacy levels in current ICT systems for school administration

pandemic. Microsoft Teams is used by the teachers mostly. So, schools principals and other administration members seems to not use it often.

This result shows a high diversity in the available ICT systems, more than 15 systems are currently in use with different extent. This diverse highlight the issues discuses in the background section. It is difficult to maintain consistent with all of these systems. Although there are the official emails there is another ICT system for communication, which is Tawasul. However, users tend to use the social media for communication such as WhatsApp and Twitter more than the email or the official system. This is very important observation to investigate. It highlights the issue of privacy and security concerns with ICT systems. This can also means the current ICT systems with this range failed to match the users’ needs, forcing them to find or use alternatives.

In addition, around 70% agreed that their schools use social media to distribute new rules or new administrative circulars. In Saudi context that is not authorised, and it is against the rule of the education ministry. Moreover, that would increase the probability of breaching the users’ privacy and threaten the organisations’ security. As can be seen, the organisation email is not considered a communication medium in educational organisations. Around 32% of the participants use Twitter as the primary channel to contact the school while about 35% of the participants use WhatsApp. Additionally, more than 46% of the parents agreed, and 11% strongly agreed that social media is the first communication medium. Email is more secure and can help protect the users’ privacy much better than unauthorised applications; however, lower portion of participants reported the use of Emails [5, 18, 22, 30, 33].

About 50% of the participants agreed that the internet connection impacts their use of the current ICT systems. 22% of the participants strongly agreed that the internet connection influences their usage of ICT systems [5, 21, 22, 44]. The rate of using ICT systems has been fluctuated in schools due to the infrastructure and the internet connection in particular. Moreover, users with low

or lack of internet connection will not be enthusiastic about using ICT systems. In addition, they could consider that as time and effort wasting [5,21,22,44].

The findings of the question related to the privacy and security of current ICT systems reveal a good agreement by all users on sustaining a private and secure services, as illustrated by Fig. 2. However, as there are some people think these services are not very secure that is an indicate of an issue. Another angle that it could be an unaware of the risk of using this kind of systems especially with the proportion of parents where they mainly rely on third-party applications to communicate with schools.

## 4.2 Effectiveness of Current IT Support

Around 41% of the participants agreed, and 25% strongly agreed that there is enough IT support with current ICT systems. In contrast, 16% disagreed, and 5% strongly disagreed that the current IT support is insufficient or unavailable. Roughly 25% of the participants are neutral about IT support. Limited or lack of IT support could reduce the users' of using ICT systems. Additionally, IT support plays an essential role in maintaining the ICT systems regularly, reducing the IT problems and increasing the ICT systems efficiency [5,6,37,45].

Users could stop using ICT systems if they did not find IT support to help them come up with any challenges they could face. Solving the ICT systems technical issues could impact the staff performance when they spend time and effort to resolve the ICT technical problems. The school members could hesitate to solve these IT issues independently, but they are not authorised and face the consequences [5,6,37,45].

## 4.3 Communication Using ICT Systems

By Communication we target two perspectives: First, is the communication via ICT systems for the school management, Second, is the communication about ICT systems design and implementation.

For communication using ICT systems most participants, about 70%, are agreed on that the current ICT systems help them to share their knowledge and experiences with others easily and quickly. They also think the systems help them to save time while doing the daily work. Regarding communication with higher departments to express their needs, 54.07% of the users chose that ICT enhances communication speed and makes it more accessible. Just 43% answered that ICT helped them to get feedback from the higher departments faster. Communication plays a very critical role in the organisation. Thus, the participants' responses clearly show that communication with higher departments is not that strong and it is not in the spotlight [14,18,36,41,47].

In general, more than 70% of the participants, who are working in schools administration, agreed that they are satisfied with using current ICT systems. In contrast, around 10% are not satisfied with the current ICT systems, and just 20% are neutral about using ICT systems in schools for the administration process. ICT systems developers, planners, designers and decision-makers should

take into account the users' needs and the usage from different stakeholders. ICT systems will be insufficient when they do not meet the users' expectations; moreover, that could lead to less productivity. In addition, that may lead to resource wasting [11, 16, 19, 26, 45, 47, 54].

#### 4.4 ICT Users' Experience and Training

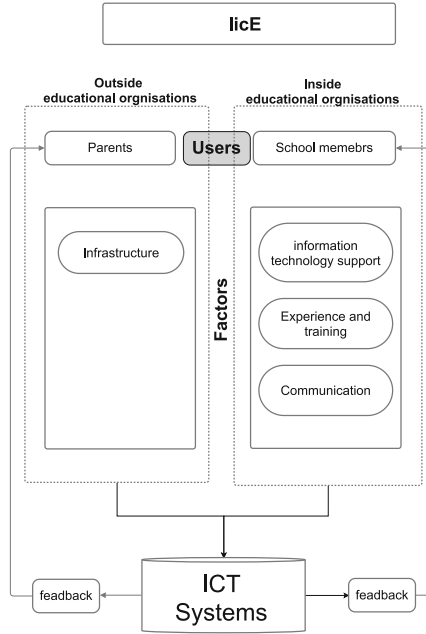
The finding shows that the weakest point in ICT systems usage for school administration is the required experience and training. Based on the survey results about the previous experience with the current ICT systems, more than 60% of the participants reported they were not experienced with the systems. Additionally, only 33% of the respondents agreed they get enough training of using the ICT system. The majority of the respondents think they are not receiving enough training.

The continuous training on how to use the ICT systems is essential for the practical and efficient utilisation of ICT systems. Providing proper training will increase the efficiency of the staff. Additionally, that will help in reducing waste and save resources [21, 23, 26, 32, 34, 37, 55].

#### 4.5 IiCE Framework

As we discussed there are four main factors that mainly affect the usage of ICT systems in school administration. Based on the exploration and analysis of the current states of the ICT systems we propose the Infrastructure IT support Communication Experience and Training (IiCE) framework for ICT systems usage in school administration, as shown in Fig. 3.

The main components of the IiCE are: users and factors. The users can be external or internal. External users include parents who have a children who is a student in a primary school. Internal users are mainly school members such as: school principle, teachers, and administrative assistants. The factors can be internal or external. External factors are the factors affecting the ICT systems out of educational organisation domain. The ICT infrastructure is considered to be an external factor. Internal factors are the elements within the educational organisations. These include IT support, communication and experience and training. The ICT systems are supposed to dynamically process the external and internal user requirements and provide proper feedback within the consideration of the external and internal factors. The proposed IiCE framework can help the ICT systems developers, designers, educational organisation members as well as decision makers to understand the ICT systems workflow within the organisation and provide better solutions.



**Fig. 3.** liCE suggested framework

## 5 Conclusion

In this study, we explored the current situation of ICT in Saudi Arabia primary schools. We categorised the factors affecting ICT systems in school managements into four groups. Then we proposed the liCE framework to better understand the ICT systems in schools in terms of users and factors. The liCE could help the schools principals to improve the administration process by providing a holistic understanding for the systems flow. Some of the findings are:

- ICT systems can help to provide more attractive and motivate workplace members, regardless of their role.
- There is a huge diverse in the existing ICT systems which is problematic in terms of consistency and privacy.
- The schools' administration process can be more effective if the ICT systems are built and designed in accordance with the aspirations of the users.
- There is a lack of communication between the users of ICT systems and the providers.
- There is a lack of sufficient training for ICT systems which impacts the user satisfaction with the current systems.

For future work we will consider the extension of the proposed liCE framework to include more details about the policy and regulations to maintain better ICT systems utilisation. Then we will apply the framework on some schools in

the domain of the study for richer evaluation. Another future work will also investigate the dominance of social media channels in school communications.

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